SRI DEV SUMAN UTTARAKHAND UNIVERSITY, BADSHAHITHAUL
TEHRI GARHWAL, UTTARAKHAND

NATIONAL EDUCATION POLICY – 2020

SYLLABUS FOR BIOTECHNOLOGY

Bachelor of Science/ Master of Science Programme

(w.e.f. 2025-26)

CURRICULAR FRAMEWORK FOUR YEAR UNDERGRADUATE PROGRAMME (FYUP)/HONOUR'S/MASTER'S PROGRAMME IN BIOTECHNOLOGY

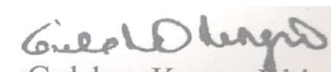
SRI DEV SUMAN UTTARAKHAND UNIVERSITY, BADSHAHITHAUL,

TEHRI GARHWAL, UTTARAKHAND

(2025-26)

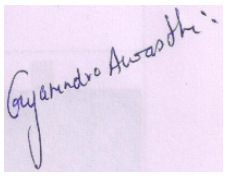
NEP-2020- (BOS 2025-26)

Board of Studies Member



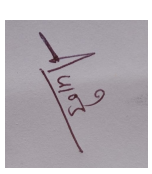
Prof. G. K. Dhingra [Convener]
Dean, Faculty of Science,
Pt. L.M.S. Campus, Rishikesh,
Sridev Suman Uttarakhand University

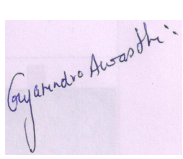
Dr. Veena Pande [Co-convener]
Professor, Department of Biotechnology
Kumaon University, Nainital



Dr. Gyanendra Awasthi [External Expert]
Professor & Head, Department of Biochemistry
Dolphin (PG) Institute of Biomedical & Natural Sciences
Dehradun

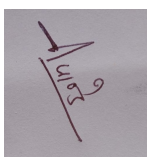
Sr. No.	List of Paper types	Full form
1.	**DSC**	Discipline Specific Course
2.	**DSE**	Discipline Specific Elective
3.	**GE**	General Elective
4.	**SEC**	Skill enhancement Course

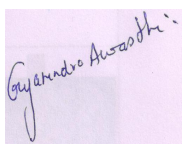




UG/PG Biotechnology: Program Structure

Year	1		2		3		4		5		Total Credits
Semester	**I**	**II**	**III**	**IV**	**V**	**VI**	**VII**	**VIII**	**IX**	**X**	
Discipline Specific Core (DSC)	3 (4)	3 (4)	3 (4)	3 (4)	3 (4)	3 (4)	1 (4)	1 (4)	1 (4)	1 (4)	88
Discipline Specific Elective (DSE)	-	-	1 DSE (4) **OR** 1 GE (4)	1 DSE (4) **OR** 1 GE (4)	1 DSE (4) **AND** 1 GE (4)	1 DSE (4) **AND** 1 GE (4)	3DSE (4) OR 2DSE+1GE (4) OR 1DSE+2GE (4)	3DSE (4) OR 2DSE+1GE (4) OR 1DSE+2GE (4)	3DSE (4) OR 2DSE+1GE (4) OR 1DSE+2GE (4)	3DSE (4) OR 2DSE+1GE (4) OR 1DSE+2GE (4)	80
Generic Elective (GE)	1 GE (4)	1 GE (4)									
Ability Enhancement Course (AEC)	1 (2)	1 (2)	1 (2)	1 (2)	-	-	-	-	-		8
Skill Enhancement Course (SEC)	1 (2)	1 (2)	1 SEC (2) Or 1 IAPC (2)	1 SEC (2) Or 1 IAPC (2)	1 SEC (2) Or 1 IAPC (2)	1 SEC (2) Or 1 IAPC (2)	-	-	-		12
Internship/Apprenticeship/Project/ Community Outreach (IAPC)	-	-									
Value addition course (VAC)	1 (2)	1 (2)	1 (2)	1 (2)	-	-	-	-	-		8
Dissertation on Major/Minor/ Academic project/ Entrepreneurship	-	-	-	-	-	-	Dissertation/ Academic project/ Entrepreneurship (6)	Dissertation/ Academic project/ Entrepreneurship (6)	Dissertation/ Academic project/ Entrepreneurship (6)	Dissertation / Academic project/ Entrepreneurship (6)	24
Total Credits	22	22	22	22	22	22	22	22	22	22	**220**



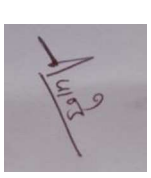


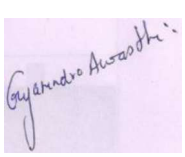
Expert/Advisory Committee:

Name	Designation	Affiliation
Prof. Shravan K. Mishra	Professor	IISER Mohali
Prof. A.K.Gaur	Dean CBSH	G. B. P. U. A. & T. Pantnagar
Prof. S.K.Guru	Professor and Head	Department of Plant Physiology, G. B. P. U. A. & T. Pantnagar
Prof. Gopal Joshi	Professor and Head	Department of Biotechnology, H.N.B.G.U., Srinagar
Dr. Santan Barthwal	Scientist G	FRI, Dehradun
Dr. Rohit Joshi	Principal Scientist	IHBT, Palampur

Department of Biotechnology: Program Structure

Year	1		2		3		4		5		Total Credits
Semester	I	II	III	IV	V	VI	VII	VIII	IX	X	
Discipline Specific Core (DSC)	3 (4)	3 (4)	3 (4)	3 (4)	3 (4)	3 (4)	1 (4)	1 (4)	1 (4)	1 (4)	88
Discipline Specific Elective (DSE)	-	-	1 DSE (4) **OR** 1 GE (4)	1 DSE (4) **OR** 1 GE (4)	1 DSE (4) **AND** 1 GE (4)	1 DSE (4) **AND** 1 GE (4)	3DSE (4) OR 2DSE+1GE (4) OR 1DSE+2GE (4)	3DSE (4) OR 2DSE+1GE (4) OR 1DSE+2GE (4)	3DSE (4) OR 2DSE+1GE (4) OR 1DSE+2GE (4)	3DSE (4) OR 2DSE+1GE (4) OR 1DSE+2GE (4)	80
Generic Elective (GE)	1 GE (4)	1 GE (4)									
Ability Enhancement Course (AEC)	1 (2)	1 (2)	1 (2)	1 (2)	-	-	-	-	-		8
Skill Enhancement Course (SEC)	1 (2)	1 (2)	1 SEC (2) Or 1 IAPC (2)	1 SEC (2) Or 1 IAPC (2)	1 SEC (2) Or 1 IAPC (2)	1 SEC (2) Or 1 IAPC (2)	-	-	-		12
Internship/Apprenticeship/Project/ Community Outreach (IAPC)	-	-									
Value addition course (VAC)	1 (2)	1 (2)	1 (2)	1 (2)	-	-	-	-	-		8

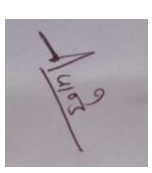


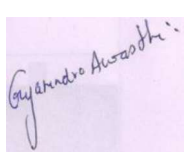


Dissertation on Major/Minor/ Academic project/ Entrepreneurship	-	-	-	-	-	-	Dissertation/ Academic project/ Entrepreneurship (6)	Dissertation/ Academic project/ Entrepreneurship (6)	Dissertation/ Academic project/ Entrepreneurship (6)	Dissertation / Academic project/ Entrepreneurship (6)	24
Total Credits	22	22	22	22	22	22	22	22	22	22	**220**

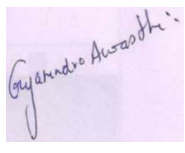
SEMESTER WISE SUMMARY OF THE COURSES/PAPERS

YEAR 1- UNDERGRADUATE CERTIFICATE IN BIOTECNOLOGY Minimum requirement for getting Certificate in Biotechnology After One Year 44 Credit				
SEMESTER-I			**Theory/ Practical**	**Credits**
DSC-1	Elementary Biochemistry	Discipline Specific Core (DSC)	Theory	4
DSC-2	Introductory Microbiology	Discipline Specific Core (DSC)	Theory	4
DSC-3	Basics Cell Biology	Discipline Specific Core (DSC)	Theory	4
GE-1	Mathematics for Biologists	Generic Elective (GE)	Theory	4
AEC-1	Choose one course from pool of University Ability Enhancement Course	Ability Enhancement Course(AEC)	Theory/Practical	2
SEC-1	Experimental Biotechniques – I	Skill Enhancement Course (SEC)	Practical	2
VAC-1	Choose one from the University pool	Value addition course (VAC)	Theory	2
			Total of Semester I - 22 Credits	
SEMESTER-II			**Theory/ Practical**	**Credits**
DSC-4	Elementary Molecular Biology	Discipline Specific Core (DSC)	Theory	4
DSC-5	Basic Instrumentation in Biotechnology	Discipline Specific Core (DSC)	Theory	4
DSC-6	Experimental Biotechniques – II	Discipline Specific Core (DSC)	Practical	4
GE-2	Chemistry for Biologists	Generic Elective (GE)	Theory	4
AEC-2	Choose one course from pool of University Ability Enhancement Course	Ability Enhancement Course (AEC)	Theory/Practical	2
SEC-2	Introduction to Microsoft Office	Skill Enhancement Course (SEC)	Theory + Practical	2
VAC-2	Choose one from the University pool	Value addition course (VAC)	Theory/Practical	2
			Total of Semester II - 22 Credits	
YEAR 2- UNDERGRADUATE DIPLOMA IN BIOTECHNOLOGY Minimum requirement for getting Diploma in Biotechnology After Two Years 44+44=88 Credits				
SEMESTER-III			**Theory/ Practical**	**Credits**
DSC-7	Environmental Biotechnology	Discipline Specific Core (DSC)	Theory	4
DSC-8	Plant Physiology	Discipline Specific Core (DSC)	Theory	4
DSC-9	Principles of Genetics	Discipline Specific Core (DSC)	Theory	4
DSE -1 **OR** **GE-3**	Human Physiology OR Physics for Biologists	Discipline Specific Elective (DSE) OR Generic Elective (GE)	Theory	4
AEC-3	Choose one course from pool of University Ability Enhancement Courses	Ability Enhancement Course (AEC)	Theory/Practical	2
SEC-3	Biostatistics and Bioinformatics	Skill Enhancement Course (SEC)	Theory/Practical	2
VAC-3	Choose one from the University pool	Value addition course (VAC)	Theory/Practical	2
			Total of Semester III- 22 Credits	
SEMESTER-IV			**Theory/ Practical**	**Credits**
DSC-10	Elementary Plant Biotechnology	Discipline Specific Core (DSC)	Theory	4



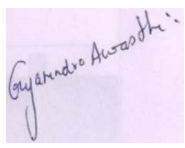


DSC-11	Food Biotechnology	Discipline Specific Core (DSC)	Theory	4
DSC-12	Introductory Animal Biotechnology	Discipline Specific Core (DSC)	Theory	4
DSE-2 **OR** **GE-4**	Industrial Biotechnology OR Biology of Plants	Discipline Specific Elective (DSE) OR Generic Elective (GE)	Theory	4
AEC-4	Choose one course from pool of University Ability Enhancement Course	Ability Enhancement Course (AEC)	Theory/Practical	2
SEC-4	Experimental Biotechniques – III	Skill Enhancement Course (SEC)	Theory/Practical	2
VAC-4	Choose one from the University pool	Value addition course (VAC)	Theory/Practical	2
			Total of Semester IV- 22 Credits	
YEAR 3- BACHELOR'S DEGREE IN BIOTECHNOLOGY **Minimum requirement for getting Bachelor's Degree in Biotechnology (Honours) After Three Years 44+44+44=132 Credits**				
SEMESTER-V			**Theory/ Practical**	**Credits**
DSC-13	Genetic Engineering	Discipline Specific Core (DSC)	Theory	4
DSC-14	Basic Immunology	Discipline Specific Core (DSC)	Theory	4
DSC-15	Experimental Biotechniques – IV	Discipline Specific Core (DSC)	Practical	4
DSE-3	Biosafety and Bioethics	Discipline Specific Elective (DSE)	Theory	4
GE-5	Biology of Animals	Generic Elective (GE)	Theory	4
SEC-5	Intellectual Property Rights (IPR) Or Internship/ Apprenticeship/Project/Community Outreach	Skill Enhancement Course (SEC)	Theory/Practical	2
			Total of Semester V- 22 Credits	
SEMESTER-VI			**Theory/ Practical**	**Credits**
DSC-16	Medicinal Plant Biochemistry and Biotechnology	Discipline Specific Core (DSC)	Theory	4
DSC-17	Research Methodology	Discipline Specific Core (DSC)	Theory	4
DSC-18	Introductory Nano-biotechnology	Discipline Specific Core (DSC)	Theory	4
DSE-4	Pharmaceutical Biotechnology	Discipline Specific Elective (DSE)	Theory	4
GE-6	Medicinal Chemistry	Generic Elective (GE)	Theory	4
SEC-6	Scientific Communication Or Internship/ Apprenticeship/Project/Community Outreach	Skill Enhancement Course (SEC)	Theory	2
			Total of Semester VI- 22 Credits	
YEAR 4- B.Sc. (HONOURS/ HONOURS WITH RESEARCH)/ M.Sc. I Year **Minimum requirement for getting B.Sc. in Biotechnology (Honours with Research) After Four Years 44+44+44+44 = 176 Credit/M.Sc. I Year = 44**				
SEMESTER-VII			**Theory/ Practical**	**Credits**
DSC-19	Molecular Biology	Discipline Specific Core (DSC)	Theory	4



DSE **OR/&** **GE**	***Choose any three Discipline Specific Elective (DSE 3x4)*** Advanced Biochemistry Microbiology Experimental Biotechniques - V ***OR*** ***Choose any two Discipline Specific Elective (DSE 2x4) and any one Generic Elective course (GE 1x4)*** ***OR*** ***Choose any one Discipline Specific Elective (DSE 1x4) and any two Generic Elective courses (GE 2x4)*** Biofertilizer and Bio control Agent Fermentation Technology	Discipline Specific Elective OR/& Generic Elective courses	Theory/Practical	12
Dissertation	Dissertation on Major OR Dissertation on Minor OR Academic project/Entrepreneurship	Dissertation / Academic project/Entrepreneurship	-	6
			Total of Semester VII- **22 Credits**	

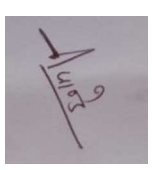
SEMESTER-VIII			**Theory/ Practical**	**Credits**
DSC-20	Cell Biology	Discipline Specific Core (DSC)	Theory	4
DSE **OR/&** **GE**	***Choose any three Discipline Specific Elective (DSE 3x4)*** Immunology and Immunotechnology Analytical Techniques Experimental Biotechniques- VI ***OR*** ***Choose any two Discipline Specific Elective (DSE 2x4) and any one Generic Elective course (GE 1x4)*** ***OR*** ***Choose any one Discipline Specific Elective (DSE 1x4) and any two Generic Elective courses (GE 2x4)*** Waste Management Strategies Water Quality Analysis	Discipline-Specific Elective OR/& Generic Elective courses	Theory/Practical	12
Dissertation	Dissertation on Major OR Dissertation on Minor OR Academic project/Entrepreneurship	Dissertation / Academic project/Entrepreneurship	-	6
			Total of Semester VIII- **22 Credits**	

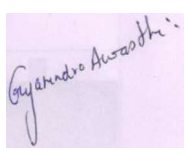


M.Sc. II Year = 44 Credit

SEMESTER-IX			Theory/ Practical	Credits
DSC-21	Genetic Engineering	Discipline Specific Core (DSC)	Theory	4
DSE **OR/&** **GE**	***Choose any three Discipline Specific Elective (DSE 3x4)*** **Plant Biotechnology** **Infection Biology** **Experimental Biotechniques – VII** ***OR*** ***Choose any two Discipline Specific Elective (DSE 2x4) and any one Generic Elective course (GE 1x4)*** ***OR*** ***Choose any one Discipline Specific Elective (DSE 1x4) and any two Generic*** Elective courses (GE 2x4) Bioprocess Engineering and Technology	Discipline Specific Elective OR/& Generic Elective courses	Theory/Practical	12
	Biodiversity Conservation			
Dissertation	Dissertation on Major OR Dissertation on Minor OR Academic project/Entrepreneurship	Dissertation / Academic project/Entrepreneurship	-	6
			Total of Semester IX- **22 Credits**	

SEMESTER-X			Theory/ Practical	Credits
DSC-22	Molecular Genetics	Discipline Specific Core (DSC)	Theory	4
DSE **OR/&** **GE**	Choose any three Discipline Specific Elective (DSE 3x4) Genomics and Proteomics Animal Biotechnology Molecular Virology OR Choose any two Discipline Specific Elective (DSE 2x4) and any one Generic Elective course (GE 1x4) OR Choose any one Discipline Specific Elective (DSE 1x4) and any two Generic Elective courses (GE 2x4) Climate change and sustainable development Forensic Biology Techniques	Discipline Specific Elective OR/& Generic Elective courses	Theory/Practical	12
Dissertation	Dissertation on Major OR Dissertation on Minor OR Academic project/Entrepreneurship	Dissertation / Academic project/Entrepreneurship	-	6



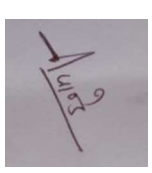


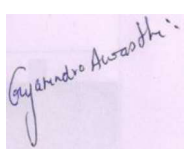
Total of Semester X- **22 Credits**

Students on exit shall be Master's in Core subject after securing the requisite 220 credits on completion of Semester X ***Total Credits =220***

Programme Outcomes (POs) for: Certificate/Diploma/ Bachelor Degree in Biotechnology (Honours)/ Degree in Biotechnology (Honours with research)/ Master Degree in Biotechnology

Programme outcomes for the course include various subject specific skills and generic skills like Research Temperament, experiment designing, critical thinking, logical reasoning, data analysis and interpretation, oral and written scientific communication skills, innovation and entrepreneurship which will help in keeping pace with advancement in Technology and Research. The programme





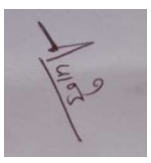
learning outcomes also enable students to prepare for higher studies and employment. The various learning outcomes of the programme are mentioned below:

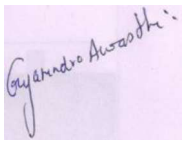
PO-1	After completing UG/PG program, students would acquire in-depth theoretical and practical knowledge in Biotechnology.
PO-2	Develop skills, attitude and values required for self-directed lifelong learning and professional development.
PO-3	Develop insights related to the fundamentals of biotechnology viz., cellular and molecular biology, plant and animal biotechnology, environmental science, immunology etc.
PO-4	Able to apply the acquired knowledge to provide cost-effective and sustainable solutions in Biotechnology.
PO-5	Translate biotechnological know-how to address environmental, ethical, intellectual property rights and societal issues.
PO-6	Demonstrate knowledge for in-depth analytical and critical thinking to identify, formulate and solve the issues related to Biotechnology Industry, Pharma industry, Medical or hospital related organizations, Regulatory Agencies, & Academia.
PO-7	Develop an ability to solve, analyze and interpret data generated from experiments done in project work or practical courses.
PO-8	Appreciate and execute their professional roles in society as biotechnology professionals, employers and employees in various industries, regulators, researchers, educators and managers.
PO-9	Demonstrate empathetic social concern and equity catered national development, and the ability to act with an informed awareness of issues and participate in civil life through volunteering.
PO-10	Understand the issues of environmental contexts and sustainable development.
PO-11	Acquire the ability to engage in independent and life-long learning in the broadest context socio-technological changes.
PO-12	Apply responsibilities to promote societal health and safety, upholding the trust given to the profession by the society.

Programme Specific Outcomes (PSOs) for Undergraduate Programme (Certificate/Diploma/ Bachelor Degree in Biotechnology/ Master Degree in Biotechnology)

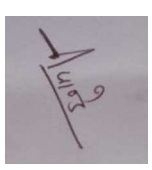
After completing UG/PG, the learners will be able to:

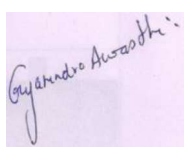
PSO-1	Demonstrate an advanced understanding of the application of biotechnology across various domains within the life sciences, including agriculture, medicine, microbiology, and animal science.
PSO-2	Students will engage in a range of theory-based courses that emphasize practical applications, thereby enhancing their skills in experimental design, execution, and interpretation.
PSO-3	Students will exhibit progressive and effective development of competencies in the fields of science, technology, and research, which possess the potential to positively influence the community.
PSO-4	Learners will be equipped to identify the characteristics and responsibilities associated with the roles of researcher, educator, entrepreneur, scientist, manager, and consultant. This understanding will facilitate the development of knowledge and essential soft skills, enabling learners to effectively apply their insights when faced with critical decision-making scenarios.
PSO-5	Students will acquire essential research and analytical skills, effectively applying both quantitative and qualitative knowledge in their prospective careers within the fields of science, technology, and research.
PSO-6	The students can acquire knowledge, skills, and attitudes by the end of the programme.





PSO-7	Learners will demonstrate proficiency through their ability to engage in competitive examinations such as the National Eligibility Test (NET), Graduate Aptitude Test in Engineering (GATE), Graduate Record Examinations (GRE), and various entrance assessments for advanced education.
PSO-8	The students will have a comprehensive understanding of the fundamental principles of biochemistry, cellular and molecular biology, genetic engineering, as well as proteomics and genomics, will enhance the student's grasp of the essential building blocks of life.
PSO-9	An in-depth analysis of current trends in microbiology and their practical applications is essential. It is imperative to demonstrate proficiency in the design, execution, and interpretation of experiments conducted during practical courses, with a particular focus on the research aspects of microbiology.
PSO-10	Upon completing the Bioanalytical Techniques and Microbial Techniques course, students will effectively use laboratory equipment and conduct qualitative analyses of biomolecules while staying updated on current instrumentation trends. They will design and execute experiments focused on analytical methodologies and apply good laboratory and manufacturing practices relevant to the biotechnology industry.
PSO-11	Evaluate biotechnological practices while developing innovative strategies to address contemporary and future challenges of health and environmental sustainability. Acquire and apply genetic engineering techniques and principles in the field of bioremediation. Cultivate a comprehensive understanding of current environmental trends and the factors contributing to global warming. Demonstrate the ability to design, conduct, and analyze experiments in practical courses, with a specific focus on aspects related to environmental reconfiguration...
PSO-12	The Biosafety and Bioethics course provides students with essential knowledge of the ethical, legal, and social implications of biotechnology and biomedical research, along with safe laboratory practices. The Intellectual Property Rights (IPR) course covers key topics like trademarks, trade secrets, copyrights, patents, and industrial designs, equipping students to manage IP rights and understand relevant cyber laws.
PSO-13	Learners will have the opportunity to pursue advanced degree such as PhD.
PSO-14	Students will be equipped to excel in competitive examinations across various domains of life sciences, including but not limited to biotechnology, biochemistry, genetics, environment science, animal/plant biotechnology, microbiology, and immunology





SEMESTER I

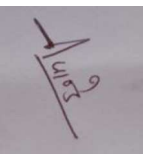
DISCIPLINE SPECIFIC CORE - Elementary Biochemistry						
No. of Hours-60						
CREDIT DISTRIBUTION, ELIGIBILITY AND PRE-REQUISITES OF THE COURSE						
Course Title	Credits	Credit distribution of the Course			Eligibility criteria	Pre-requisite of the Course (if any)
		Lecture	Tutorial	Practical/Practice		
DSC-1 Elementary Biochemistry	4	3	1	0	10+2	Nil
Course: DSC 1		Course Title: Elementary Biochemistry				
Max. Marks: As per Univ. rules		Min. Passing Marks: As per Univ. rules				

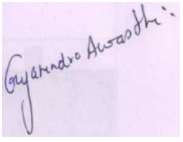
Course Outcomes:

Upon successful completion of this course, students will be able to:

- Understand the chemical and molecular foundations of life.
- Understand the classification, structure, chemical properties and biological functions of carbohydrates, lipids, amino acids, proteins and nucleic acids.
- Students will learn the importance of vitamins and minerals in living systems and their roles in biological organization.

Unit	Topic	No. of Hours
UNIT I	**Carbohydrates:** Introduction and classification of carbohydrates, Stereoisomerism in monosaccharides, Reactions of glucose and fructose, Reducing sugar, Mutarotation, Cyclic structure of glucose and fructose, Glycosidic bonds; Disaccharides, lactose and maltose, Polysaccharides; homo and hetero polysaccharides, Glycogen, Starch, Cellulose, glycolytic pathway, TCA cycle, Electron Transport chain (ETC)	15
UNIT II	**Lipids**: Classification, chemical and physical properties. Fatty acids: saturated, unsaturated and essential fatty acids. Structure and biological functions of triacylglycerol and phospholipids, Fatty acid oxidation: β-oxidation	10
UNIT III	**Proteins and Amino Acids**: Classification, chemical and physical properties of amino acids. Peptide bond. Structural hierarchy of proteins: primary, secondary, super- secondary, tertiary and quaternary structures. Globular and fibrous proteins: structure and functions of hemoglobin, collagen, glycogenic and ketogenic amino acids, Urea cycle	10





UNIT IV	**Nucleic Acids:** Chemistry of purine and pyrimidine, nucleosides, and nucleotides. Types of DNA: structure and properties of A-, B-, and Z-DNA. Types and functions of RNA: rRNA, mRNA, tRNA.	**10**
UNIT V	**Vitamins:** Sources, requirements, functions, and deficiency symptoms of Vitamin-C, Thiamine, Riboflavin, Pyridoxine, Folic acid, Vitamin B12. Absorption of fat-soluble vitamins- A, D, E, and K. **Hormones:** Classification of hormones based on chemical nature and mechanism of action of the following hormones: Glucagon and insulin	**15**

Recommended Readings:

1. Lehninger AL, Nelson DL and Cox MM, *Lehninger principles of biochemistry* (7th ed.), New York: W.H. Freeman, 2017.
2. Berg JM, Stryer L, Tymoczko J and Gatto G, *Biochemistry* (9th ed.), New York: WH Freeman, 2019.
3. Voet D, Voet JG and Pratt CW, Principles of biochemistry (4th ed.) Singapore: John Wiley & Sons, Inc., 2012.

Note-**Latest edition of the text books should be used.**

Suggested Continuous Evaluation Methods: Since the class is conceived as learner-centric and built around tasks that require learners to actively use various language skills, formative assessment can and should be used extensively. Oral presentations, peer interviews, and group tasks can be used for this purpose. The end-semester written examination will test all the areas targeted in the course.

Suggested equivalent online courses: epg-pathshala, egyankosh.ac.in, https://www.esalq.usp.br, https://www.thebiomics.com/

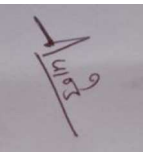
DISCIPLINE SPECIFIC CORE - Introductory Microbiology						
No. of Hours-60						
CREDIT DISTRIBUTION, ELIGIBILITY AND PRE-REQUISITES OF THE COURSE						
Course Title	**Credits**	**Credit distribution of the Course**			**Eligibility criteria**	**Pre-requisite of the Course (if any)**
		Lecture	**Tutorial**	**Practical/Practice**		
DSC- 2 Introductory Microbiology	**4**	**3**	**1**	**0**	**10+2**	**Nil**
Course: DSC 2		**Course Title: Introductory Microbiology**				
Max. Marks: As per Univ. rules		**Min. Passing Marks: As per Univ. rules**				

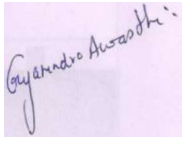
Course Outcome(s):

The course will enable the students to:

- Acquire a detailed knowledge in the structure, function, characteristic and applications of microorganisms,
- Skill sets in handling microorganisms in the laboratory and their applications in academia and industry
- Understanding the current trends in microbiology and its applications.
- Demonstrating the ability to design, perform and interpret the experiments during the practical courses with an emphasis on microbiological research aspects.

Unit	Topic	No. of Hours
Unit I	**MILESTONES IN MICROBIOLOGY:** History and scope of Microbiology. Classification of microorganisms: Microbial taxonomy, criteria used-including molecular approaches.	**15**
Unit II	**DIVERSITY:** Introduction of Prokaryotic and Eukaryotic cells, Distribution and characterization. Unique features of Bacteria, Algae, Fungi, Protozoa and viruses.	**15**
Unit III	**CULTURE & ITS MAINTENANCE:** Introduction and types of Media, Nutritional requirements and nutritional types of micro-organisms, methods of isolation, Purification and preservation. Microbial growth; Growth curve, Generation time, synchronous batch and continuous culture, measurement of growth and factors affecting growth of bacteria.	**15**
Unit IV	**CONTROL & DISEASES:** Control of Microorganisms: Concept of sterilization. Physical, chemical and chemotherapeutic Agents for Sterilization. Infections and diseases caused by bacteria: tuberculosis, typhoid Diseases caused by human viruses: Retro viruses (HIV), Hepatitis viruses; SARS-CoV	**15**





SUGGESTED READINGS:

1. Willey JM, Sherwood LM, and Woolverton CJ. Prescott, Harley and Klein's Microbiology. 7th edition. McGraw Hill Higher Education.

2. Alexopoulos CJ, Mims CW, and Blackwell M. Introductory Mycology.John and Sons, Inc.

3. Madigan MT, Martinko JM and Parker J. Brock Biology of Microorganisms. Pearson/Benjamin Cummings.

4. Pelczar MJ, Chan ECS and Krieg NR. Microbiology. McGraw Hill Book Company.

5. Stanier RY, Ingraham JL, Wheelis ML, and Painter PR.General Microbiology. 5thedition. McMillan.

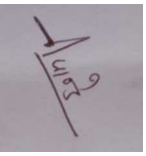
6. Tortora GJ, Funke BR, and Case CL. (2008). Microbiology: An Introduction. Pearson Education.

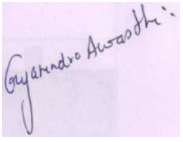
Suggested Continuous Evaluation Methods: Students can be evaluated through class participation, group discussion, group projects, presentations, and practical knowledge assessment to ensure comprehensive and regular learning. Additionally, they can be routinely evaluated through quizzes, assignments and class-tests etc.

Suggested equivalent online courses: Swayam, Vidyamitra.inflibnet.ac.in, ePG-pathshala, egyankosh.ac.in, https://ocw.mit.edu/, NPTEL etc.

DISCIPLINE SPECIFIC CORE – Basic Cell Biology						
No. of Hours-60						
CREDIT DISTRIBUTION, ELIGIBILITY AND PRE-REQUISITES OF THE COURSE						
Course Title	Credits	Credit distribution of the Course			Eligibility criteria	Pre-requisite of the Course (if any)
		Lecture	Tutorial	Practical/Practice		
DSC-3 Basic Cell Biology	4	3	1	0	10+2	Nil

Course: DSC 3	Course Title: Basic Cell Biology
Max. Marks: As per Univ. rules	Min. Passing Marks: As per Univ. rules



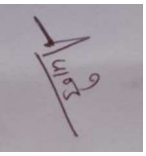


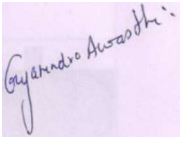
Course Outcomes:

The course will enable the students to:

- Acquire fundamental knowledge about basics of cell, cell components, and its different types.
- The students will learn about various proposed cell theory and origin of cell
- The students will gain knowledge of structure and functions of various cell organelles and their interaction within cell to promote cell growth and division
- The students will gain in depth knowledge about cytoskeletal organization intercellular communication
- The student will understand the concepts of cell death and concept of ageing and cancer cell
- The students will have an understanding of the concept of membrane transport

Unit	Topic	No. of Hours
Unit I	Cell as a unit of living system. Eukaryotic and Prokaryotic cells, Biochemical composition of cells (Proteins, lipids, carbohydrates, and nucleic acids)	10
Unit II	Structure and functions of: Cell Membrane, Cell wall and Extracellular matrix, endoplasmic reticulum, mitochondria, Golgi complex, chloroplast, lysosomes.	14
Unit III	Structure and functions of nucleus, nucleolus and chromosomes, cytoskeleton and cell motility: Structure and function of microtubules, microfilaments, Intermediate filaments	14
Unit IV	Cell division (Mitosis and Meiosis); Cell cycle, cell death and apoptosis; Difference between cancerous and normal cells	12
Unit V	Membrane transport: Functions of membrane transport, mechanisms for transport across cell membrane	10

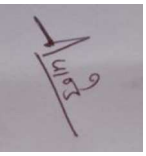


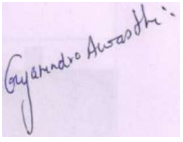


Recommended Readings

Books:

- Alberts, B., Johnson, A., Lewis, J., Raff, M., Roberts, K., & Walter, P. (2014). Molecular Biology of the Cell (6th Ed.). New York: Garland Science
- Cooper, G. M., and Hausman, R. E. (2013). The Cell: a Molecular Approach (6th Ed.). Washington: ASM; Sunderland
- Rastogi S.C. (2008). Cell Biology (3rd edition)
- Sheeler Phillip (1987). Cell and Molecular Biology (3rd edition)
- Karp, G. Cell and Molecular Biology. Concepts and experiments. John Harris, D., Wiley & sons, New York
- Iwasa J., Marshal W. Karp's Cell Biology (2018) (8th edition) Wiley & Sons, NY
- Iwasa J., Marshal W. Karp's Cell and Molecular Biology: Concepts and experiments. (2015) (8th edition) Wiley & sons, New York
- Watson, J. D. Baker TA, Bell, SP Gann, A. Levine, M. Losick R. (2008). Molecular Biology of the Gene (5th ed.). Pearson
- Lodish, H F. Berk, A. Kaiser, CA, Krieger, M. Bretscher, A. Ploegh, H. Aman, A. Martin, K. (2016). Molecular Cell Biology (8th Ed.). New York: W.H. Freeman
- Gupta P.K. Cell and Molecular Biology 2018. 5th edition Rastogi Publication India.





Suggested online links:

- https://ocw.mit.edu/courses/biological-engineering/20-310j-molecular-cellular-and-tissuebiomechanics-spring- 2015/readings/MIT20_310JS15_Kamm2.2.pdf
- https://ocw.mit.edu/courses/find-bytopic/#cat=science&subcat=biology&spec=cell_biology
- https://onlinecourses.swayam2.ac.in/cec19_bt12/preview
- https://onlinecourses.nptel.ac.in/noc21_cy15/preview
- https://ocw.mit.edu/high-school/biology/exam-prep/cells/subcellular-organization/cytoskeleton/
- https://epgp.inflibnet.ac.in/Home/ViewSubject?catid=2rAs1Puvga4LW93zMe83aA

Suggested Continuous Evaluation Methods: Since the class is conceived as learner-centric and built around tasks that require learners to actively use various science communication skills, formative assessment can and should be used extensively. Oral presentations, quiz, and group tasks can be used for this purpose. The end-semester written examination will test all the areas targeted in the course.

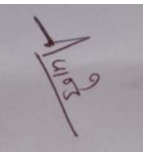
GENERIC ELECTIVE (GE) – Mathematics for Biologists						
No. of Hours-60						
CREDIT DISTRIBUTION, ELIGIBILITY AND PRE-REQUISITES OF THE COURSE						
Course Title	**Credits**	**Credit distribution of the Course**			**Eligibility criteria**	**Prerequisite of the Course (if any)**
		Lecture	**Tutorial**	**Practical/Practice**		
GE-1 Mathematics for Biologists	**4**	**2**	**2**	**0**	**10+2**	
Course: GE 1		**Course Title: Mathematics for Biologists**				
Max. Marks: As per Univ. rules		**Min. Passing Marks: As per Univ. rules**				

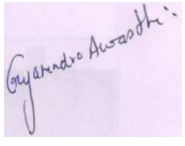
Course Outcomes:

After successful completion of this course, students will be able to:

- Solve simultaneous linear and quadratic equations and apply partial fractions to simplify complex expressions
- Understand and perform arithmetic operations on matrices and use determinants to solve systems of equations
- Understand differentiation techniques and integration methods

Unit	**Topic**	**No. of Hours**





Unit I	• Algebra- Simultaneous equations (linear and quadratic) upto two variables only • Determinants- properties of determinants; • Matrices- definition and types, Arithmetic operations on matrices, • Partial fraction	10
Unit II	• Differential Calculus- Differentiation, Differentiation of Standard functions including functions of a function (chain rule), Differentiation of implicit functions, Logarithmic differentiation. • Integral calculus- Integration of parts, substitution of partial fractions, Integration of algebraic functions	15
Unit III	• Frequency distribution- graphical representation of frequency distribution using bar chart, pie chart, histograms, frequency polygon, frequency curve, and cumulative frequency curve. • Mean, Median, and Mode and their characteristics; quartiles, range, dispersion, mean deviation, standard deviation, standard error of mean	15
Unit IV	• Correlation and regression- definition, • Karl -Pearson's coefficient of correlation, • Line of regression, regression coefficient	10
Unit V	• Basic idea of probability; Test of significance (null hypothesis), level of significance (5% and 1%); t-test	10

Recommended Readings:

- Differential Calculus by Shanti Narayan & P.K. Mittal – *S. Chand*
- Integral Calculus by Shanti Narayan – *S. Chand*
- Calculus of One Variable by M. Thamban Nair
- Applied Statistics by S.C. Gupta & V.K. Kapoor – *Sultan Chand & Sons*
- A Textbook of Determinants, Matrices and Algebraic Forms by W.L. Ferrar – *Oxford University Press*

Suggested Continuous Evaluation Methods: In addition to the theoretical inputs the course will be delivered through Assignments, Presentation, Group Discussions, etc.

Suggested equivalent online courses: Swayam, Vidyamitra.inflibnet.ac.in, nptel.ac.in, literature study-online.com, epg-pathshala, egyankosh.ac.in,

Skill Enhancement Course (SEC) – Experimental Biotechniques-I						
No. of Hours-30						
CREDIT DISTRIBUTION, ELIGIBILITY AND PRE-REQUISITES OF THE COURSE						
Course Title	**Credits**	**Credit distribution of the Course**			**Eligibility criteria**	**Pre-requisite of the Course (if any)**
		Lecture	**Tutorial**	**Practical/Practice**		

SEC-1 Experimental Biotechniques-I	**2**	**0**	**0**	**2**	**10+2**	**Nil**
Course: SEC-1			**Course Title: Experimental Biotechniques-I**			
Max. Marks: As per Univ. rules			**Min. Passing Marks: As per Univ. rules**			

Course Outcomes:

After finishing the course, the students will be able to:

- Learn the skill sets in handling microorganisms in the laboratory and their applications in academia and industry
- Understanding the current trends in microbiology and its applications.
- Demonstrating the ability to design, perform, and interpret the experiments during the practical courses with an emphasis on microbiological research aspects.
- Students will gain practical knowledge of basic biochemistry concepts such as preparing chemical solutions and performing qualitative analysis of carbohydrates and amino acids.

Topic	No. of Hours
• Introduction to SOPs of laboratory equipment: pH-meter, weighing balance, autoclave, shaker incubator, laminar air flow cabinet, microscope • Laboratory safety, hygiene, good laboratory practices (GLP), and sterilization • Preparation of Molar, Molal, Normal Solution, and Percent solution • Preparation of standard and buffer solutions • Qualitative analysis of sugars • Qualitative analysis of amino acids • Media Preparation (solid and liquid), sterilization, and growth for bacterial cells • Differential staining (Gram-positive and Gram-negative bacteria) • Visualization of bacterial cell under light microscope • Glycerol Stock Preparation	30

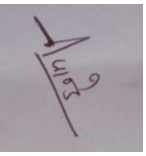
Recommended Readings

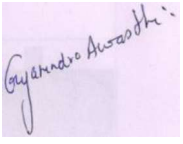
Books:

- Willey JM, Sherwood LM, and Woolverton CJ. Prescott, Harley and Klein's Microbiology. 7th edition. McGraw Hill Higher Education.
- Alexopoulos CJ, Mims CW, and Blackwell M. Introductory Mycology. John and Sons, Inc.
- Madigan MT, Martinko JM and Parker J. Brock Biology of Microorganisms. Pearson/Benjamin Cummings.
- Lehninger AL, Nelson DL and Cox MM, Lehninger principles of biochemistry (7th ed.), New York: W.H. Freeman, 2017.
- Berg JM, Stryer L, Tymoczko J and Gatto G, Biochemistry (9th ed.), New York: WH Freeman, 2019.
- Voet D, Voet JG and Pratt CW, Principles of biochemistry (4th ed.) Singapore: John Wiley & Sons, Inc., 2012

Suggested Continuous Evaluation Methods: Since the class is conceived as learner-centric and built around tasks that require learners to actively use various science communication skills, formative assessment can and should be used extensively. Oral presentations, quiz, and group tasks can be used for this purpose. The end-semester written examination will test all the areas targeted in the course.

***** The syllabus of value added course (VAC) and the ability enhancement course (AEC) are designed and standardized as per NEP guidelines by Kumaun University. Students will opt for the VAC/AEC of their choice from the University pool.***





SEMESTER II

DISCIPLINE SPECIFIC CORE- ELEMENTARY MOLECULAR BIOLOGY						
No. of Hours-60						
CREDIT DISTRIBUTION, ELIGIBILITY AND PRE-REQUISITES OF THE COURSE						
Course Title	Credits	Credit distribution of the Course			Eligibility criteria	Pre-requisite of the Course (if any)
		Lecture	Tutorial	Practical/Practice		
DSC: 4 ELEMENTARY MOLECULAR BIOLOGY	4	3	1	0	10+2	Nil
Course: DSC 4		Course Title: ELEMENTARY MOLECULAR BIOLOGY				
Max. Marks: As per Univ. rules		Min. Passing Marks: As per Univ. rules				

Course Outcomes:

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

- Get familiarized with the central role of the information molecule – the DNA, in controlling all physiological and cellular processes
- Learn to appreciate the flow of information from nucleic acids to proteins, and the significance of the central dogma
- Gain insight into the molecular mechanisms and regulation of DNA replication, repair, transcription, post-transcriptional processing and protein synthesis

Unit	Topic	No. of Hours
UNIT I	**INTRODUCTION AND HISTORY OF MOLECULAR BIOLOGY:** Discovery of DNA as genetic material: experiments of Griffith, Avery, McLeod, and McCarty, Hershey and Chase experiment, and Friedrich Miescher's experiment. Types of DNA and RNA. Central dogma of molecular biology.	12
UNIT II	**DNA REPLICATION:** Messelson–Stahl experiment of semiconservative DNA replication. DNA replication in prokaryotes: enzymes and proteins involved in replication.	12
UNIT III	**TRANSCRIPTION**: Transcription in prokaryotes: types of RNA polymerases. DNA elements in transcription: promoters, enhancers, silencers, transcription factors. Structure of mRNA in prokaryotes and eukaryotes. Codon, characteristics of the genetic code, and wobble hypothesis.	12

UNIT IV	**TRANSLATION**: Mechanism of translation in prokaryotes: amino acid activation, initiation, elongation, and termination.	**12**
UNIT V:	**REGULATION OF GENE EXPRESSION**: Positive and negative control: - *lac* operon and - *trp* operon.	**12**

SUGGESTED READING:

1. Watson JD, Baker TA, Stephen PB, et al., Molecular biology of the gene (7th ed.), San Francisco: Pearson Education, 2017.
2. Lehninger AL, Nelson DL and Cox MM, *Lehninger principles of biochemistry* (7th ed.), New York: W.H. Freeman, 2017.
3. Berg JM, Stryer L, Tymoczko J and Gatto G, *Biochemistry* (9th ed.), New York: WH Freeman, 2019.

Suggested Continuous Evaluation Methods: Since the class is conceived as learner-centric and built around tasks that require learners to actively use various language skills, formative assessment can and should be used extensively. Oral presentations, peer interviews, and group tasks can be used for this purpose. The end-semester written examination will test all the areas targeted in the course.

Suggested equivalent online courses: epg-pathshala, egyankosh.ac.in, https://www.esalq.usp.br, https://www.biologydiscussion.com, https://www.thebiomics.com/

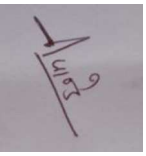
DISCIPLINE SPECIFIC CORE: BASIC INSTRUMENTATION IN BIOTECHNOLOGY						
No. of Hours-60						
CREDIT DISTRIBUTION, ELIGIBILITY AND PRE-REQUISITES OF THE COURSE						
Course Title	**Credits**	**Credit distribution of the Course**			**Eligibility criteria**	**Pre-requisite of the Course (if any)**
		Lecture	**Tutorial**	**Practical/Practice**		
DSC – 5 BASIC INSTRUMENTATION IN BIOTECHNOLOGY	**4**	**3**	**1**	**0**	**10+2**	**Nil**
Course: DSC 5		**Course Title: BASIC INSTRUMENTATION IN BIOTECHNOLOGY**				
Max. Marks: As per Univ. rules		**Min. Passing Marks: As per Univ. rules**				

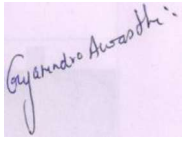
Course Outcomes:

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

- Understand and apply molecular biology techniques and principles in Instrumentation
- Understanding the current trends in instrumentation and its applications. Demonstrating the ability to design, perform and interpret the experiments during the practical courses with an emphasis on analytical research aspect
- Gain thorough knowledge and apply good laboratory practice and good manufacturing practices in biotech industries.

Unit	Topic	No. of Hours
Unit I	**MICROSCOPY:** Light Microscopy, phase contrast, dark field microscope, Types of Compound microscopes. Electron microscope (SEM & TEM).	**12**
Unit II	**SPECTROSCOPY:** Lambert-Beer law, spectrophotometer and colorimetry, UV-Vis, fluorescence, concept, emission, chemiluminescence, fluorimetry.	**12**
Unit III	**ISOTOPES & RADIATIONS** Introduction of radioactive compounds, alpha, beta, gamma radiations, radioactive decay concept of half-life, isotopes important in biological experiments, measurement of radioactivity, autoradiography.	**12**
Unit IV	**Chromatography and Electrophoresis:** Chromatography: basic principle and applications of Paper, TLC, Column chromatography, gel exclusion, ion-exchange, affinity. Electrophoresis: principle and applications of Agarose gel, SDS PAGE, Native PAGE.	**12**
Unit V	**Centrifugation**: Principle and types, sedimentation coefficient, sedimentation velocity, ultracentrifugation, density gradient centrifugation	**12**





SUGGESTED READINGS:

1. Principles and Techniques of Practical Biochemistry, Keith Wilson (Editor) and JohnWalker (Editor): Cambridge University Press.
2. Principles of Physical Biochemistry, K. E. Van Holde, *et al.*: Prentice Hall
3. Principles of Instrumental Analysis, Douglas A. Skoog, et al: Harcourt College Publishers.
4. Molecular cell biology – Ladish, Berk, Matsudara, Kaiser, Krieger, Zipursky, Darnell (W.H.Freeman, Co.)
5.Biophysics - Cotrell (Eastern Economy Edition)
6. Clinical Biophysics –Principles and Techniques- P. Narayanan (Bhalani Pub., Mumbai)
7. Biophysics – Pattabhi and Gautham (Narosa Publishing House)
8.. Instrumentation measurements and analysis – Nakara, Choudhari (Tata Mc Graw Hill)
9. Handbook of analytical instruments – R.S. Khandpur (Tata Mc Graw Hill)
10. Biophysical Chemistry- Upadhyay, Upadhyay and Nath – (Himalaya Pub. House, Delhi)

Suggested Continuous Evaluation Methods: Students can be evaluated through class participation, group discussion, group projects, presentations, and practical knowledge assessment to ensure comprehensive and regular learning. Additionally, they can be routinely evaluated through quizzes, assignments and class-tests etc.

Suggested equivalent online courses: Swayam, Vidyamitra.inflibnet.ac.in, ePG-pathshala, egyankosh.ac.in, https://ocw.mit.edu/, NPTEL etc.

DISCIPLINE SPECIFIC CORE – Experimental Biotechniques-II						
No. of Hours-60						
CREDIT DISTRIBUTION, ELIGIBILITY AND PRE-REQUISITES OF THE COURSE						
Course Title	**Credits**	**Credit distribution of the Course**			**Eligibility criteria**	**Pre-requisite of the Course (if any)**
		Lecture	**Tutorial**	**Practical/Practice**		
DSC-6 Experimental Biotechniques -II	**4**	**0**	**2**	**2**	**10+2**	**Nil**
Course: DSC-6		**Course Title: Experimental Biotechniques -II**				
Max. Marks: As per Univ. rules		**Min. Passing Marks: As per Univ. rules**				

Course Outcomes:

The course will enable the students to:

- Understand and apply molecular biology techniques and principles in Instrumentation
- Understanding the current trends in instrumentation and its applications. Demonstrating the ability to design, perform and interpret the experiments during the practical courses with an emphasis on analytical research aspect
- Gain thorough knowledge and apply good laboratory practice

Topic	No. of Hours
• Introduction to SOPs of laboratory equipments : pH meter, weighing balance, autoclave, shaker incubator, laminar air flow cabinet, microscope • Laboratory safety, hygiene, good laboratory practices (GLP), and sterilization • Thin Layer Chromatography (TLC) for biomolecules separation • Paper Chromatography for biomolecules separation • Chlorophyll estimation • Isolation of plant genomic DNA • Quantification of plant genomic DNA • Agarose Gel Electrophoresis of plant genomic DNA • Restriction Digestion of DNA	60

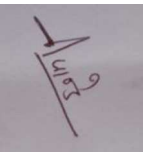
Recommended Readings

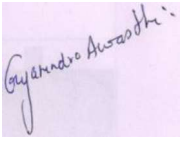
Books:

- Instrumentation measurements and analysis – Nakara, Choudhari (Tata Mc Graw Hill)
- Handbook of analytical instruments – R.S. Khandpur (Tata Mc Graw Hill)
- Biophysical Chemistry- Upadhyay, Upadhyay and Nath – (Himalaya Pub. House, Delhi)
- Watson JD, Baker TA, Stephen PB, et al., Molecular biology of the gene (7th ed.), San Francisco: Pearson Education, 2017.
- Lehninger AL, Nelson DL and Cox MM, *Lehninger principles of biochemistry* (7th ed.), New York: W.H. Freeman, 2017.
- Berg JM, Stryer L, Tymoczko J and Gatto G, *Biochemistry* (9th ed.), New York: WH Freeman, 2019.

Suggested Continuous Evaluation Methods: Since the class is conceived as learner-centric and built around tasks that require learners to actively use various science communication skills, formative assessment can and should be used extensively. Oral presentations, quiz, and group tasks can be used for this purpose. The end-semester written examination will test all the areas targeted in the course.

Suggested online courses: Swayam, Vidyamitra.inflibnet.ac.in, ePG-pathshala, egyankosh.ac.in, https://ocw.mit.edu/, NPTEL etc.





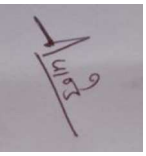
GENERIC ELECTIVE (GE) – Chemistry for Biologists						
No. of Hours-60						
CREDIT DISTRIBUTION, ELIGIBILITY AND PRE-REQUISITES OF THE COURSE						
Course Title	**Credits**	**Credit distribution of the Course**			**Eligibility criteria**	**Pre-requisite of the Course (if any)**
		Lecture	**Tutorial**	**Practical/Practice**		
GE- 2 Chemistry for Biologists	**4**	**2**	**2**	**0**	**10+2**	**Nil**
Course: GE-2		**Course Title: Chemistry for Biologists**				
Max. Marks: As per Univ. rules		**Min. Passing Marks: As per Univ. rules**				

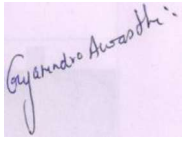
Course Outcome(s):

The course will enable the students to:

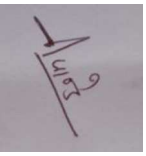
- Understand concepts of atomic structure, chemical bonding, thermodynamics, and biomolecule chemistry as they apply to living systems.
- Prepare solutions and buffers, and understand principles of titrations and spectrophotometric assays.
- Will be able to connect concepts from physical, organic, and inorganic chemistry to biological macromolecules, enzymatic reactions, and physiological processes.
- These outcomes reflect core competencies recommended for undergraduate courses bridging chemistry and biology, ensuring both conceptual understanding and practical laboratory skills.

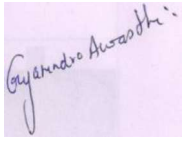
Unit	Topic	No. of Hours
Unit I	**Basic Chemical Principles for Biologists** • Atomic structure, Heisenberg uncertainty principle, atomic orbitals, quantum numbers, Pauli's exclusion principle, Aufbau rule, Hund's rule, electronic configuration of s block, p- block, d block, and f block elements, general idea of modern periodic table, atomic radii, electronegativity, electron affinity. • Chemical bonding: ionic, covalent, coordination, and hydrogen bonds • Intermolecular forces: van der Waals, hydrophobic, electrostatic interactions • Solutions and concentrations: molarity, molality, normality, mole fraction, ppm • Acids, bases, and buffers: Arrhenius, Bronsted-Lowry, and Lewis concepts, pH, pKa, buffers in biology	**20**





Unit II	**Thermodynamics and Chemical Kinetics in Biological Systems** • Laws of thermodynamics, Gibbs free energy, enthalpy, entropy • Spontaneity and equilibrium in biochemical reactions • Chemical kinetics: rate laws, order of reactions, effect of temperature and catalysts on rates, collision theory, activation energy	**15**
Unit III	**Organic Reaction Mechanisms and Stereochemistry** • General introduction of organic compounds (e.g. aliphatic, aromatic, heterocyclic), IUPAC nomenclature of compounds (Alcohols, Ether, Ketones, Aldehydes, Carboxylic acid and Esters) • Electronic effects: inductive, resonance, hyperconjugation, mesomeric • Structure and reactivity: electrophiles, nucleophiles, reaction intermediates (carbocations, carbanions) • Stereochemistry: chirality, optical activity, enantiomers/diastereomers, Fischer projections, R/S and E/Z nomenclature • Fundamental organic reactions important in biology: substitution, elimination, addition, condensation, hydrolysis.	**15**
Unit IV	**Chemistry of Biomolecules** • Carbohydrates- Introduction, occurrence, classification of Mono-, Di- and Polysaccharides, Structure of Glucose and Fructose • Lipids- General introduction, Classification & Structure of Simple & Compound lipids • Proteins- General introduction, Amino acids, Classification, Structure of Primary, Secondary, Tertiary & Quaternary proteins (elementary idea)	**10**





SUGGESTED READINGS:

- Charles H. Corwin, Introductory Chemistry: Concepts And Connections, 5Th Edition, Pearson College Div; ISBN: 9780132321488 (2007)
- Bahl, Arun, and B.S. Bahl. A Textbook of Organic Chemistry. New Delhi: S. Chand Publishing.
- Nelson, David L., and Michael M. Cox. Lehninger Principles of Biochemistry. 8th ed. New York: W. H. Freeman, 2021.
- McMurry, John, and Robert C. Fay. Chemistry. 9th ed. Boston: Pearson, 2016.

Suggested Continuous Evaluation Methods: Students can be evaluated through class participation, group discussion, group projects, presentations, and practical knowledge assessment to ensure comprehensive and regular learning. Additionally, they can be routinely evaluated through quizzes, assignments and class-tests etc.

Suggested online courses: Swayam, Vidyamitra.inflibnet.ac.in, ePG-pathshala, egyankosh.ac.in, https://ocw.mit.edu/, NPTEL etc.

Skill Enhancement Course (SEC) – Introduction to Microsoft Office

No. of Hours-30

CREDIT DISTRIBUTION, ELIGIBILITY AND PRE-REQUISITES OF THE COURSE

Course Title	Credits	Credit distribution of the Course			Eligibility criteria	Pre-requisite of the Course (if any)
		Lecture	Tutorial	Practical/Practice		
SEC-2 Introduction to Microsoft Office	2	1	1	0	10+2	Nil

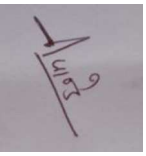
Course: SEC 2	**Course Title: Introduction to Microsoft Office**
Max. Marks: As per Univ. rules	**Min. Passing Marks: As per Univ. rules**

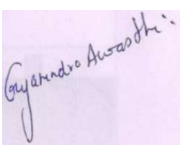
Course Outcome(s):

The course will enable the students to:

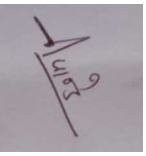
- Understand basic computer concepts, navigate the Windows environment, and manage files and folders.
- They will be able to create, edit, and format text documents, work with tables, images, templates, etc.
- Students will be able to develop, format, and manage spreadsheets, use formulas and basic functions, create charts/graphs.
- Students will be able to design presentations, integrate text, images, tables, and multimedia elements, and utilize transitions and animations.

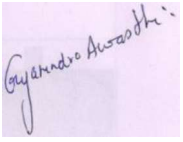
Unit	Topic	No. of Hours





Unit I	**Introduction to Computers and Office Suite** • Overview of computer and Key hardware components • Basic overview of Operating systems, Definition of Software • Introduction to Microsoft Office and its components (Word, Excel, PowerPoint, and Access) • Understanding the Office user interface: ribbons, menus, toolbars, shortcuts	**8**
Unit II	**Microsoft Word** • Creating, opening, saving, and organizing documents • Editing and formatting text: fonts, paragraphs, styles • Working with lists, tables, images, and shapes • Page setup: margins, headers/footers, page numbers • Proofing tools: spelling, grammar, thesaurus, word count • Using templates; mail merge for letters/labels • Preparing and printing documents	**8**
Unit III	**Microsoft Excel** • Understanding worksheets, workbooks, cells and ranges • Entering, editing, sorting and filtering data • Formatting cells, rows, and columns • Introduction to formulas and basic functions (SUM, AVERAGE, MIN, MAX) • Creating charts and graphs from data: Bar-diagram, Pie chart, Scatterplot: Displaying line equation and R^2 Value • Using conditional formatting • Printing worksheets and page setup basics	**7**
Unit IV	**Microsoft PowerPoint** • Creating, opening, and saving presentations • Working with slides: layouts, text, images, and multimedia • Basic formatting: themes, backgrounds, color schemes • Using SmartArt, charts, and tables in slides • Applying transitions and animations • Running and printing slide shows	**7**





SUGGESTED READINGS:

- Wang, Wallace. Microsoft Office 2013 for Dummies. Hoboken: Wiley, 2013.
- Satish Jain, M. Geetha, Kratika. Microsoft Office 2007 Training Guide, Visual Approach to Learning MS Office 2007 Package. New Delhi: BPB Publications.
- Nelson, Steven, et al. Microsoft Office 365: In Practice. New York: McGraw-Hill Education, 2020.

Suggested Continuous Evaluation Methods: Students can be evaluated through class participation, group discussion, group projects, presentations, and practical knowledge assessment to ensure comprehensive and regular learning. Additionally, they can be routinely evaluated through quizzes, assignments and class-tests etc.

Suggested online courses: Swayam, Vidyamitra.inflibnet.ac.in, ePG-pathshala, egyankosh.ac.in, https://ocw.mit.edu/, NPTEL etc.

***** The syllabus of value-added course (VAC) and ability enhancement course (AEC) are designed and standardized as per NEP guidelines by Kumaun University. Students will opt for the VAC/AEC of their choice from the University pool.***

SEMESTER III

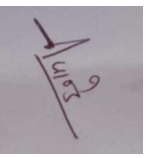
DISCIPLINE SPECIFIC CORE- Environmental Biotechnology						
No. of Hours-60						
CREDIT DISTRIBUTION, ELIGIBILITY AND PRE-REQUISITES OF THE COURSE						
Course Title	**Credits**	**Credit distribution of the Course**			**Eligibility criteria**	**Pre-requisite of the Course (if any)**
		Lecture	**Tutorial**	**Practical/Practice**		
DSC: 7 Environmental Biotechnology	**4**	**3**	**1**	**0**	UG Certificate	**Nil**
Course: DSC-7		**Course Title: Environmental Biotechnology**				
Max. Marks: As per Univ. rules		**Min. Passing Marks: As per Univ. rules**				

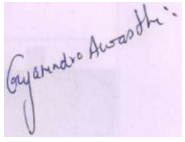
Course Outcome(s):

The course will enable the students to:

- Explore the biotechnological practices and demonstrate innovative thinking in addressing the current day and future challenges with respect to health, and environment
- Understand and apply genetic engineering techniques and principles in Bioremediation. Understanding the current trends in environment and reasons of global warming
- Demonstrating the ability to design, perform and interpret the experiments during the practical courses with an emphasis on environmental rearrangement aspect.

Unit	**Topic**	**No. of Hours**





Unit I	**ECOSYSTEM, BIODIVERSITY AND ITS CONSERVATION**: Ecosystem - concept - structure and function - producers, consumers and decomposers - Food chain - Food web - Ecological pyramids - Energy flow - Forest, Grassland, desert and aquatic ecosystem. Biodiversity - Definition - Values and uses of biodiversity - conservation of biodiversity – In-situ & Ex-situ.	**15**
Unit II	**ENVIRONMENTAL POLLUTION AND MANAGEMENT** Environmental Pollution - Causes - Effects and control measures of Air, Water, Marine, soil, solid waste, Thermal, Nuclear pollution and Role of individuals in prevention of pollution Microbial assessment of air (open plate and air sample) and water.	**15**
Unit III	**INDUSTRIAL MANAGEMENT OF WASTE:** Microbiology of waste water treatment, aerobic process - activated sludge, oxidation ponds, trickling filter, towers, Anaerobic process - anaerobic digestion, anaerobic filters, up-flow anaerobic sludge blanket reactors	**15**
Unit IV	**XENOBIOTICS AND ITS MANAGEMENT** Xenobiotic compounds - organic (chlorinated hydrocarbons, substituted simple aromatic compounds, polyaromatic hydrocarbons, pesticides, surfactants) and inorganic (metals, radionuclides, phosphates, nitrates). Bioremediation of xenobiotics in environment - ecological consideration, molecular techniques in bioremediation.	**15**

SUGGESTED READINGS:

1. Waste water engineering - treatment, disposal and reuse, Metcalf and Eddy Inc., Tata McGraw Hill, New Delhi.

2. Environmental Chemistry, AK. De, Wiley Eastern Ltd, New Delhi.

3. Introduction to Biodeterioration, D.Allsopp and K.J. Seal, ELBS / Edward Arnold.

4. Bioremidation, Baaker, KH and Herson D.S., 1994. Mc.GrawHill Inc, NewYork.

5. Industrial and Environmental Biotechnology - Nuzhat Ahmed, Fouad M. Qureshi and Obaid Y. Khan, 2006. Horizon Press.

6. Environmental Molecular Biology, Paul. A, Rochelle, 2001.Horizon Press.

Suggested Continuous Evaluation Methods: Students can be evaluated through class participation, group discussion, group projects, presentations, and practical knowledge assessment to ensure comprehensive and regular learning. Additionally, they can be routinely evaluated through quizzes, assignments and class-tests etc.

Suggested equivalent online courses: Swayam, Vidyamitra.inflibnet.ac.in, ePG-pathshala, egyankosh.ac.in, https://ocw.mit.edu/, NPTEL etc.

DISCIPLINE SPECIFIC CORE- PLANT PHYSIOLOGY						
No. of Hours-60						
CREDIT DISTRIBUTION, ELIGIBILITY AND PRE-REQUISITES OF THE COURSE						
Course Title	**Credits**	**Credit distribution of the Course**			**Eligibility criteria**	**Pre-requisite of the Course (if any)**
		Lecture	**Tutorial**	**Practical/Practice**		

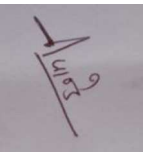
DSC-8 PLANT PHYSIOLOGY	4	3	1	0	UG Certificate	Nil
Course: DSC 8			**Course Title: PLANT PHYSIOLOGY**			
Max. Marks: As per Univ. rules			**Min. Passing Marks: As per Univ. rules**			

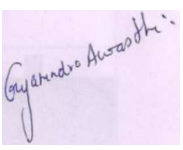
Course Outcomes:

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

- Understand the role of physiological and metabolic processes for plant growth and development.
- Assimilate knowledge about Biochemical constitution of plant diversity.
- Acquire knowledge in respect to biochemical and molecular mechanism involved under different abiotic and biotic stress in plants.
- Perceive detailed understanding of photosynthesis and nitrogen fixation.
- Understand role of different plant hormones in plant growth and development

Unit	Topic	No. of Hours
UNIT I:	**Water relations and mineral nutrients:** Plant–water relations: movement of water through a flowering plant, transpiration, and stomatal mechanism. Ascent of water in xylem: cohesion, adhesion, and root pressure. Significance of nutrients in plants: macronutrients and micronutrients	**12**
UNIT II:	**Mechanism of Photosynthesis**: Photosynthesis: Photosynthetic apparatus, pigments of photosynthesis, -Calvin cycle (C3 plants), Hatch-Slack (C4 plants) & CAM pathways of carbon reduction and their regulation, Structure, and function of RUBISCO	**12**
UNIT III:	**Plant Stress Physiology:** Plant stress, plant responses to abiotic and biotic stresses, salinity, water, heat, chilling, heavy metals, radiations and their impact on plant growth and metabolism, mechanisms of resistance to biotic stress and abiotic stress, antioxidative defense mechanism.	**12**
UNIT IV:	**Nitrogen Metabolism:** Role of nitrogen in plants, sources of nitrogen – molecular nitrogen, organic & inorganic nitrogen. Conversion of nitrate into ammonia, regulation of nitrate reductase. Biological nitrogen fixation - symbiotic and non-symbiotic nitrogen fixation	**12**
UNIT V:	**Plant Cell growth and development:** Plant growth regulators: phytohormones biological functions (auxin, gibberellin, cytokinin, abscisic acid, and ethylene. Structure, function, and mechanisms of action of phytochromes and photoperiodism.	**12**





SUGGESTED READING:

1. Norman P. A. Hünerand William G. Hopkins, Introduction to Plant Physiology, 3rd. Edition
2. Lincoln Taiz, Eduardo Zeiger, Ian M. Møller, and Angus Murphy, Plant Physiology and Development, 6 th Edition
3. F. Salisbury and Cleon W. Ross, Plant Physiology 4 th Edition.
4. S K Verma,Mohit Verma, A Textbook of Plant Physiology, Biochemistry and Biotechnology

Suggested Continuous Evaluation Methods: Since the class is conceived as learner-centric and built around tasks that require learners to actively use various language skills, formative assessment can and should be used extensively. Oral presentations, peer interviews, and group tasks can be used for this purpose. The end-semester written examination will test all the areas targeted in the course.

Suggested equivalent online courses: epg-pathshala, egyankosh.ac.in, https://www.esalq.usp.br, https://www.biologydiscussion.**com https://www.thebiomics.com**

DISCIPLINE SPECIFIC CORE- Principles of Genetics
No. of Hours-60

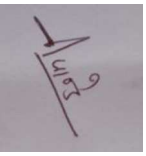
CREDIT DISTRIBUTION, ELIGIBILITY AND PRE-REQUISITES OF THE COURSE						
Course Title	**Credits**	**Credit distribution of the Course**			**Eligibility criteria**	**Pre-requisite of the Course (if any)**
		Lecture	**Tutorial**	**Practical/Practice**		
DSC: 9 Principles of Genetics	**4**	**3**	**1**	**0**	UG Certificate	**Nil**
Course: DSC-9			**Course Title: Principles of Genetics**			
Max. Marks: As per Univ. rules			**Min. Passing Marks: As per Univ. rules**			

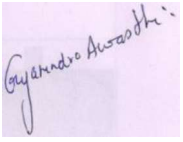
Course Outcomes:

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

- Demonstrate an understanding of fundamental genetic concepts and principles.
- Analyze and interpret Mendel's laws of inheritance at the molecular level.
- Evaluate experimental evidence supporting DNA as the genetic material.
- Explain the structural organization of chromosomes and the implications of chromosomal aberrations.
- Recognize the different types of mutations and their effects on organisms.
- Assess the applications and ethical implications of genetic engineering.

Unit	Topic	No. of Hours
Unit I:	**Introduction to the Genre**: Types of Genetic Concepts: Gene, Genome, Allele, Genotype, Phenotype, Mendel's Laws of Inheritance	12
Unit II:	**Mendel's Laws of Inheritance:** Mendel's First Law (Law of Segregation) Overview, Mendel's First Law Mendel's Second Law (Law of Independent Assortment) Overview, Understanding the principle and its significance	12
Unit III:	**DNA as the Genetic Material:** Historical background leading to the identification of DNA as the genetic material Griffith's experiment, Avery-MacLeod-McCarty experiment, Hershey-Chase experiment	12
Unit IV:	**Chromosomal Organization:** Chromosome structure in eukaryotes: Functional significance and implications Numerical and Structural Chromosomal Aberrations Types of chromosomal aberrations: deletions, duplications, inversions, translocations, Consequences of chromosomal aberrations	12
Unit V:	**Mutation:** Types of mutations: point mutations, insertions, deletions, frameshift mutations Chemical and physical mutagens: understanding their mechanisms and effects	12





SUGGESTED READING:

1. "Genetics: From Genes to Genomes" by Leland H. Hartwell, Michael L. Goldberg, Janice Fischer, and Leroy Hood. This textbook provides a comprehensive overview of genetics, covering topics from basic principles to advanced concepts.
2. "Principles of Genetics" by D. Peter Snustad and Michael J. Simmons. This textbook offers a clear and concise explanation of genetic principles, including Mendelian genetics, molecular genetics, and population genetics.
3. "Genetics: Analysis and Principles" by Robert J. Brooker. This textbook emphasizes problem-solving and critical thinking skills, helping students apply genetic principles to real-world scenarios.
4. "Introduction to Genetic Analysis" by Anthony J.F. Griffiths, Susan R. Wessler, Sean B. Carroll, and John Doebley. This classic textbook provides a thorough introduction to genetics, with a focus on experimental evidence and analysis.
5. "Essential Genetics: A Genomic Perspective" by Daniel L. Hartl. This textbook explores genetics from a genomic perspective, integrating modern research findings with classical principles.

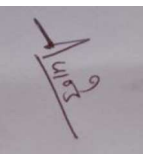
Suggested Continuous Evaluation Methods: Since the class is conceived as learner-centric and built around tasks that require learners to actively use various language skills, formative assessment can and should be used extensively. Oral presentations, peer interviews, and group tasks can be used for this purpose. The end-semester written examination will test all the areas targeted in the course.
Suggested equivalent online courses: epg-pathshala, egyankosh.ac.in, https://www.esalq.usp.br, https://www.biologydiscussion.com, https://www.thebiomics.com/

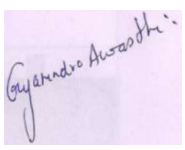
DISCIPLINE SPECIFIC ELECTIVE (DSE) – Human Physiology						
No. of Hours-60						
CREDIT DISTRIBUTION, ELIGIBILITY AND PRE-REQUISITES OF THE COURSE						
Course Title	**Credits**	**Credit distribution of the Course**			**Eligibility criteria**	**Pre-requisite of the Course (if any)**
		Lecture	**Tutorial**	**Practical/Practice**		
DSE-1 Human Physiology	**4**	**3**	**1**	**0**	**UG Certificate**	**Nil**
Course: DSE-1			**Course Title: Human Physiology**			
Max. Marks: As per Univ. rules			**Min. Passing Marks: As per Univ. rules**			

Course Outcomes:
The course will enable the students to:

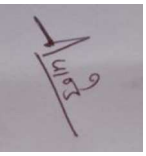
- Have an enhanced knowledge and appreciation of mammalian physiology; homeostasis mechanisms
- Know about membrane physiology
- Understand the functions of important physiological systems including the cardio-respiratory, renal, reproductive, and digestive system.
- Students will gain an understanding of muscle physiology, and the nervous system

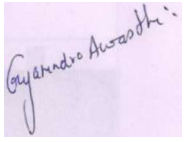
Unit	**Topic**	**No. of Hours**





Unit I	**Basic concepts of structural organization of human:** cells, tissues, organs and organ systems, basic understanding of the concept of homeostasis. Membrane Physiology: Chemical composition of membranes, membrane architectures, mechanisms for transport of solute and water across membranes: passive and active transport; bulk transport system: endocytosis, and exocytosis	12
Unit II	**Body fluids:** Major types of body fluids; Composition of blood, lymph, Plasma proteins & their role; Blood group and transfusion, Mechanism of coagulation of blood. Muscle Physiology: Structure of cardiac, smooth & skeletal muscle, Physical, chemical & electrical events of the mechanism of muscle contraction	12
Unit III	**Circulation of blood:** Components of the circulatory system; the basic structure of the human heart, Physiological properties of cardiac muscles, cardiac cycle, cardiac output, Electrical activity of the heart (ECG). Digestion and absorption: Components of the digestive system, Digestion & absorption of carbohydrates, proteins, lipids, and nucleic acid, Composition of bile, Saliva, Pancreatic, gastric and intestinal juice	12
Unit IV	**Respiration:** Exchange of gases, respiratory pigments, transport of oxygen and carbon dioxide, oxygen dissociation curve, chloride shift Nervous system: Cells of the nervous system and their functions, Mechanism of generation & propagation of nerve impulse, structure of synapse, synaptic transmission, saltatory conduction, Neurotransmitters	12
Unit V	**Excretion:** Functions of different excretory devices in humans; Composition of urine; Mechanism of urine formation; Regulation of Osmolarity and counter-current mechanism Reproduction and Endocrine System: Physiology of Male Reproduction, Physiology of Female Reproduction. Structure and Function of Pituitary, Thyroid, Parathyroid, Pancreas and Adrenal gland.	12





Recommended Readings

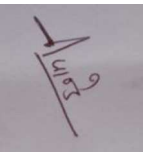
- Simon, Eric J. Campbell Essential Biology with Physiology (1967)- 6th Edition
- S.C. Rastogi. Essentials of Animal Physiology (4th Edition)
- Hill. Wyse. Anderson. Animal Physiology (3rd Edition)
- Williams Textbook of Endocrinology, 14th Edition
- Guyton and Hall Textbook of Medical Physiology - 11th Edition
- Berne & Levy Physiology - 7th Edition

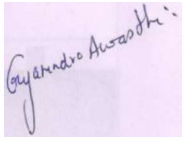
Note-**Latest edition of the text books should be used.**

Suggested Continuous Evaluation Methods: Since the class is conceived as learner-centric and built around tasks that require learners to actively use various science communication skills, formative assessment can and should be used extensively. Oral presentations, written tests, quizzes, and group tasks can be used for this purpose. The end-semester written examination will test all the areas targeted in the course.

Suggested online links

- Human Physiology - Course (nptel.ac.in)
- PHYSIOLOGY AND BIOCHEMISTRY - Course (swayam2.ac.in)
- Animal Physiology - Course (nptel.ac.in)





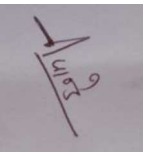
GENERIC ELECTIVES (GE): PHYSICS FOR BIOLOGISTS						
No. of Hours-60						
Course Title	**Credits**	**Credit distribution of the Course**			**Eligibility criteria**	**Prerequisite of the Course (if any)**
		Lecture	**Tutorial**	**Practical/Practice**		
GE-3 Physics for Biologists	**4**	**3**	**1**	**0**	**UG Certificate**	
Course: GE-3		**Course Title: Physics for Biologists**				
Max. Marks: As per Univ. rules		**Min. Passing Marks: As per Univ. rules**				

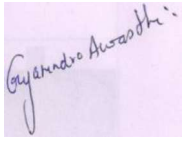
Course Outcomes:

After successful completion of this course, students will be able to:

- Apply fundamental concepts of mechanics
- Interpret thermodynamic principles in biological contexts
- Understand electrical and magnetic phenomena relevant to biotechnology
- Explore optics and its applications in biology
- Explain foundational concepts of modern physics
- Demonstrate competence in practical physics-based techniques

Unit	Topic	No. of Hours
Unit I	**Mechanics:** • Kinematics & Dynamics – Displacement, velocity, acceleration, Newton's laws, torque • Energy & Conservation Laws – Work, energy, power, conservation of momentum and angular momentum • Mechanical Properties – Surface tension, viscosity, elasticity in fluids and solids	12
Unit II	**Thermodynamics:** • Temperature and heat, heat capacity, specific heat, heat capacity of ideal gases, • Zeroth, First and second laws of thermodynamics. • Entropy, Enthalpy, Gibbs free energy, and their relevance in biochemical reactions	12





Unit III	**Electricity and Magnetism:** • Electrostatics: Coulomb's law, and Gauss's law and their application • Magnetism: Diamagnetic, Para, and Ferromagnetic material • Electromagnetic Induction: Faraday's law of induction, Lenz's Law, Self and Mutual Inductance • Types of AC Circuits (Purely Resistive Circuit, Purely Inductive Circuit, Purely Capacitive Circuit, RL, RC, and LRC circuit), Power factor, impedance, and power dissipation.	12
Unit IV	**Optics:** • Light Properties: Wavelength, frequency, energy and intensity • Laws of Reflection and Refraction (Snell's Law) • Diffraction and Interference of light • Polarization: Types and analysis of polarized light, Polarizers & Analyzers, Brewster's and Malus law	12
Unit V	**Modern Physics:** • Wave particle duality, de Broglie waves, Photoelectric effect, Heisenberg Uncertainty Principle • Compton scattering and pair production • X-rays, their production and uses.	12

Recommended Readings:

- Concepts of Physics (Part I & II) by H.C. Verma
- Physics for Degree Students – B.Sc First Year by C.L. Arora
- Electricity and Magnetism by R. Murugeshan
- Undergraduate Physics Vol II by Asit Baran Bhattacharya & R. Bhattacharya
- Optics and Atomic Physics by D.P. Khandelwal
- Quantum Mechanics: A Textbook for Undergraduates by Mahesh C. Jain
- A Handbook of Practicals in Physics by N.P. Barde & P.M. Kokne

Suggested Continuous Evaluation Methods: In addition to the theoretical and practical inputs the course will be delivered through Assignments, Presentation, Group Discussions.etc

Suggested equivalent online courses: Swayam, Vidyamitra.inflibnet.ac.in, nptel.ac.in literature study-online.com, epg-pathshala, egyankosh.ac.in,

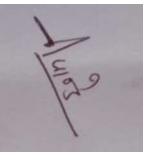
Skill Enhancement Course (SEC) – Biostatistics and Bioinformatics

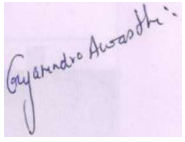
No. of Hours-30

CREDIT DISTRIBUTION, ELIGIBILITY AND PRE-REQUISITES OF THE COURSE

Course Title	Credits	Credit distribution of the Course			Eligibility criteria	Pre-requisite of the Course (if any)
		Lecture	Tutorial	Practical/Practice		
SEC-3 Biostatistics and Bioinformatics	**2**	**1**	**1**	**0**	**UG Certificate**	**Nil**

Course: SEC-3	Course Title: Biostatistics and Bioinformatics	
Max. Marks: As per Univ. rules	**Min. Passing Marks: As per Univ. rules**	
Course Outcomes: The course will enable the students to: • To gain understanding on fundamentals of computers and biostatistics for managing and analyzing the scientific data generated.		
Unit	**Topic**	**No. of Hours**
Unit I	Brief description and Tabulation of data and its graphical representation. Measure of central tendency and description: Mean, Mode, Median, Range, Standard deviation, Variance, Idea of two types of errors and level of significance, Tests of significance (F and T test), Chi-Square tests.	10
Unit II	Introduction of digital computers: Organizations, definition and examples of Low-level and High-level languages, Binary and Decimal system. Flow charts and Programming techniques. Introduction to data structures and data base concepts, Introduction to internet and its applications.	10
Unit III	Bio-informatics- Internet access and using web search engines to access biological databases, sequence, structure and strain database, Secondary and sequence analysis of DNA, RNA and proteins.	10
Recommended Readings		





- Rosner, B. (2000). **Fundamentals of Biostatistics**. Boston, MA: DuxburyPress.
- Daniel, W. W. (1987). **Biostatistics, a Foundation for Analysis in the Health Sciences**. New York: Wiley
- Mariappan P. (2013) **Biostatistics**.Pearson
- Rastogi VB.(2015). **Biostatistics** (3rd Edition).MedTec
- Lesk, A. M. (2002). **Introduction to Bioinformatics**. Oxford: Oxford University Press
- Baxevanis, A. D., & Ouellette, B. F. (2001). **Bioinformatics: a Practical Guide to the Analysis of Genes and Proteins**. New York:Wiley-Interscience

Note-**Latest edition of the text books should be used.**

Suggested Continuous Evaluation Methods: Since the class is conceived as learner-centric and built around tasks that require learners to actively use various science communication skills, formative assessment can and should be used extensively. Oral presentations, written tests, quizzes, and group tasks can be used for this purpose. The end-semester written examination will test all the areas targeted in the course.

Suggested online links

- https://ocw.mit.edu/courses/electrical-engineering-and-computer-science/6- 092bioinformatics-and-proteomics-january-iap-2005/lecture-notes/
- https://ocw.mit.edu/courses/biology/7-91j-foundations-of-computational-and-systems-biologyspring-2014/
- https://ocw.mit.edu/courses/biology/7-91j-foundations-of-computational-and-systems-biologyspring-2014/lecture-slides/

***** The syllabus of value added course (VAC) and ability enhancement course (AEC) are designed and standardized as per NEP guidelines by Kumaun University. Students will opt for the VAC/AEC of their choice from the University pool.***

SEMESTER IV

DISCIPLINE SPECIFIC CORE – Elementary Plant Biotechnology						
No. of Hours-60						
CREDIT DISTRIBUTION, ELIGIBILITY AND PRE-REQUISITES OF THE COURSE						
Course Title	**Credits**	**Credit distribution of the Course**			**Eligibility criteria**	**Pre-requisite of the Course (if any)**
		Lecture	**Tutorial**	**Practical/Practice**		
DSC- 10 Elementary Plant Biotechnology	**4**	**3**	**1**	**0**	UG Certificate	**Nil**

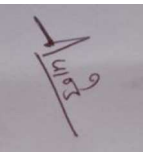
Course: DSC 10	Course Title: Elementary Plant Biotechnology
Max. Marks: As per Univ. rules	**Min. Passing Marks: As per Univ. rules**

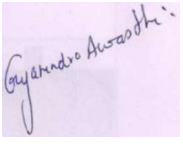
Course Outcome(s):

The course will enable the students to:

- Explain fundamental principles and techniques of plant tissue culture, including aseptic methods, media preparation, and culture initiation.
- Identify the factors affecting in vitro growth and regeneration, optimizing culture conditions for different plant species and morphogenetic pathways such as organogenesis and somatic embryogenesis.
- Analyze and interpret experimental data from tissue culture experiments and understand the applications and limitations of plant tissue culture in research, conservation, and commercial production.
- Get the required knowledge to apply the micropropagation and advanced tissue culture methods for mass propagation, germplasm conservation, synthetic seed production, and secondary metabolite biosynthesis.

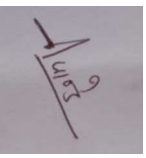
Unit	Topic	No. of Hours
Unit I	**Introduction and Principles of Plant Tissue Culture** • History and scope of plant tissue culture • Basic principles: totipotency, differentiation, dedifferentiation and redifferentiation • Laboratory basics: organization, design, essential instruments • Applications and potential in biotechnology	**15**
Unit II	**Laboratory Setup, Sterilization, and Culture Media** • Requirements for laboratory organization and safety practices • Sterilization methods: physical and chemical • Preparation of stock solutions and various culture media (Murashige & Skoog's medium, Overview of other media) • Role of nutrients and plant growth regulators in culture • Good laboratory and aseptic practices	**15**
Unit III	**Establishment and Maintenance of Cultures** • Types of explants: collection, preparation, and surface sterilization • Aseptic inoculation, incubation (light, temperature, humidity conditions) • Callus induction, subculture, and maintenance • Cell suspension cultures: initiation and monitoring • Growth measurements: fresh/dry weight, cell counts, spectrophotometry	**15**
Unit IV	**Micropropagation & Applications of Plant Tissue Culture** • Micropropagation: stages, explant selection, clonal propagation, • Meristem culture for virus-free plants; shoot tip and nodal culture • Acclimatization of *in vitro* plantlets to soil and field conditions • Overview and applications of: Anther and pollen culture • Synthetic seeds, Cryopreservation and germplasm conservation	**15**

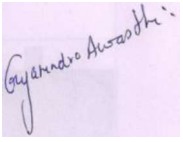




SUGGESTED READINGS:

- George, E. F., M. A. Hall, and G. J. De Klerk. Plant Propagation by Tissue Culture. 3rd ed. Dordrecht: Springer, 2008.
- Bhojwani, S. S., and M. K. Razdan. Plant Tissue Culture: Theory and Practice. New Delhi: Elsevier, 1996.
- Dixon, R. A., and Robert A. Gonzales. Plant Cell Culture: A Practical Approach. 2nd ed. New York: Oxford University Press, 2023.
- Loyola-Vargas, Victor M., and Neftali Ochoa-Alejo, eds. Plant Cell Culture Protocols. 4th ed. New York: Humana Press, 2024.
- Park, Sunghun. Plant Tissue Culture: Techniques and Experiments. 4th ed. Boca Raton, FL: CRC





Press, 2023.
- Reinert, J., and D. S. Yeoman. Plant Cell and Tissue Culture: Laboratory Manual. Berlin: Springer, 1983.

Suggested Continuous Evaluation Methods: Students can be evaluated through class participation, group discussion, group projects, presentations, and practical knowledge assessment to ensure comprehensive and regular learning. Additionally, they can be routinely evaluated through quizzes, assignments and class-tests etc.

Suggested equivalent online courses: Swayam, Vidyamitra.inflibnet.ac.in, ePG-pathshala, egyankosh.ac.in, https://ocw.mit.edu/, NPTEL etc.

DISCIPLINE SPECIFIC CORE (DSC) – Food Biotechnology						
No. of Hours-60						
CREDIT DISTRIBUTION, ELIGIBILITY AND PRE-REQUISITES OF THE COURSE						
Course Title	**Credits**	**Credit distribution of the Course**			**Eligibility criteria**	**Pre-requisite of the Course (if any)**
		Lecture	**Tutorial**	**Practical/Practice**		
DSC-11 Food Biotechnology	**4**	**3**	**1**	**0**	UG Certificate	**Nil**
Course: DSC 11		**Course Title: Food Biotechnology**				
Max. Marks: As per Univ. rules		**Min. Passing Marks: As per Univ. rules**				

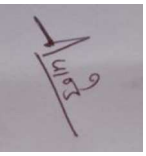
Course Outcome(s):

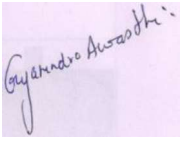
The course will enable the students to:

- Understand the concepts of food biotechnology and would be able to relate the role of biotechnology in the food industry.
- They will get concepts regarding, food components, preservation, fermentation, spoilage and microbes involved in fermentation and spoilage..

Unit	**Topic**	**No. of Hours**

Unit I	**Introduction to Food Biotechnology** • Historical Background of Food technology • Traditional fermented foods (meat, fish, bread, soy bean, Sauerkraut, Pickles, coffee, cocoa, tea) • Modification of food using enzymes: Carbohydrases, proteases, Lipases • Improvements through Biotechnology (e.g. Golden Rice, Potato, Flavr Savr Tomato etc.)	**15**
Unit II	**Food Fermentations and Food preservation:** • Common fermented foods - Cheese, Butter, Yoghurt, fermented/condensed milk, and kefir	**15**
	• Brief overview of Alcoholic beverages (Beer, Wine, Whisky, Rum, Brandy, Vodka, Gin) • Source of microorganisms in milk and their types. • Microbiological examination of milk (standard plate count, direct microscopic count, reductase and phosphatase test). • Dehydration and pasteurization of milk • Food preservants and their applications	
Unit Iii	**Vitamins, Minerals, and Value added products** • Importance of Vitamins and their supplementation infoods • Important minerals and their function in body and deficiency conditions • Value addition products like High Fructose Syrup, Invert Sugars etc. SCPs (e.g. *Spirulina*, Yeast etc.) as food supplements, • Edible fungus: Mushrooms. Potential of Probiotics. • Flavor enhancers: Nucleosides, nucleotides and related compounds. Organic acids (Citric acid, Acetic acid) and their uses in foods/food products.	**15**
Unit IV	**Growth of microorganisms in food:** • Food Spoilage (microbial and non-microbial), Control mechanisms of food spoilage: Physical and Chemical. • Microbial spoilage of food and factors affecting them: Spoilage of various kinds of foods: poultry, bread and dairy products. • Food borne intoxications: *Staphylococcal, Bacillus, Clostridium* etc. • Indicator Microorganisms: As an indicator of goodquality	**15**





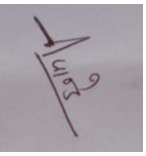
SUGGESTED READINGS:

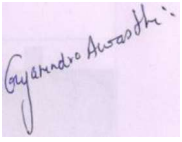
- Ray B and Bhunia A. 2008. Fundamental Food Microbiology, 4th Ed., CRC press,Taylor and Francis Group, USA.
- Martin RA and Maurice OM. 2008. Food Microbiology, 3rd Ed., The Royal Societyof Chemistry, Cambridge, UK.
- James M J. 2000. Modern Food Microbiology, 6th Ed. Aspen Publishers, Inc., Gaithersburg, Maryland, USA.
- Frazier WC, and Westhoff DC. Food Microbiology. Fourth edition, MacGraw Hills publication
- Lopez GFG, Canaas G, Nathan EV. Food Sciences and Food biotechnology.
- Adams AR, and Moss MO. *Food Microbiology*. Third edition, Royal Society of Chemistry publishing.
- Hohn T and Leisinger KM. Biotechnology of Food Crops in Developing Countries.
- Doyle MP, Beuchat LR and Montville TJ. Food Microbiology Fundamentals and Frontiers. ASM Press.

Schwartzberg HG, RaoMA. (Eds.) Biotechnology and Food Process Engineering.

Suggested Continuous Evaluation Methods: Students can be evaluated through class participation, group discussion, group projects, presentations, and practical knowledge assessment to ensure comprehensive and regular learning. Additionally, they can be routinely evaluated through quizzes, assignments and class-tests etc.

Suggested equivalent online courses: Swayam, Vidyamitra.inflibnet.ac.in, ePG-pathshala, egyankosh.ac.in, https://ocw.mit.edu/, NPTEL etc.





DISCIPLINE SPECIFIC CORE (DSC)– INTRODUCTORY ANIMAL BIOTECHNOLOGY						
No. of Hours-60						
CREDIT DISTRIBUTION, ELIGIBILITY AND PRE-REQUISITES OF THE COURSE						
Course Title	**Credits**	**Credit distribution of the Course**			**Eligibility criteria**	**Pre-requisite of the Course (if any)**
		Lecture	**Tutorial**	**Practical/Practice**		
DSC-12 INTRODUCTORY ANIMAL BIOTECHNOLOGY	**4**	**3**	**1**	**0**	UG Certificate	**Nil**
Course: DSC 12		**Course Title: INTRODUCTORY ANIMAL BIOTECHNOLOGY**				
Max. Marks: As per Univ. rules		**Min. Passing Marks: As per Univ. rules**				

Course Outcome(s):

The course will enable the students to:

- Learn theoretical and practical aspects of animal cell culture & its applications, vaccine technology, immunodiagnostics, embryo technology, animal transgenesis and gene therapy etc.

Unit	Topic	No. of Hours
Unit I	**Animal Cell Culture:** • History and development of cell culture • Layout and basic requirements for cell culture laboratory • Sterilization and preparation for cell culture • Culture media – Natural and synthetic; Importance of serum in cell culture • Growth factors- EGF, NGF, & erythropoietin	**10**
Unit II	**Application of Animal Cell Culture:** • Types of animal cell culture • Concept of transformation and neoplastic cells • Development of primary culture • Commonly used cell lines- their organization and characteristics (Vero, HeLa etc.) • Subculture and cryopreservation • Application of animal cell culture technology	**10**

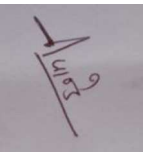
Unit Iii	**Immunodiagnostics and Vaccine Technology** • Introduction to immunodiagnostics: ELISA, Dot-blot, Immunofluorescence • Monoclonal antibodies • Introduction to vaccines • Types of vaccines • Killed V/s Attenuated vaccines • Modern generation vaccines	**15**
Unit IV	**Embryo Biotechnology and Animal Cloning** • Embryo Biotechnology: Introduction to embryo transfer technology	**15**
	• Methodology: Selection of donor; superovulation; selection of recipient; synchronization of estrous; embryo transfer; cryopreservation • Animal Cloning: Introduction to animal cloning • Importance and scope of animal cloning	
Unit V	**Fermentation Technology and Animal Transgenesis** • Introduction to fermentation Technology • Bioreactors for large scale production of animal cells • Production of insulin, growth hormones, and interferons • A brief introduction to animal transgenesis. • Various methods of animal transgenesis. • Gene Therapy: Introduction; Types of gene therapy, Applications.	**10**

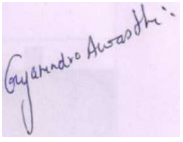
SUGGESTED READINGS:

- Animal Cell Culture Techniques. Ed. Martin Clynes, springer.
- Animal Cell Culture - Practical Approach, Ed. John R.W. Masters, OXFORD.
- Culturing of animal cells by Ian Freshney, 6th edition
- Pörtner, R. (2007). Animal Cell Biotechnology: Methods and Protocols. Totowa, NJ: Humana Press
- Singh B. Gautam SK (2013). Textbook of animal biotechnology. The Energy and Resources Institute, TERI
- Gupta PK (2018) Animal Biotechnology. Rastogi Publications
- Animal Cell Culture Methods In: Methods in Cell Biology, Vol. 57, Ed. Jenni P Mather and David Barnes, Academic Press.
- Biotechnology: Expanding Horizons by BD Singh, 3rd Edition, Kalyani Publishers

Suggested Continuous Evaluation Methods: Students can be evaluated through class participation, group discussion, group projects, presentations, and practical knowledge assessment to ensure comprehensive and regular learning. Additionally, they can be routinely evaluated through quizzes, assignments and class-tests etc.

Suggested equivalent online courses: Swayam, Vidyamitra.inflibnet.ac.in, ePG-pathshala, egyankosh.ac.in, https://ocw.mit.edu/, NPTEL etc.



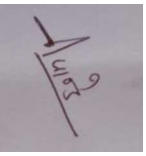


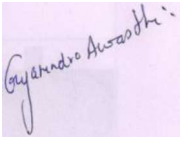
DISCIPLINE SPECIFIC ELECTIVE (DSE) – Industrial Biotechnology						
No. of Hours-60						
CREDIT DISTRIBUTION, ELIGIBILITY AND PRE-REQUISITES OF THE COURSE						
Course Title	Credits	Credit distribution of the Course			Eligibility criteria	Pre-requisite of the Course (if any)
		Lecture	Tutorial	Practical/Practice		
DSE-2 Industrial Biotechnology	4	3	1	0	UG Certificate	Nil
Course: DSE-2		Course Title: Industrial Biotechnology				
Max. Marks: As per Univ. rules		Min. Passing Marks: As per Univ. rules				

Course Outcome(s):

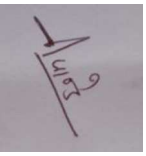
Understanding and implementation of the applications of biotechnology in industry, health-care, environmental protection, food and agricultural research, Demonstrating the ability to design, perform and interpret the experiments during the practical courses with an emphasis on technological aspects. Demonstrate comprehensive innovations and skills in the field of biomolecules, cell biology, molecular biology, bioprocess engineering and genetic engineering of plants, animals, microbes with respect to applications for human welfare.

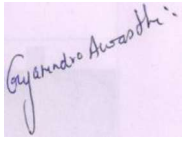
Unit	Topic	No. of Hours
Unit I	**INTRODUCTION** Introduction of Industrially important microbes, approaches of growing microorganisms, ways to increase yield of microbes, Batch, fed-batch and continuous cultures (definition and kinetics). Bioconversions, Biomining, Bioleaching, Bio-gas, Bio-fuel. Microorganisms & Agriculture – Microorganisms in Agricultural Waste water treatment, Vermiculture, Microbial pesticides.	15
Unit II	**METABOLITES** Microbial products of therapeutics & pharmacological interest. Over production of microbial metabolite, Secondary metabolism – its significance and products. Introduction to Metabolic engineering of secondary metabolism for higher productivity.	15
Unit III	**UPSTREAM & DOWNSTREAM PROCESSES** Introduction of industrial products and purification techniques, Purification & characterization of proteins, Upstream and downstream processing, influent and effluent, Solids and liquid handling. Extra cellular and Intracellular products, Distribution of microbial cells, centrifugation, filtration of fermentation broth, liquid extraction, ion-exchange & Affinity recovery of biological products. fermentation systems, Anaerobic fermentations.	15





Unit IV	**Production of microbial products** Types of bioreactors: Fluidized bed bioreactor, Baffled bioreactor, bubble column bioreactor, airlift fermentor, Packed bed bioreactor etc. Production of industrial chemicals; Propionic acid, butyric acid, 2-3 butanediol; Alcoholic beverages; Antibiotics (Penicillin, Tetracycline)	15



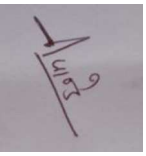


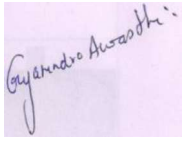
SUGGESTED READING

1. Introduction to Biodeterioration, D.Allsopp and K.J. Seal, ELBS / Edward Arnold.
2. Bioremidation, Baaker, KH and Herson D.S., 1994. Mc.GrawHill Inc, NewYork.
3. Industrial and Environmental Biotechnology - Nuzhat Ahmed, Fouad M. Qureshi and Obaid Y. Khan, 2006. Horizon Press.
4. Willey JM, Sherwood LM, and Woolverton CJ. Prescott, Harley and Klein's Microbiology. 7th edition. McGraw Hill Higher Education.

Note-**Latest edition of the text books should be used.**

Suggested Continuous Evaluation Methods: Students can be evaluated through class participation, group discussion, group projects, presentations, and practical knowledge assessment to ensure comprehensive and regular learning. Additionally, they can be routinely evaluated through quizzes, assignments and class-tests etc.
Suggested equivalent online courses: Swayam, Vidyamitra.inflibnet.ac.in, ePG-pathshala, egyankosh.ac.in, https://ocw.mit.edu/, NPTEL etc.





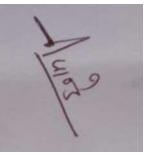
GENERIC ELECTIVE (GE) – Biology of Plants						
No. of Hours-60						
CREDIT DISTRIBUTION, ELIGIBILITY AND PRE-REQUISITES OF THE COURSE						
Course Title	**Credits**	**Credit distribution of the Course**			**Eligibility criteria**	**Pre-requisite of the Course (if any)**
		Lecture	**Tutorial**	**Practical/Practice**		
GE-4 Biology of Plants	**4**	**3**	**1**	**0**	**UG Certificate**	**Nil**
Course: GE-4		**Course Title: Biology of Plants**				
Max. Marks: As per Univ. rules		**Min. Passing Marks: As per Univ. rules**				

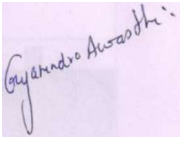
Course Outcome(s):

The course will enable the students to:

- Understand the classification, morphology, anatomy, and life cycles of major plant groups including algae, fungi, bryophytes, pteridophytes, gymnosperms, and angiosperms.
- They will be able to identify plant cell components, differentiate tissue types, secondary growth patterns and vascular anatomy in dicots and monocots.
- Students will understand the basics of water relations, mineral nutrition, photosynthesis pathways (C3, C4, CAM), respiration, enzyme roles, and hormone functions in plant growth and development.
- They will be able to develop concepts in sexual and asexual reproduction, floral structure, embryology, seed development, dormancy, and germination processes.
- They will also understand environmental adaptations, ecosystem interactions, biodiversity significance, and conservation strategies including in situ and ex situ methods.

Unit	Topic	No. of Hours
Unit I	**Basics of Plant Diversity** • Definition and scope of plant biology • Classification of plants: Algae, Fungi, Bryophytes, Pteridophytes, Gymnosperms, Angiosperms • General characteristics, morphology, and life cycles of representative groups • Economic and ecological importance of each group	**12**
Unit II	**Plant Cell-Biology and Anatomy** • Structure and function of plant cells: Structure and roles of cell wall, plasma membrane, organelles, Plastids, mitochondria, and nucleus. • Plant tissues: meristematic and permanent tissues • Tissue systems: epidermal, ground, vascular (xylem & phloem) • Secondary growth and anatomy of dicot and monocot stems and roots	**12**





Unit III	**Plant Physiology and Biochemistry** • Water relations: osmosis, diffusion, imbibition, water potential • Mineral nutrition: essential nutrients, important deficiency symptoms • Photosynthesis: light and dark reactions, Overview of C3, C4, and CAM pathways • Respiration • Plant hormones: types, functions, and applications	**12**
Unit IV	**Reproduction and Development** • Vegetative, asexual, and sexual reproduction in plants • Structure and function of flowers, pollination, fertilization	**12**
	• Development of fruits and seeds • Embryology: structure of embryo sac, development of male and female gametophytes • Seed dormancy and germination	
Unit V	**Ecology and Plant Adaptations** • Ecological concepts: populations, communities, ecosystems • Plant habitats and adaptations • Conservation of plant biodiversity: in situ and ex situ methods • Impact of climate change and human activities on plant ecosystems	**12**

SUGGESTED READINGS:

- Singh, V. Plant Systematics: Theory and Practice. New Delhi: Oxford & IBH Publishing, 2017.
- Mauseth, James D. Botany: An Introduction to Plant Biology. 6th ed. Burlington, MA: Jones & Bartlett Learning, 2014.
- Raven, Peter H., Ray F. Evert, and Susan E. Eichhorn. Biology of Plants. 8th ed. New York: W. H. Freeman, 2012.
- Taiz, Lincoln, and Eduardo Zeiger. Plant Physiology and Development. 6th ed. Sunderland, MA: Sinauer Associates, 2015.

Suggested Continuous Evaluation Methods: Students can be evaluated through class participation, group discussion, group projects, presentations, and practical knowledge assessment to ensure comprehensive and regular learning. Additionally, they can be routinely evaluated through quizzes, assignments and class-tests etc.

Suggested equivalent online courses: Swayam, Vidyamitra.inflibnet.ac.in, ePG-pathshala, egyankosh.ac.in, https://ocw.mit.edu/, NPTEL etc.

SKILL ENHANCEMENT COURSE (SEC)- Experimental Biotechniques – III

No. of Hours-30

CREDIT DISTRIBUTION, ELIGIBILITY AND PRE-REQUISITES OF THE COURSE

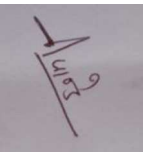
Course Title	Credits	Credit distribution of the Course			Eligibility criteria	Pre-requisite of the Course (if any)
		Lecture	Tutorial	Practical/Practice		
SEC-4 Experimental Biotechniques - III	**2**	**0**	**1**	**1**	UG Diploma	**Nil**
Course: SEC-4		**Course Title: Experimental Biotechniques – III**				

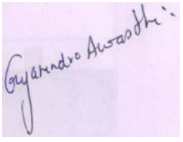
Max. Marks: As per Univ. rules	Min. Passing Marks: As per Univ. rules

Course Outcomes:

- Explain fundamental principles and techniques of plant tissue culture, including aseptic methods, media preparation, and culture initiation.
- Identify the factors affecting in vitro growth and regeneration, optimizing culture conditions for different plant species and morphogenetic pathways such as organogenesis and somatic embryogenesis.
- Analyze and interpret experimental data from tissue culture experiments and understand the applications and limitations of plant tissue culture in research, conservation, and commercial production.
- Get the required knowledge to apply the micropropagation and advanced tissue culture methods for mass propagation, germplasm conservation, synthetic seed production, and secondary metabolite biosynthesis
- To gain understanding on fundamentals of computers and biostatistics for managing and analyzing the scientific data generated.

Unit	Topic	No. of Hours
	• Introduction to SOPs of PTC related equipment's: Laminar air flow cabinet, tissue culture room, autoclave, green-house, biological grade water purification • Sterilization techniques in PTC • Media Preparation • Explant selection and sterilization • Callus induction • Induction of rooting and shooting • Open access bibliographic resources and literature database, Pubmed, Biomed Central, • Familiarization with Nucleic acid sequence database : Genebank, EMBL, NCBI • Protein database: SWISSPORT, PDB • Sequence Alignment : BLAST	**30**





SUGGESTED READING

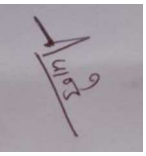
- George, E. F., M. A. Hall, and G. J. De Klerk. Plant Propagation by Tissue Culture. 3rd ed. Dordrecht: Springer, 2008.
- Bhojwani, S. S., and M. K. Razdan. Plant Tissue Culture: Theory and Practice. New Delhi: Elsevier, 1996.
- Dixon, R. A., and Robert A. Gonzales. Plant Cell Culture: A Practical Approach. 2nd ed. New York: Oxford University Press, 2023.
- Loyola-Vargas, Victor M., and Neftali Ochoa-Alejo, eds. Plant Cell Culture Protocols. 4th ed. New York: Humana Press, 2024.
- Park, Sunghun. Plant Tissue Culture: Techniques and Experiments. 4th ed. Boca Raton, FL: CRC Press, 2023.
- Reinert, J., and D. S. Yeoman. Plant Cell and Tissue Culture: Laboratory Manual. Berlin: Springer, 1983.

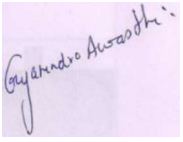
Suggested Continuous Evaluation Methods: Students can be evaluated through class participation, group discussion, group projects, presentations, and practical knowledge assessment to ensure comprehensive and regular learning. Additionally, they can be routinely evaluated through quizzes, assignments and class-tests etc.

Suggested equivalent online courses: Swayam, Vidyamitra.inflibnet.ac.in, ePG-pathshala, egyankosh.ac.in, https://ocw.mit.edu/, NPTEL etc.

SEMESTER V

DISCIPLINE SPECIFIC CORE (DSC)- Genetic Engineering
No. of Hours-60



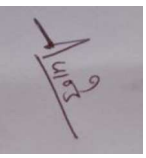


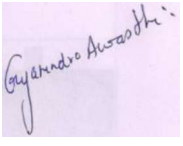
CREDIT DISTRIBUTION, ELIGIBILITY AND PRE-REQUISITES OF THE COURSE						
Course Title	**Credits**	**Credit distribution of the Course**			**Eligibility criteria**	**Pre-requisite of the Course (if any)**
		Lecture	**Tutorial**	**Practical/Practice**		
DSC-13 Genetic Engineering	**4**	**3**	**1**	**0**	UG Diploma	**Nil**
Course: DSC-13			**Course Title: Genetic Engineering**			
Max. Marks: As per Univ. rules			**Min. Passing Marks: As per Univ. rules**			

Course Outcomes:

- Understand and apply recombinant DNA -techniques and principles in genetic engineering,
- Understanding the current trends in genetic engineering and its applications.
- Demonstrating the ability to design, perform and interpret the experiments during the practical courses with an emphasis on restriction, modification, recombination aspect,
- Gain thorough knowledge and apply good laboratory practice and good manufacturing practices in biotech industries.

Unit	Topic	No. of Hours
Unit I	**MOLECULAR TOOLS & APPLICATIONS:** Introduction to nucleic acids & its structure, Restriction enzymes, nomenclature of RE, ligases, polymerases, Alkaline phosphatase, Blunt end & cohesive end ligation techniques, gene cloning, blue-white selection of recombinants	**15**
Unit II	**GENE RECOMBINATION & GENE TRANSFER :** Vectors – Plasmid vectors, Cosmids, cloning vs expression vectors, lac operon, recombinant protein expression. Bacterial Conjugation, Transformation: Microinjection, Electroporation, Micro projectile, Shot Gun method, Transduction,	**15**
Unit III	**GENETIC ENGINEERING IN PLANT SYSTEM:** Genetic engineering in plants: Use of *Agrobacterium tumefaciens* and Arhizogenes, Ti plasmids, Strategies for gene transfer to plant cells, Direct DNA transfer to plants, RNA interference, Applications of genetic engineering in crop improvement	**15**
Unit IV	**MAPPING & MARKERS** Restriction mapping. Southern, Northern & Western hybridization, colony hybridization Preparation and comparison of Genomic and cDNA library, screening of recombinants, Principle and applications of Polymerase chain reaction (PCR), primer-design, and RT- (Reverse transcription) PCR, Other variations in PCR.	**15**





SUGGESTED READING

1. Brown TA.(2006). Gene Cloning and DNA Analysis. 5th edition. Blackwell Publishing, Oxford, U.K.
2. Clark DP and Pazdernik NJ. (2009). Biotechnology-Applying the Genetic Revolution. Elsevier Academic Press, USA.
3. Glick, B.R., Pasternak, J.J. (2003). Molecular Biotechnology- Principles and Applications of recombinant DNA. ASM Press, Washington
4. Primrose SB and Twyman RM. (2006). Principles of Gene Manipulation and Genomics, 7th edition. Blackwell Publishing, Oxford, U.K.
5. Sambrook J, Fritsch EF and Maniatis T. (2001). Molecular Cloning-A Laboratory Manual. 3rd edition. Cold Spring Harbor Laboratory Press.

Suggested Continuous Evaluation Methods: Students can be evaluated through class participation, group discussion, group projects, presentations, and practical knowledge assessment to ensure comprehensive and regular learning. Additionally, they can be routinely evaluated through quizzes, assignments and class-tests etc.

Suggested equivalent online courses: Swayam, Vidyamitra.inflibnet.ac.in, ePG-pathshala, egyankosh.ac.in, https://ocw.mit.edu/, NPTEL etc.

Discipline Specific Core (DSC): Basic Immunology

No. of Hours-60

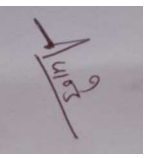
CREDIT DISTRIBUTION, ELIGIBILITY AND PRE-REQUISITES OF THE COURSE

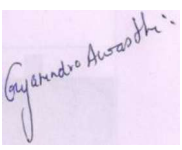
Course Title	Credits	Credit distribution of the Course			Eligibility criteria	Pre-requisite of the Course (if any)
		Lecture	Tutorial	Practical/Practice		
DSC-14 Basic Immunology	**4**	**3**	**1**	**0**	UG Diploma	**Nil**

Course: DSC-14	**Course Title: : Basic Immunology**
Max. Marks: As per Univ. rules	**Min. Passing Marks: As per Univ. rules**

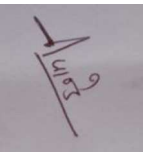
Course Outcome(s):

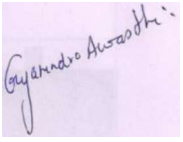
- The students taking this course will get the understanding of the functions and components of the mammalian immune system.
- Students will also be able to distinguish between innate and adaptive immune responses, and understand the mechanisms of diverse types of immune system components.
- They will also develop the understanding of immune system's role in health and disease.





Unit	Topic	No. of Hours
Unit I	**Introduction to Mammalian Immune System** • Functions and importance of Immune system. • Organs and tissues of the immune system: Primary (bone marrow, thymus) and secondary (lymph nodes, spleen, MALT); Innate and adaptive immunity.	**12**
	• Cells of the immune system: Macrophages, dendritic cells, neutrophils, acidophils, basophils, mast cells etc.	
Unit II	**Innate Immunity** • Physical and chemical barriers; Cellular components of innate immunity: Phagocytes (macrophages, neutrophils), natural killer (NK) cells. • Complement system: Introduction and functions.	**12**
Unit III	**Adaptive Immunity** • Antigen presentation: Major histocompatibility complex (MHC) class I and II, antigen-presenting cells (APCs). Helper and cytotoxic T-cells, B-cells: plasma cells & memory B cells • Antibody structure and function, Brief overview of classes of antibodies (IgG, IgA, IgM, IgE, IgD). • Antibody response Vs T cell-mediated cytotoxicity	**12**
Unit IV	**Immune System in Health and Disease** • Infection and Inflammation • Overview of Hypersensitivity reactions, Autoimmune diseases, and Immunodeficiency. • Vaccination: Principles of vaccine design, types of vaccines (live-attenuated, inactivated, subunit, mRNA vaccine).	**12**
Unit V	**Applied Immunology** • Immunological techniques: ELISA and its types, Western blotting, immunohistochemistry. • Overview of Hybridoma Technology and Monoclonal antibodies	**12**





Recommended Readings:

- Kuby Immunology (8th edition); By: Jenni Punt, Sharon Stranford, Patricia Jones, and Judith A Owen; Published by: Macmillan Learning; ISBN: 131911475X, 9781319114756
- Cellular and Molecular Immunology (10th Edition, 2021); By: Abul K. Abbas, Andrew H. Lichtman, and Shiv Pillai; Published by: Elsevier Saunders, Philadelphia; ISBN: 978-0-323-75748-5
- Immunobiology; By: Charles A Janeway, Jr, Paul Travers, Mark Walport, and Mark J Shlomchik: Published by: Garland Science, New York; ISBN-10: 0-8153-3642-X

Suggested Continuous Evaluation Methods: Students can be evaluated through class participation, group discussion, group projects, presentations, and practical knowledge assessment to ensure comprehensive and regular learning. Additionally, they can be routinely evaluated through quizzes, assignments and class-tests etc.

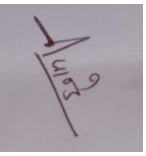
Suggested equivalent online courses: Swayam, Vidyamitra.inflibnet.ac.in, ePG-pathshala, egyankosh.ac.in, https://ocw.mit.edu/, NPTEL etc.

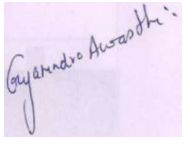
Discipline Specific Core (DSC): Experimental Biotechnology – IV						
No. of Hours-60						
CREDIT DISTRIBUTION, ELIGIBILITY AND PRE-REQUISITES OF THE COURSE						
Course Title	**Credits**	**Credit distribution of the Course**			**Eligibility criteria**	**Pre-requisite of the Course (if any)**
		Lecture	**Tutorial**	**Practical/Practice**		
DSC-15 Experimental Biotechnology - IV	**4**	**0**	**2**	**2**	UG Diploma	**Nil**
Course: DSC-15		**Course Title: Experimental Biotechnology – IV**				
Max. Marks: As per Univ. rules		**Min. Passing Marks: As per Univ. rules**				

Course Outcome(s):

- After completing this practical course, students are expected to become proficient in key genetic engineering techniques such as plasmid DNA isolation, DNA quantification using spectroscopy, agarose gel electrophoresis, and the analysis of DNA fragments through restriction digestion.
- Students will also gain hands-on experience in immunological assays: blood-group determination, antigen-antibody interactions via Ouchterlony double immunodiffusion, and ELISA

Unit	**Topic**	**No. of Hours**





	1. Transformation 2. Isolation of Plasmid DNA 3. DNA-estimation using spectroscopy 4. Restriction digestion of DNA with REs 5. Agarose gel electrophoresis of Restriction- digested DNA fragments. 6. PCR 7. Determination of blood group 8. Antibody and Antigen interaction- Ouchterlony double immunodiffusion 9. ELISA 10. DOT-BLOT	**60**

Recommended Readings:

- Molecular Cloning: A Laboratory Manual; By: Michael R. Green and Joseph Sambrook; Published by: Cold Spring Harbor Laboratory Press; ISBN: 978-1-936113-42-2
- Practical Immunology; By: Frank C. Hay and Olwyn M.R. Westwood; Published by: Wiley; ISBN:9780865429611, Online ISBN:9780470757475

Suggested Continuous Evaluation Methods: Students can be evaluated through class participation, group discussion, group projects, presentations, and practical knowledge assessment to ensure comprehensive and regular learning. Additionally, they can be routinely evaluated through quizzes, assignments and class-tests etc.

Suggested equivalent online courses: Swayam, Vidyamitra.inflibnet.ac.in, ePG-pathshala, egyankosh.ac.in, https://ocw.mit.edu/, NPTEL etc.

DISCIPLINE SPECIFIC COURSE (DSE)- Biosafety and Bioethics						
No. of Hours-60						
CREDIT DISTRIBUTION, ELIGIBILITY AND PRE-REQUISITES OF THE COURSE						
Course Title	**Credits**	**Credit distribution of the Course**			**Eligibility criteria**	**Pre-requisite of the Course (if any)**
		Lecture	**Tutorial**	**Practical/Practice**		
DSE-3 Biosafety and Bioethics	**4**	**3**	**1**	**0**	**UG Diploma**	**Nil**

Course: DSE-3	**Course Title: Biosafety and Bioethics**
Max. Marks: As per Univ. rules	**Min. Passing Marks: As per Univ. rules**

Course Outcome(s):

- The course will equip students with the knowledge and skills needed to understand the ethical, legal, and social implications of biotechnology and biomedical research.
- The students will be better prepared to follow safe laboratory practices in research environments.

Unit	Topic	No. of Hours
Unit I	**Introduction:** • Definition and scope of biosafety and bioethics. • Importance of biosafety and bioethics in the life sciences. • Historical background of biosafety and bioethics.	12
Unit II	**Principles and Practices of Biosafety:** • Understanding Biohazards, Bioterrorism, Biocrime, Biovigilance etc. • Biosafety levels (BSL-1 to BSL-4) and containment facilities. • Personal protective equipments (PPEs) and general laboratory safety protocols.	15
Unit III	**Biosafety Regulations and Guidelines:** • Overview (Components) of Laboratory biosafety manual of WHO. • Overview of National biosafety guidelines and policies. • Institutional biosafety committee (IBC) and its role.	15
Unit IV	**Bioethics in Biotechnology-research and practices:** • Bioethics: Definition and scope. • Ethical conduct in scientific research: Plagiarism, falsification etc. • Human and animal subjects in research: Ethical considerations, informed consent, confidentiality, and ethical treatment of animal subjects (3Rs principle: Replacement, Reduction, Refinement). • Genetic engineering and biotechnology ethics: Ethical issues in genetic modification, animal cloning, Impact of CRISPR technology, Ethical issues related to transgenic plants • Case studies on controversies arisen at different times on biosafety	18

Recommended Readings:

- Bioethics: Principles, Issues, and Cases (Fifth Edition, 2022); by Lewis Vaughn; Published by: Oxford University Press; ISBN: 9780197609026
- Biological Safety: Principles and Practices; Edited by: Dawn P. Wooley, Karen B. Byers; Published by: Wiley; ISBN:9781555819637, 155581963X
- https://dbtindia.gov.in/guidelines-biosafety
- https://www.ncbi.nlm.nih.gov/books/NBK537210/
- Laboratory biosafety manual, (WHO, 4th edition, 21 December 2020); https://www.who.int/publications/i/item/9789240011311
- Introduction to Plant Biotechnology (3/e; 2011); By H S Chawla; Published by: CRC Press; ISBN:9781000765465, 1000765466

Suggested Continuous Evaluation Methods: Students can be evaluated through class participation, group discussion, group projects, presentations, and practical knowledge assessment to ensure comprehensive and regular learning. Additionally, they can be routinely evaluated through quizzes, assignments, and class-tests etc.

Suggested equivalent online courses: Swayam, Vidyamitra.inflibnet.ac.in, ePG-pathshala, egyankosh.ac.in, https://ocw.mit.edu/, NPTEL etc.

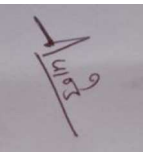
GENERIC ELECTIVE (GE) – BIOLOGY OF ANIMALS						
No. of Hours-60						
CREDIT DISTRIBUTION, ELIGIBILITY AND PRE-REQUISITES OF THE COURSE						
Course Title	**Credits**	**Credit distribution of the Course**			**Eligibility criteria**	**Pre-requisite of the Course (if any)**
		Lecture	**Tutorial**	**Practical/Practice**		
GE-5 Biology of Animals	**4**	**3**	**1**	**0**	**UG Diploma**	**Nil**
Course: GE-5		**Course Title: Biology of Animals**				
Max. Marks: As per Univ. rules		**Min. Passing Marks: As per Univ. rules**				

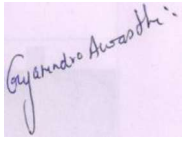
Course Outcome(s):

The course will enable the students to:

- Students will understand the basics of classification and identify major animal phyla, from Protozoa to Chordates, understand their distinguishing features, and appreciate their evolutionary relationships.
- They will also understand the structural organization of animals, including organ system and their physiological functions.
- Students will explain reproductive strategies, gametogenesis, fertilization, embryonic development stages, and growth regulation in representative animal groups.
- Understand interactions of animals' with their environment and evolutionary principles underlying adaptation and diversity.

Unit	Topic	No. of Hours
Unit I	**Introduction to Animal Biology and Classification** • General characteristics of Kingdom Animalia • Basis of classification: major animal phyla with emphasis on distinguishing features • Overview of animal diversity: Protista, Porifera, Cnidaria, Platyhelminthes, Nematoda, Annelida, Arthropoda, Mollusca, Echinodermata, Protochordates and Chordates	**15**





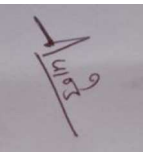
Unit II	**Anatomy and Physiology of Vertebrates** • Structure and classification of major vertebrate classes: Fish, Amphibians, Reptiles, Birds, Mammals • Overview of Anatomy and physiology organ systems: skeletal, digestive, respiratory, circulatory, excretory, nervous, and endocrine systems	**15**
Unit III	**Reproduction, Development and Growth**	**15**
	• Reproductive strategies and mechanisms: sexual and asexual reproduction • Gametogenesis, fertilization, embryonic development stages • Developmental patterns in selected animals, metamorphosis, and growth regulation	
Unit IV	**Ecology, Behavior and Evolution** • Animal habitats and ecosystem roles • Population dynamics and community interactions • Behavioral biology basics: locomotion, feeding, communication, reproduction • Principles of evolution, natural selection, and phylogeny of animals	**15**

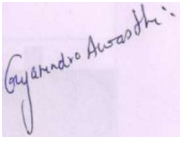
SUGGESTED READINGS:

- H.C. Nigam, Comparative Anatomy of Vertebrates, Vishal Publishing Co.; 1st edition 2021.
- Barnes, R. D. Invertebrate Zoology, 7th Edition, Saunders College Publishing, 1982.
- Pechenik, Jan A. Biology of the Invertebrates, 7th Edition, McGraw-Hill Education, 2015.
- H.C. Nigam, Life of Non Chordates-I, Vishal Publishing Co.; 1st edition, 2020.
- Hickman, C. P., et al. Integrated Principles of Zoology, 17th Edition, McGraw Hill, 2017.
- Randall, David. Eckert's Animal Physiology: Mechanisms and Adaptations, 5th Edition, W. H. Freeman, 2011.

Suggested Continuous Evaluation Methods: Students can be evaluated through class participation, group discussion, group projects, presentations, and practical knowledge assessment to ensure comprehensive and regular learning. Additionally, they can be routinely evaluated through quizzes, assignments and class-tests etc.

Suggested equivalent online courses: Swayam, Vidyamitra.inflibnet.ac.in, ePG-pathshala, egyankosh.ac.in, https://ocw.mit.edu/, NPTEL etc.





SKILL ENHANCEMENT COURSE (SEC)- INTELLECTUAL PROPERTY RIGHTS (IPR)						
No. of Hours-30						
CREDIT DISTRIBUTION, ELIGIBILITY AND PRE-REQUISITES OF THE COURSE						
Course Title	**Credits**	**Credit distribution of the Course**			**Eligibility criteria**	**Pre-requisite of the Course (if any)**
		Lecture	**Tutorial**	**Practical/Practice**		
SEC-5 INTELLECTUAL PROPERTY RIGHTS	**2**	**1**	**1**	**0**	**UG Diploma**	**Nil**

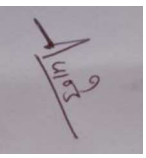
Course: SEC-5	**Course Title: INTELLECTUAL PROPERTY RIGHTS (IPR)**
Max. Marks: As per Univ. rules	**Min. Passing Marks: As per Univ. rules**

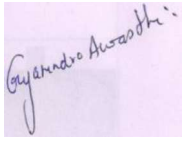
Course Outcomes:

At the end of the course, the students will be able:

- To understand the concept of IPR
- To understand Trademarks, Trade Secretes and GI of goods.
- To understand Copyrights, Patents and Industrial Designs.
- To learn about how to manage IP rights and legal aspects.
- To understand the concepts of Cyber laws in IPR.

Unit	Topic	No. of Hours
Unit I	**Introduction:** Introduction to Intellectual Property Rights, types of intellectual property, importance of intellectual property rights, Agencies responsible for IPR registrations.	**7**
Unit II	**Trade Marks:** Purpose and function of trademarks, Acquisition of trade mark rights, registration of trademarks, claims. **Trade Secrets:** Trade secret law, determination of trade secret status, Geographical Indication of Goods: Basic aspects and need for the registration.	**8**
Unit III	**Copyrights:** Fundamentals of copyright law, originality of material, right of reproduction, right to perform the work publicly. **Patents:** , Basic Criteria of Patentability, Foundation of patent law, patent searching overview **Industrial Designs:** Kind of protection provided in Industrial design.	**7**





Unit IV	**Managing IP Rights:** Acquiring IP Rights: letters of instruction, joint collaboration agreement, Protecting IP Rights: non-disclosure agreement, cease and desist letter, settlement memorandum. **Introduction to Cyber law:** Brief overview of Information Technology Act, cybercrime, data security, confidentiality, privacy, international aspects of computer and online crime	**8**

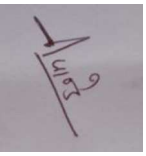
Recommended Readings:

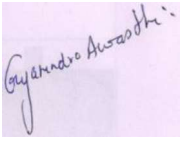
- Intellectual property right by Deborah E Bouchoux
- Cyber law, Text and cases South western special topics collection.
- Intellectual property rights by N.K Acharya
- Fundamentals of IPR for engineers, BY komal bansal
- Intellectual property rights by P. Radhakrishnan

Note-**Latest edition of the text books should be used.**

Suggested Continuous Evaluation Methods: Since the class is conceived as learner-centric and built around tasks that require learners to actively use various science communication skills, formative assessment can and should be used extensively. Oral presentations, quiz, and group tasks can be used for this purpose. The end-semester written examination will test all the areas targeted in the course.

Suggested equivalent online courses: epg-pathshala, egyankosh.ac.in, https://www.esalq.usp.br, https://www.biologydiscussion.com, https://www.thebiomics.com/





Semester VI

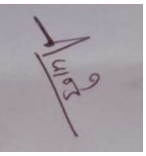
DISCIPLINE SPECIFIC CORE (DSC)– Medicinal Plant Biochemistry and Biotechnology						
No. of Hours-60						
CREDIT DISTRIBUTION, ELIGIBILITY AND PRE-REQUISITES OF THE COURSE						
Course Title	Credits	Credit distribution of the Course			Eligibility criteria	Pre-requisite of the Course (if any)
		Lecture	Tutorial	Practical/Practice		
DSC-16 Medicinal Plant Biochemistry and Biotechnology	4	3	1	0	UG Diploma	Nil
Course: DSC-16		Course Title: Medicinal Plant Biochemistry and Biotechnology				
Max. Marks: As per Univ. rules		Min. Passing Marks: As per Univ. rules				

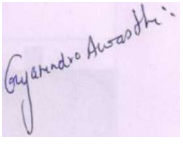
Course Outcomes:

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

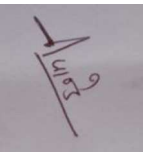
- Understand the biochemical pathways involved in the synthesis of bioactive compounds in medicinal plants.
- Apply tissue culture techniques for the propagation and production of bioactive compounds.
- Analyze genomic and transcriptomic data to identify genes involved in biosynthesis pathways.
- Utilize bioinformatics tools for the analysis and prediction of pharmacological activities of medicinal plant compounds.
- Design and execute experiments in medicinal plant biochemistry and biotechnology.
- Evaluate the potential of medicinal plants for drug discovery and development.

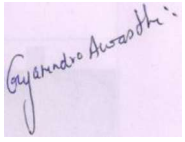
Unit	Topic	No. of Hours
Unit I:	**Introduction to Medicinal Plants** : Overview of medicinal plants and their significance in traditional and modern medicine. Phytochemical extracts, fractions, and compound purification strategies, Key bioactive compounds and their pharmacological properties: taxol, artimisnin, podophyllotoxin, cannabidiol, curcumin.	15
Unit II:	**Plant Metabolomics:** Metabolomics: Techniques for profiling plant metabolites. Applications in medicinal plant research and quality control. Identification and characterization of bioactive compounds using spectroscopic techniques.	15
Unit III:	**Plant Tissue Culture Techniques**: Principles and applications of tissue culture methods in medicinal plant biotechnology. Techniques for micropropagation, somatic embryogenesis, and organ culture.	15





Unit IV:	**Bioinformatics in Medicinal Plant Research:** Introduction to bioinformatics resources for analyzing genomic and transcriptomic data in medicinal plants Hands-on practice of sequence analysis, annotation, and data mining Bioinformatics approaches for phytochemical analysis and prediction of pharmacological activities Utilization of bioinformatics tools for drug discovery and development	15





SUGGESTED READING:

1. "Medicinal Plants: Chemistry, Biology and Omics" by Debprasad Chattopadhyay
2. "Biochemistry of Plant Secondary Metabolism" by Michael Wink
3. "Plant Biochemistry" by Hans-Walter Heldt and Birgit Piechulla
4. "Plant Biotechnology and Genetics: Principles, Techniques, and Applications" by C. Neal Stewart Jr.
5. "Medicinal Plant Biotechnology" by Rajesh Arora

Note-**Latest edition of the text books should be used.**

Suggested Continuous Evaluation Methods: Since the class is conceived as learner-centric and built around tasks that require learners to actively use various language skills, formative assessment can and should be used extensively. Oral presentations, peer interviews, and group tasks can be used for this purpose. The end-semester written examination will test all the areas targeted in the course.

Suggested equivalent online courses: epg-pathshala, egyankosh.ac.in, https://www.esalq.usp.br, https://www.biologydiscussion.com, https://www.thebiomics.com/

DISCIPLINE SPECIFIC CORE (DSC)– Research Methodology						
No. of Hours-60						
CREDIT DISTRIBUTION, ELIGIBILITY AND PRE-REQUISITES OF THE COURSE						
Course Title	**Credits**	**Credit distribution of the Course**			**Eligibility criteria**	**Pre-requisite of the Course (if any)**
		Lecture	**Tutorial**	**Practical/Practice**		
DSC-17 Research Methodology	**4**	**3**	**1**	**0**	**UG Diploma**	**Nil**
Course: DSC-17		**Course Title: Research Methodology**				
Max. Marks: As per Univ. rules		**Min. Passing Marks: As per Univ. rules**				

Course Outcomes:

The course will enable the students to:

- Utilize scientific principles and methodologies to design innovative solutions for data analysis, experimentation, and product development for challenges in translational research.
- To learn about different types of study designs and their strengths and limitations.
- To acquire skills in data collection, management, and quality assurance.
- To gain efficiency in using softwares for statistical analysis, plagiarism check, and reference management
- To interpret statistical results and communicate findings effectively.

Unit	Topic	No. of Hours
Unit I	**Introduction**: Foundations of Research: Meaning, Objectives, Motivation, And Utility. Concept of theory, Characteristics of scientific method – Understanding the language of research – Concept, Construct, Definition, Variable. Research Process; Problem Identification & Formulation – Research Question – Investigation Question – Measurement Issues – Hypothesis –Null Hypothesis & Alternative Hypothesis. Hypothesis Testing – Logic & Importance	12
Unit II	**Measurement:** Problems in measurement in research – Sample Validity and Reliability. Levels of measurement – Nominal, Ordinal, Interval, Ratio; Sampling: Concepts of Statistical Population, Sample, Sampling Frame, Sampling Error, Sample Size, Determining size of the sample – Practical considerations in sampling and sample size	12
Unit III	**Research Design**: Exploratory Research Design – concept, types and uses, Descriptive Research Designs – concept, types and uses. Experimental Design: Concept of Independent & Dependent variables; Qualitative and Quantitative Research.	12
Unit IV	**Data Analysis**: Data Preparation – Univariate analysis (frequency tables, bar charts, pie charts, percentages), Bivariate analysis – Cross tabulations and Chi-square test including testing hypothesis of association; Interpretation of Data and Paper Writing – Layout of a Research.	12
Unit V	**Paper Impact factor of Journals**: Ethical issues related to publishing, Plagiarism and Self-Plagiarism; Use of tools/techniques for Research: methods to search required information effectively, Reference Management Software like Zotero/Mendeley, Software for paper formatting like LaTeX/MS Office, Software for detection of Plagiarism.	12

Recommended Readings
Books Recommended:

1. Research Methodology – C. R. Kothari
2. Singh, Y.K., 2006. Fundamental of research methodology and statistics. New Age International.
3. Thomas, C. George. Research Methodology and Scientific Writing

Note-**Latest edition of the text books should be used.**
Suggested online link:
https://onlinecourses.nptel.ac.in/noc22_ge08/preview
Research Methodology - Course (swayam2.ac.in)
Research Methodology - Course (nptel.ac.in)
Suggested Continuous Evaluation Methods: Since the class is conceived as learner-centric and built around tasks that require learners to actively use various science communication skills, formative assessment can and should be used extensively. Oral presentations, written tests, quizzes, and group tasks can be used for this purpose. The end-semester written examination will test all the areas targeted in the course.

DISCIPLINE SPECIFIC CORE (DSC) - Introductory Nano-biotechnology

No. of Hours-60

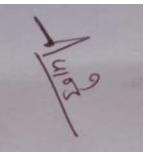
CREDIT DISTRIBUTION, ELIGIBILITY AND PRE-REQUISITES OF THE COURSE

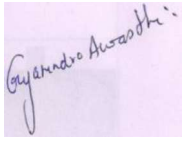
Course Title	Credits	Credit distribution of the Course			Eligibility criteria	Pre-requisiteof the Course (if any)
		Lecture	Tutorial	Practical/Practice		
DSC:18 Introductory Nano-Biotechnology	4	3	1	0	UG Diploma	Nil
Course: DSC-18		Course Title: Introductory Nano-Biotechnology				
Max. Marks: As per Univ. rules		Min. Passing Marks: As per Univ. rules				

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

- Demonstrate an understanding of fundamental nanobiotechnology concepts and principles.
- Analyze the synthesis, characterization, and behavior of nanomaterials in biological systems.
- Evaluate the applications of nanobiotechnology in healthcare, agriculture, and environmental science.
- Assess the ethical and societal implications of nanobiotechnology research and applications.
- Apply nanobiotechnology techniques and methodologies to solve practical problems in biomedicine, agriculture, and environmental science.

Unit	Topic	No. of Hours
Unit I	**Foundations of Nanobiotechnology:** Basics of Nanotechnology and Biotechnology Introduction to Nanobiotechnology Historical Development Importance and Applications in Healthcare, Agriculture, and Environment	15





Unit II	**Nanomaterials in Biotechnology** Synthesis of Nanomaterials Characterization Techniques in Nanobiotechnology: UV-Vis, TEM, SEM Interactions between Nanomaterials and Biomolecules	**15**
Unit III	**Applications of Nanobiotechnology** Nanomedicine: Drug Delivery Systems, Diagnostic Techniques Nanobiotechnology in Agriculture: Nanoparticle-based Pesticides, Soil Remediation Environmental Applications: Nanomaterials for Pollution Detection and Treatment	**15**
Unit IV	**Ethical and Societal Considerations in Nanobiotechnology** Ethical Issues in Nanobiotechnology Research and Applications Societal Impact of Nanobiotechnology Regulation and Governance.	**15**

SUGGESTED READING:

1. "Nanobiotechnology: Concepts, Applications and Perspectives" by Christof M. Niemeyer and Chad A. Mirkin
2. "Nanobiotechnology: Bioinspired Devices and Materials of the Future" by Oded Shoseyov and Ilan Levy
3. "Nanobiotechnology: Principles and Applications" by David S. Goodsell
4. "Nanobiotechnology in Molecular Imaging, Diagnostics, and Therapy" edited by Jeff W.M. Bulte and Michel M.J. Modo
5. "Nanobiotechnology: Applications in Tissue Engineering" edited by Alexandru Mihai Grumezescu

Note-**Latest edition of the text books should be used.**

Suggested Continuous Evaluation Methods: Since the class is conceived as learner-centric and built around tasks that require learners to actively use various language skills, formative assessment can and should be used extensively. Oral presentations, peer interviews, and group tasks can be used for this purpose. The end-semester written examination will test all the areas targeted in the course.

Suggested equivalent online courses: epg-pathshala, egyankosh.ac.in, https://www.esalq.usp.br, https://www.biologydiscussion.com https://www.thebiomics.com

DISCIPLINE SPECIFIC ELECTIVE (DSE) – Pharmaceutical Biotechnology						
No. of Hours-60						
CREDIT DISTRIBUTION, ELIGIBILITY AND PRE-REQUISITES OF THE COURSE						
Course Title	Credits	Credit distribution of the Course			Eligibility criteria	Pre-requisite of the Course (if any)
		Lecture	Tutorial	Practical/Practice		
DSE-4 Pharmaceutical Biotechnology	4	3	1	0	UG Diploma.	Nil
Course: DSE -4		Course Title: Pharmaceutical Biotechnology				
Max. Marks: As per Univ. rules		Min. Passing Marks: As per Univ. rules				

Course Outcome(s):

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

- Students completing this course will understand the role of biotechnology in drug discovery, development, and the production of biopharmaceuticals.
- They will also learn about proteins, peptides, nucleic acids, and cell-based therapies and will also develop understanding of genetic engineering techniques, drug design, and pharmacogenomics.
- Students will also acquire knowledge about the regulatory and ethical issues in pharmaceutical biotechnology.

Unit	Topic	No. of Hours
Unit I	**Introduction to Pharmaceutical Biotechnology** • Overview of role of biotechnology in drug discovery and development. • Biopharmaceuticals (with examples): Proteins, peptides, nucleic acids, and cell-based therapies. • Basic principles of molecular biology: DNA, RNA, protein synthesis, genetic code and Central dogma.	12
Unit II	**Genetic Engineering and Recombinant DNA Technology** • Tools and techniques in genetic engineering: Restriction enzymes, ligases, DNA Polymerases, and polymerase chain reaction (PCR). • Gene Cloning and expression in prokaryotes and mammalian system; gene therapy • Basic overview of gene-knockdown and Gene editing technologies: siRNA and CRISPR-Cas9.	12

Unit III	**Production of Biopharmaceuticals** • Applications in pharmaceutical biotechnology: Production of insulin and growth hormones. • Overview of Hybridoma technology and production of monoclonal antibodies • Vaccines and their various types; overview of vaccine production	**12**
Unit IV	**Drug Design and Development** • Introduction to Pharmacogenomics; role of pharmacogenomics in drug-target identification • Rational drug design: overview of molecular docking and computer-aided drug design. • Personalized medicine and tailored therapeutics; Biosimilars • Molecular diagnostic techniques	**12**
Unit V	**Regulatory Aspects and Ethical Considerations** • Quality control and assurance: Good Manufacturing Practices (GMP) and Pharmacovigilance • Regulatory framework: Role of FDA, EMA, and Central Drugs Standard Control Organization (CDSCO) • Ethical issues in pharmaceutical biotechnology: Clinical trials, gene therapy and gene editing	**12**

Recommended Readings:

- Pharmaceutical Biotechnology: Concepts And Applications; By: Gary Walsh; Published by: Wiley (India); ISBN: 9788126530250
- Concepts And Applications of Pharmaceutical Biotechnology; By: Jones K.; ISBN-10: 1666867411, ISBN-13: 978-1666867411
- Pharmaceutical Biotechnology: Fundamentals and Applications (5th edition, 2019); Edited by: Daan J. A. Crommelin, Robert D. Sindelar, Bernd Meibohm; Published by: Springer USA; ISBN:978-3-030-00710-2.

Note:- Latest edition of the text books should be used.

Suggested Continuous Evaluation Methods: Students can be evaluated through class participation, group discussion, group projects, presentations, and practical knowledge assessment to ensure comprehensive and regular learning. Additionally, they can be routinely evaluated through quizzes, assignments and class-tests etc. Suggested equivalent online courses: Swayam, Vidyamitra.inflibnet.ac.in, ePG-pathshala, egyankosh.ac.in, https://ocw.mit.edu/, NPTEL etc.

GENERIC ELECTIVE COURSE (GE) – Medicinal Chemistry				
No. of Hours-60				
CREDIT DISTRIBUTION, ELIGIBILITY AND PRE-REQUISITES OF THE COURSE				
		Credit distribution of the Course	**Eligibility**	**Pre-requisite of**

Course Title	Credits	Lecture	Tutorial	Practical	criteria	the Course (if any)
GE-6 Medicinal Chemistry	**4**	**3**	**1**	**0**	**UG Diploma**	**Nil**
Course: GE-6			**Course Title: Medicinal Chemistry**			
Max. Marks: As per Univ. rules			**Min. Passing Marks: As per Univ. rules**			

Course Outcomes:

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

- Develop analytical aptitude for industrially important medicinal compounds.
- Learn the different types of plants secondary metabolites and their medicinal importance.
- Understand the importance of natural compounds as lead molecules for new drug discovery.

Unit	Topic	No. of Hours
Unit I	Introductory Medicinal Chemistry: Drug discovery, design and development; Basic Retrosynthetic approach. Drug action-receptor theory. Structure – activity relationships of drug molecules, binding role of –OH group, -NH2 group, double bond and aromatic ring.	12
Unit II	Mechanism of action of the representative drugs of the following classes: analgesics agents, antipyretic agents, anti-inflammatory agents (Aspirin, paracetamol); antibiotics (Chloramphenicol); antifungal agents (Amphotericin-B, Itraconazole); antiviral agents (Acyclovir), HIV-AIDS related drugs (AZT- Zidovudine)	12
Unit III	Introduction to Polymer: Monomers, Oligomers, Polymers and their characteristics, Classification of polymers: Natural, synthetic, linear, cross linked. Homopolymers and Co-polymers, Bonding in polymers: Primary and secondary bond forces in polymers; cohesive energy, and decomposition of polymers.	12
Unit IV	Synthetic Dyes: Colour and constitution (electronic Concept), Classification of dyes, and biological application of Methyl orange, Congo red, crystal violet, phenolphthalein, fluorescein.	12
Unit V	**Alkaloids & Terpenes:** Medicinal importance of Nicotine, Quinine, Morphine, Cocaine. Natural Occurrence and classification of terpenes, isoprene rule.	12

Suggested Readings:

1. Davis, B. G., Fairbanks, A. J., Carbohydrate Chemistry, Oxford Chemistry Primer, Oxford University Press.
2. Finar, I. L. Organic Chemistry (Volume 2), Dorling Kindersley (India) Pvt. Ltd.(Pearson Education).
3. Nelson, D. L. & Cox, M. M. Lehninger's Principles of Biochemistry 7th Ed., W. H. Freeman.
4. Berg, J. M., Tymoczko, J. L. & Stryer, L. Biochemistry 7th Ed., W. H. Freeman.
5. Morrison, R. T. & Boyd, R. N. Organic Chemistry, Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).
6. Patrick, G. L. Introduction to Medicinal Chemistry, Oxford University Press, UK, 2013.
7. Singh, H. & Kapoor, V.K. Medicinal and Pharmaceutical Chemistry, Vallabh Prakashan, Pitampura, New Delhi, 2012.
8. Atkins, P. W. & Paula, J. de Atkin's Physical Chemistry Ed., Oxford University Press 13 (2006).
9. Ball, D. W. Physical Chemistry Thomson Press, India (2007).

Suggested online links:

http://heecontent.upsdc.gov.in/Home.aspx
https://nptel.ac.in/courses/104/105/104105124/
https://nptel.ac.in/courses/103/106/105106204/
https://nptel.ac.in/courses/104/105/104105034/
https://nptel.ac.in/courses/104/103/104103121/
https://nptel.ac.in/courses/104/102/104102016/
https://nptel.ac.in/courses/104/106/104106106/

Note-**Latest edition of the text books should be used.**

Suggested Continuous Evaluation Methods: In addition to the theoretical inputs the course will

be delivered through Assignments, Presentation, and Group Discussions. This will instill in student a sense of decision making and practical learning.
Suggested equivalent online courses: On Swayam, Vidyamitra.inflibnet.ac.in, literature-study-online.com, epg-pathshala, egyankosh.ac.in

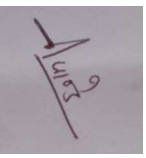
SKILL ENHANCEMENT COURSE (SEC)- SCIENTIFIC COMMUNICATION						
No. of Hours-30						
CREDIT DISTRIBUTION, ELIGIBILITY AND PRE-REQUISITES OF THE COURSE						
Course Title	**Credits**	**Credit distribution of the Course**			**Eligibility criteria**	**Pre-requisite of the Course (if any)**
		Lecture	**Tutorial**	**Practical/Practice**		
SEC-6 SCIENTIFIC COMMUNICATION	**2**	**1**	**1**	**0**	**UG Diploma**	**Nil**

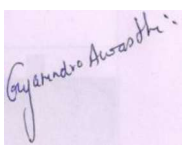
Course: SEC-6	**Course Title: SCIENTIFIC COMMUNICATION**
Max. Marks: As per Univ. rules	**Min. Passing Marks: As per Univ. rules**

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

- Develop essential skills and understand the fundamental concepts of scientific writing
- Enhance their ability to communicate research findings ethically and effectively.

Unit	Topic	No. of Hours
Unit I	**Introduction to Scientific Writing:** Importance of scientific writing in research and academia. **Types of scientific writing:** research articles, reports, reviews, book-chapters etc.	**5**
Unit II	**Fundamentals of Scientific Communication:** Principles of effective scientific communication, structure and organization of a research article, Writing abstracts, introductions, methods, results, discussions, and conclusions.	**10**
Unit III	**Data Presentation:** Graphical representation of data; Use of tables and figures in scientific writing Statistical consideration in scientific writing	**5**
Unit IV	**Literature Review:** Conducting literature reviews; Sources of literature; Introduction to key databases used for searching scientific articles**.** Citation and referencing styles; Common tools for managing references Understanding the peer review process.	**6**

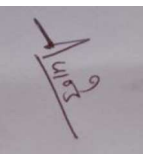


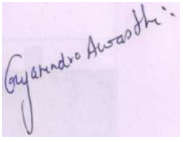


Unit V	**Ethical Considerations in Scientific writing:** Plagiarism and its implications; Common tools for detecting plagiarism**,** Research integrity and ethical writing practices; Recent guidelines on of AI in Scientific writing	**4**

Recommended Readings:

- 'Writing Science: How to Write Papers That Get Cited and Proposals That Get Funded'; by Joshua Schimel. Published by: Oxford University Press; ISBN-10: 0199760241; ISBN-13: 978-0199760244





- "The Scientist's Guide to Writing, 2nd Edition: How to Write More Easily and Effectively throughout Your Scientific Career" by Stephen B. Heard; Published by: Publisher: Princeton University Press; 2nd edition (February 8, 2022); ISBN-10: 0691219184; ISBN-13: 978-0691219189
- Writing Science in Plain English (Chicago Guides to Writing, Editing, and Publishing); by Anne E. Greene; Published by: University of Chicago Press; Chicago Guides to Writing, Editing and Publishing edition (May 24, 2013); ISBN-10: 022602637X, ISBN-13: 978-0226026374

Note-**Latest edition of the text books should be used.**

Suggested Continuous Evaluation Methods: Students can be evaluated through class participation, group discussion, group projects, presentations, and practical knowledge assessment to ensure comprehensive and regular learning. Additionally, they can be routinely evaluated through quizzes, assignments, and class-tests etc.

Suggested equivalent online courses: Swayam, Vidyamitra.inflibnet.ac.in, ePG-pathshala, egyankosh.ac.in, https://ocw.mit.edu/, NPTEL etc.

Semester VII

DISCIPLINE SPECIFIC COURSE(DSC)- MOLECULAR BIOLOGY						
No. of Hours- 60						
CREDIT DISTRIBUTION, ELIGIBILITY AND PRE-REQUISITES OF THE COURSE						
Course Title	Credits	Credit distribution of the Course			Eligibility criteria	Pre-requisite of the Course (if any)
		Lecture	Tutorial	Practical/Practice		
DSC-19 MOLECULAR BIOLOGY	4	3	1	0	UG Degree	Nil

Course: DSC-19	Course Title: MOLECULAR BIOLOGY
Max. Marks: As per Univ. rules	Min. Passing Marks: As per Univ. rules

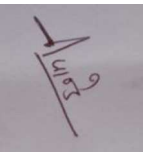
Course Outcomes:

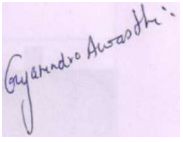
After completing this course the students will be able to:

- Understand the organization and functions of DNA, RNA, and proteins.
- They will be able to describe the molecular regulation of various biological processes.
- Develop clear understanding of established concepts and perceive recent scientific developments in the field of molecular biology.

Unit	Topic	No. of Hours

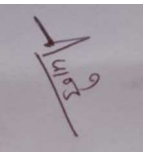
Unit I	**Genome Organization** Organization of bacterial genome; Structure of eukaryotic chromosomes; Role of nuclear matrix in chromosome organization and function; Matrix binding proteins; Heterochromatin and Euchromatin; DNA reassociation kinetics (Cot curve analysis); Repetitive and unique sequences; Satellite DNA; DNA melting and buoyant density.	**15**
Unit II	**DNA Structure; Replication and Repair** Structure of DNA-A-,B-, Z- and triplex DNA. Replication initiation, elongation and termination in prokaryotes and eukaryotes; Enzymes and accessory proteins; Fidelity; **Mutations and its types**: Spontaneous, Induced, Reversed, Suppressor Nonsense, missense and point mutations; Intragenic and Intergenic suppression; Frameshift mutations; Physical, chemical and biological mutagens. **DNA repair**- Enzymes; Photoreactivation; Base excision repair, Nucleotide excision repair; Mismatch correction; Direct repair SOS repair.	**15**
Unit III	**Prokaryotic & Eukaryotic Transcription** Prokaryotic Transcription; Transcription unit; Promoters- Constitutive and Inducible; Operators; Regulatory elements; Initiation; Attenuation; Termination-Rho-dependent and independent; Anti- termination; Transcriptional regulation-Positive and negative; Operon concept- lac and trp. Eukaryotic transcription and regulation; RNA polymerase structure and assembly; RNA polymerase I, II, III; Eukaryotic promoters and enhancers; General Transcription factors; TATA binding proteins (TBP) and TBP associated factors (TAF); Activators and repressors.	**15**
Unit IV	**Post Transcriptional Modification** Processing of hnRNA, tRNA, rRNA; 5'-Cap formation; 3'-end processing and polyadenylation; Splicing; RNA editing. **Translation** Translation machinery; Ribosomes; Composition and assembly; Universal genetic code; Degeneracy of codons; Termination codons. Wobble hypothesis; Mechanism of initiation, elongation and termination. Key differences in prokaryotic and eukaryotic translation.	**15**

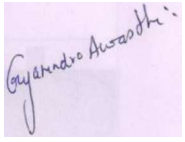




Recommended Readings:

- Watson, J. D. Baker TA, Bell, SP Gann, A. Levine, M. Losick R. (2008). Molecular Biology of the Gene (5th ed.). Pearson
- Lodish, H F. Berk, A. Kaiser, CA, Krieger, M. Bretscher, A. Ploegh, H. Aman, A. Martin, K. (2016). Molecular Cell Biology (8th Ed.). New York: W.H.Freeman
- Karp, G. Cell and Molecular Biology. Concepts and experiments. John Harris, D., Wiley & sons, NewYork
- Old, R. W., Primrose, S. B., & Twyman, R. M. (2006). Principles of Gene Manipulation and Genomics, 7th Edition: BlackwellPublishing.
- Brown, T. A. (2018). Genomes 4. (4 edition) New York: Garland SciencePub.





Note-**Latest edition of the text books should be used.**

Suggested Continuous Evaluation Methods: Students can be evaluated through class participation, group discussion, group projects, presentations, and practical knowledge assessment to ensure comprehensive and regular learning. Additionally, they can be routinely evaluated through quizzes, assignments, and class-tests etc.

Suggested equivalent online courses: Swayam, Vidyamitra.inflibnet.ac.in, ePG-pathshala, egyankosh.ac.in, https://ocw.mit.edu/, NPTEL etc.

DISCIPLINE SPECIFIC ELECTIVES (DSE)- ADVANCED BIOCHEMISTRY						
No. of Hours- 60						
CREDIT DISTRIBUTION, ELIGIBILITY AND PRE-REQUISITES OF THE COURSE						
Course Title	**Credits**	**Credit distribution of the Course**			**Eligibility criteria**	**Pre-requisite of the Course (if any)**
		Lecture	**Tutorial**	**Practical/Practice**		
DSE ADVANCED BIOCHEMISTRY	**4**	**3**	**1**	**0**	**UG Degree**	**Nil**

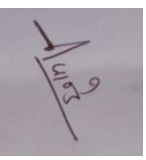
Course: DSE	**Course Title: ADVANCED BIOCHEMISTRY**
Max. Marks: As per Univ. rules	**Min. Passing Marks: As per Univ. rules**

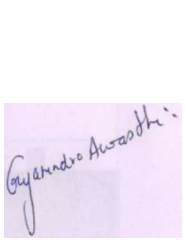
Course Outcomes:

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

- To develop a clear understanding of the concepts related to structures and functions of biomolecules for better understanding of energetics and regulation of metabolic pathways.
- To develop hands-on-ability in young minds to plan and execute different biochemical experiments in the laboratory.

Unit	**Topic**	**No. of Hours**
Unit I	**Chemical basis of life:** Composition of living matter; Water- properties, pH, pKa, Titration curves of weak acids, Buffers, Handerson- Hasselbach equations, ionization and hydrophobicity; Emergent properties of biomolecules in water; Water as a reactant.	**12**
Unit II	**Proteins:** Amino acids as building blocks of proteins and their chemical properties, pI and pKa values, Primary, Secondary, Tertiary and Higher order structure of Proteins, Ramchandran Plot, Conjugated proteins- Glycoproteins, Lipoproteins, Heamproteins.	**12**





Unit III	**Enzymes**: General principles of catalysis, Quantitation of enzyme activity and efficiency, Enzyme characterization and Michaelis- Menten kinetics, Relevance of enzymes in metabolic regulation, activation, inhibition and covalent modification; Single substrate enzymes	**12**
Unit IV	**Carbohydrates:** Mono- Di- and Polysaccharides, Optical isomerism, Structure of Carbohydrates, Glycolysis, Gluconeogenesis, Pentose phosphate pathways, Citric acid cycle and their regulation. **Bioenergetics:** Basic principles; Equilibria and concept of free energy; Group transfer, concept of Entropy, Enthalpy and free energy , Oxidation and Reduction reactions, Electron Transport Chain, Oxidative phosphorylation; photosynthesis.	**12**
Unit V	**Lipids:** Classification and structural analysis of fatty acids, Glycerols, Waxes, Glycolipids, Phospholipids, Sphingolipids, Sterols, Lipoproteins, β-oxidation, Biosynthesis of Cholesterol and Fatty acids. **Nucleic acids:** Biosynthetic pathways of purines and pyrimidines, degradation pathways.	**12**

Recommended Readings:

- Lehninger: Principles of Biochemistry, 3rd edition, by David L. Nelson and M.M. Cox (2000) Maxmillan/ Worthpublishers.
- Fundamentals of Biochemistry by Donald Voet and Judith G Voet (1999). John Wiley & Sons, NY
- Biochemistry, 2nd edition, by R.H. Garrett and C.M. Grisham (1999). Saunders College Publishing,NY.
- Outlines of Biochemistry by E.E.Conn, P.K.Stumpf, G. Bruenimg and Ray H.Doi (1987). John Wiley & Sons,NY
- Biochemistry,2ndedition,byLaurenceA.Moran,K.G.Scrimgeour,H.R.Horton,
- R.S. Ochs and J. David Rawn (1994), Neil Patterson Publishers Prentice Hall.
- Berg, JM Tymoczko, JL. Gatto, GJ., Stryer, L. (2015). Biochemistry. (8th ed.) W H Freeman and Company NewYork.
- Satyanarayana U. Chakrapani U. (2013). Biochemistry. (4th edition). Elsevier and Books and Allied (P)Ltd

Suggested online links:

1.https://nptel.ac.in/courses/104/105/104105076/
2.https://nptel.ac.in/courses/102/106/102106087/
3.https://ocw.mit.edu/courses/find-by- topic/#cat=healthandmedicine&subcat=spectroscopy
4.https://ocw.mit.edu/courses/chemistry/5-07sc-biological-chemistry-i-fall- 2013/module-i/session4/
5.https://ocw.mit.edu/courses/biology/7-016-introductory-biology-fall-2018/lecturevideos/lecture-4enzymes-and-metabolism/
6.https://ocw.mit.edu/courses/chemistry/5-07sc-biological-chemistry-i-fall- 2013/module-i/session3/

DISCIPLINE SPECIFIC ELECTIVES (DSE)- MICROBIOLOGY

No. of Hours- 60						
CREDIT DISTRIBUTION, ELIGIBILITY AND PRE-REQUISITES OF THE COURSE						
Course Title	**Credits**	**Credit distribution of the Course**			**Eligibility criteria**	**Pre-requisite of the Course (if any)**
		Lecture	**Tutorial**	**Practical/Practice**		
DSE MICROBIOLOGY	**4**	**3**	**1**	**0**	**UG Degree**	**Nil**

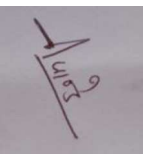
Course: DSE	**Course Title: MICROBIOLOGY**
Max. Marks: As per Univ. rules	**Min. Passing Marks: As per Univ. rules**

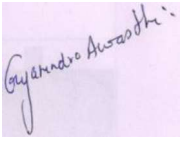
Course Outcomes:

After completing this course the students will be able to:

- To develop understanding of the basic concepts on Microbial growth and physiology, Microbial diversity and systematics.
- To develop understanding on the microbes and their relations to environment.

Unit	Topic	No. of Hours
Unit I	**Microbial Diversity & Systematics.** The Milestones in Microbiology: The discovery of microbial world by Antony van Leeuwenhocek, The controversy over spontaneous generation, Golden age of Microbiology. Criteria for classification of microorganism; 16S rDNA sequencing.	**12**
Unit II	**Microbial Growth & Physiology** Cell Structure and Functions: Prokaryote cell, size, shape and arrangement of bacterial cells, Cell wall, External and Internal structures to the cell wall of Eubacteria. Ultrastructure of Archaea (Methanococcus). Microbial growth: Batch, fed-batch, continuous kinetics, synchronous growth, methods of growth estimation, stringent response. Methods in Microbiology: Pure culture techniques, The theory and practice of sterilization, Principles of microbial nutrition, Construction of culture media, Enrichment of culture techniques, Pure culture and its maintenance	**12**
Unit III	**Microbial Interactions and Infection** Host-pathogen interactions; Microbes infecting animals and plants; Disease reservoirs, epidemiological terminologies, infectious diseases transmission, pathogenicity islands and their role in bacterial virulence	**12**





Unit IV	**Microbes and Environment** Salient features of extremophiles (halophiles, thermophiles, psychrophiles) archaeabacteria. aerobic and anaerobic bacteria, phototrophic and gliding bacteria, prosthecate and budding bacteria. Ecological impacts of microbes; Symbiosis (Nitrogen fixation and ruminant symbiosis).	**12**
Unit V	**Industrial Applications** Microbial fuel cells; Prebiotics and Probiotics; Vaccines. Microbial processes-production, optimization, screening, strain improvement, for the production of ethanol, organic acids, antibiotics etc. Basic principles in bioprocess technology; Media Formulation; Sterilization; Batch and continuous sterilization systems; Bioprocess control and monitoring variables such as temperature, agitation, pressure, pH.	**12**

Recommended Readings:

- Madigan, M. T., Martinko, J. M., & Parker, J. (2003). Brock biology of microorganisms. Upper Saddle River, NJ: Prentice Hall/PearsonEducation.

- Prescott, and Joanne M. Willey. Prescott's Microbiology. New York: McGraw-Hill, 2011.
- Pelczar, M. J., Chan, E. C. S., & Krieg, N. R. (1993). Microbiology: Concepts and applications. New York:McGraw-Hill.
- Tortora, Gerard J, Berdell R. Funke, and Christine L. Case. Microbiology: An Introduction. , 2004.
- Mattha, W, Berg C Y, and Black JG. (2005). Microbiology, Principles and Explorations. Boston, MA: John Wiley & Sons.
- Ananthanarayana R, PanickerCKJ(2020). Ananthanarayana and Panicker's Textbook of Microbiology(11edition) Universities Press (India) Pvt.Ltd

Suggested online links:

1. https://microbeonline.com
2. https://ocw.mit.edu/courses/find-by topic/#cat=science&subcat=biology&spec=microbiology
3. https://nptel.ac.in/courses/102/103/102103015/

Note-**Latest edition of the text books should be used.**

Suggested Continuous Evaluation Methods: Students can be evaluated through class participation, group discussion, group projects, presentations, and practical knowledge assessment to ensure comprehensive and regular learning. Additionally, they can be routinely evaluated through quizzes, assignments, and class-tests etc.

Suggested equivalent online courses: Swayam, Vidyamitra.inflibnet.ac.in, ePG-pathshala, egyankosh.ac.in, https://ocw.mit.edu/, NPTEL etc.

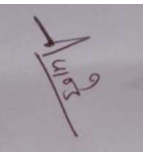
DISCIPLINE SPECIFIC ELECTIVE (DSE) – EXPERIMENTAL BIOTECHNIQUES-V						
No. of Hours-60						
CREDIT DISTRIBUTION, ELIGIBILITY AND PRE-REQUISITES OF THE COURSE						
Course Title	**Credits**	**Credit distribution of the Course**			**Eligibility criteria**	**Pre-requisite of the Course (if any)**
		Lecture	**Tutorial**	**Practical/Practice**		
DSE EXPERIMENTAL BIOTECHNIQUES-V	**4**	**0**	**1**	**3**	**UG Degree**	**Nil**
Course: DSE		**Course Title: EXPERIMENTAL BIOTECHNIQUES-V**				
Max. Marks: As per Univ. rules		**Min. Passing Marks: As per Univ. rules**				

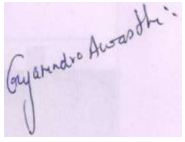
Course Outcome(s):

The course will enable the students to:

- Gain practical knowledge in biochemistry, molecular biology and microbiology
- Carry out qualitative/quantitative determination of biomolecules
- Learn separation techniques related to nucleic acids, lipids and proteins

Unit	Topic	No. of Hours
Unit I	**Biochemistry Practicals** • Preparation of solutions and their pH adjustment • Titration of Amino Acids. • Determination of pKa. • Quantitative estimation of Proteins • Quantitative estimation of Sugars • Paper chromatography, • TLC separation of plant extract	**20**
Unit II	**Molecular Biology Practicals** • Isolation of plant genomic DNA • Isolation of bacterial genomic DNA • Isolation of plasmid DNA • Spectrophotometric Quantitation of DNA. • Observation of DNA Hyperchromacity using Spectrophotometry • Restriction digestion • Agarose gel electrophoresis • Purification of DNA from an agarose gel • Polymerase Chain reaction	**20**

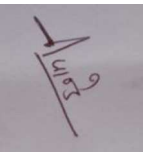


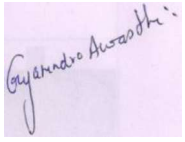


Unit III	**Microbiology Practicals** • Sterilization, disinfection, safety in microbiological laboratory. • Preparation of media for growth of various microorganisms. • Isolation and maintenance of organisms by plating, Streaking and Serial dilution methods- slants and stab cultures, Storage of microorganisms. • Gram Staining and enumeration of microorganisms. • Growth curve, measure of bacterial population by turbidometry and studying the effect of temperature, pH, carbon and nitrogen.	**20**

SUGGESTED READINGS:

- Brown, Tom, and Mike Gait. Essential Molecular Biology: A Practical Approach, Volumes 1 & 2. Oxford: IRL Press, Oxford University Press.
- Sharga, Boris M., Ulyana I. Chromiak, Diana B. Pylypiv, and Volodymir P. Feketa. Molecular Biology Practicals. Uzhhorod National University, 2022.
- Walker, John M. Practical Handbook of Biochemistry and Molecular Biology. Boca Raton: CRC Press, 2009.
- Sahu, A. C. Essentials of Molecular Biology: Theory & Practical (CBCS). New Delhi: Kalyani





Publishers.
- Chaitanya, K. S. Cell and Molecular Biology: A Lab Manual. New Delhi: PHI Learning Private Limited.
- Jain, Amita, Jyotsna Agarwal, and Vimala Venkatesh. Microbiology Practical Manual. New Delhi: Elsevier, 2018.
- Green, Lorrence H., and Emanuel Goldman. Practical Handbook of Microbiology. 4th ed. Boca Raton: CRC Press, 2023.
- Miller, J. M. Handbook of Specimen Collection and Handling in Microbiology. Atlanta: Centers for Disease Control, 1981.
- Parija, Subhash Chandra. Textbook of Practical Microbiology. New Delhi: Ahuja Publishing House.
- Rajendiran, Soundravally, and Pooja Dhiman. Biochemistry Practical Manual. 1st ed. New Delhi: Elsevier, 2019.
- Plummer, David T. An Introduction to Practical Biochemistry. 3rd ed. New Delhi: Tata McGraw-Hill, 1988.
- Jayaraman, J. Laboratory Manual in Biochemistry. New Delhi: New Age International Publishers, 1981.
- Sattanathan, G., S. S. Padmapriya, and B. Balamuralikrishnan. Practical Manual of Biochemistry. 1st ed. Tamil Nadu: Skyfox Publishing Group, 2020.

Suggested Continuous Evaluation Methods: Students can be evaluated through class participation, group discussion, group projects, presentations, and practical knowledge assessment to ensure comprehensive and regular learning. Additionally, they can be routinely evaluated through quizzes, assignments and class-tests etc.
Suggested equivalent online courses: Swayam, Vidyamitra.inflibnet.ac.in, ePG-pathshala, egyankosh.ac.in, https://ocw.mit.edu/, NPTEL etc.

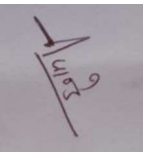
GENERICELECTIVECOURSE(GE)– Biofertilizers and Biocontrol agents						
No. of Hours-60						
CREDIT DISTRIBUTION, ELIGIBILITY AND PRE-REQUISITES OF THE COURSE						
Course Title	**Credits**	**Credit distribution of the Course**			**Eligibility criteria**	**Prerequisite of the Course (if any)**
		Lecture	**Tutorial**	**Practical/Practice**		
GE: BIOFERTILIZERS AND BIOCONTROL AGENTS	**4**	**3**	**1**	**0**	**UG Degree**	**Nil**
Course: GE		**Course Title: Biofertilizers and Biocontrol Agents**				
Max. Marks : As per Univ. rules		**Min. Passing Marks: As per Univ. rules**				

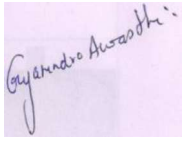
Course Outcomes:

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

- Provide knowledge about role of bio-fertilizers in quality parameters of various agricultural products and key role of biofertilizers in maintaining soil health, sustainable agriculture and environment
- To acquaint with types, potential of environment friendly biocontrol agents, and their importance in present scenario
- To learn formulation, mass production, quality control, delivery systems etc, for their commercial production

Unit	Topic	No. of Hours
Unit I	Introduction: History of biofertilizers, types and importance of biofertilizers, Classification of biofertilizers, biopesticides and biocontrol agents in agriculture and organic farming system	10
Unit II	Nitrogen cycle , Nitrogen fixation -Free living and symbiotic nitrogen fixation, *Rhizobium*- infection in legumes, nodulation process, and biochemistry of nitrogen fixation, Role of Nif and Nod genes, Overview of Nitrogen fixing microbes: *Rhizobium, Frankia,* Cyanobacterial biofertilizers-- *Anabaena*, *Nostoc, Azotobacter,* Azospirillum. Mechanism of P solubilization: PSB *Bacillus* & *Pseudomonas* P mobilization by microbes – AM mycorrhiza and ectomycorhiza.	14
Unit III	Production technology: Strain selection, growth, and mass production of biofertilizers. Quality control of biofertilizers, their storage and shelf life, Packing of biofertilizers. Factors influencing the efficacy of biofertilizers. Application technology of bio fertilizers.	12





Unit IV	Integrated Pest Management and use of Biocontrol Agents- History, Classification, Mode of action, advantages and limitations of biocontrol agents - Botanicals, Biochemicals, Phytopathogenic and Entomopathogenic microbes (virus, bacteria, fungus) , Predators insects , Insectivorous birds. Mechanism of action of Biocontrol agents: Antagonism, Competition, Mycoparasitism/Hyperparasitism, Antibiosis, Lysis, Enzymes, Biofilm formation etc.	10
Unit V	Significance of fungi- *Trichoderma* spp., *Beauveria bassiana, Lecanicillium lecanii;* bacteria- *Pseudomona*s spp. and *Bacillus* spp.; Viruses (NPV and GV) as a biocontrol agent. Successful Bio-Control Programmes in India. GMOs for their potential use in biofertilizers and as biopesticides biocontrol agents	14

Recommended Readings:

- A Text Book on Applied Entomology Vol. I&II. (4th ed.), K. P. Srivastava, Kalyani Publishers, 2010
- Biofertilizers And Biocontrol Agents For Organic Farming, Dr. Reeta Khosla, Kojo Press, 2017
- Biofertilizers for Sustainable Agriculture and Environment. Bhoopander Giri et al. Springer Cham. 2019
- Handbook of Biofertlizers & Microbial Pesticides. Mrs. H.N. Shelat and M.S. Vora. Satish Serial Publishing House. 2013
- Entomology and Pest Management, Seventh Edition. Larry P. Pedigo et al. Waveland Press, Inc.2021
- Bioinoculants for Sustainable Agriculture and Forestry. S.M. Reddy et al. Scientific Publishers.2023

Note-Latest edition of the text books should be used.

Suggested Continuous Evaluation Methods: In addition to the theoretical inputs the course will be delivered through Assignments, Presentation, Group Discussions.etc

Suggested equivalent online courses: Swayam,Vidyamitra.inflibnet.ac.in, nptel.ac.in literature study-online.com, epg-pathshala, egyankosh.ac.in

GENERIC ELECTIVE COURSE (GE) – FERMENTATION TECHNOLOGY

No. of Hours-60

CREDIT DISTRIBUTION, ELIGIBILITY, AND PRE-REQUISITES OF THE COURSE

Course Title	Credits	Credit distribution of the Course			Eligibility criteria	Pre-requisite of the Course (if any)
		Lecture	Tutorial	Practical/Practice		
GE: Fermentation Technology	**4**	**3**	**1**	**Nil**	**UG Degree**	**Nil**

Course: GE	**Course Title: Fermentation Technology**

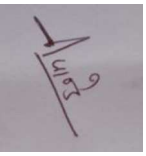
Max. Marks: As per Univ. rules	Min. Passing Marks: As per Univ. rules

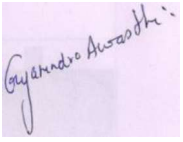
Course Outcomes:

After completing this course the students will be able to:

1. Understand and explain the fundamental principles of fermentation technology.
2. Select and utilize appropriate microbial strains for industrial fermentation processes.
3. Prepare and optimize media and conditions for maximum product yield.
4. Operate fermenters and bioreactors, maintaining aseptic conditions.
5. Monitor and control key fermentation parameters (pH, temperature, oxygen, etc.)
6. Apply techniques for the recovery and purification of fermentation products

UNIT	TOPICS	No. of Hours
Unit I	History of fermentation Introduction to fermentation Types of fermentation, Key products of fermentation: Ethanol, citric acid, lactic acid. Microbial growth kinetics Fermenter design and factors affecting growth and metabolite production	15
Unit II	Strategies for Isolation/preservation of industrially important microbes Media formulation Sterilization techniques and their selective utilization for different media constituents Strain improvement methods	10
Unit III	Inoculum development, Fermentation operation and control; Bioreactors' configuration: Key features of a typical bioreactor. Stirred tank, bubble column, airlift, fluidized bed, packed bed bioreactors.	15
	Product recovery and purification strategies.	
Unit IV	Process monitoring and control: Fermentation control system, Sensor and controllers. Aeration and agitation, Impact of pH, Temperature, salinity, Shear effect etc. Fermentation kinetics (batch, fed-batch, continuous),	10
Unit V	Downstream processing (filtration, extraction, purification) Industrial production (antibiotics, enzymes, alcohol, etc.) Enzyme technology Biosensors and industrial applications	10





References:

1. Microbiology - Pelczar, Chan and Kraig (ISBN 0-07-462320-6)
2. Microbiology -Prescott, Harley and Klein (ISBN 0-07-111217-0)
3. Microbiology-Bemard D Davis
4. Foundations in Microbiology-Talaro and Talaro

Note-Latest edition of the text books should be used.

Suggested Continuous Evaluation Methods: In addition to the theoretical inputs the course will be delivered through Assignments, Presentation, Group Discussions.etc

Suggested equivalent online courses: Swayam,Vidyamitra.inflibnet.ac.in, nptel.ac.in literature study-online.com, epg-pathshala, egyankosh.ac.in

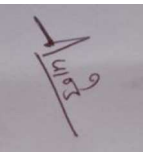
Semester VIII

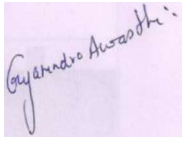
DISCIPLINE SPECIFIC CORE (DSC)– CELL BIOLOGY						
No. of Hours-60						
CREDIT DISTRIBUTION, ELIGIBILITY AND PRE-REQUISITES OF THE COURSE						
Course Title	**Credits**	**Credit distribution of the Course**			**Eligibility criteria**	**Prerequisite of the Course (if any)**
		Lecture	**Tutorial**	**Practical/Practice**		
DSC: 20 CELL BIOLOGY	**4**	**3**	**1**	**0**	**UG Degree**	**Nil**
Course: DSC- 20		**Course Title: CELL BIOLOGY**				
Max. Marks : As per Univ. rules		**Min. Passing Marks: As per Univ. rules**				

Course Outcomes:

After completing this course the students will be able to:

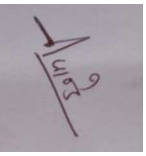
- Produce a basic understanding of the unit of life i.e., cell by theoretical and pictorial learning of the organization and function of different cell organelles and developmental biology.
- Learning critical concepts, facts, and theories relevant to cellular mechanisms also understand the functions of different organelles of the cell and their interrelationships.

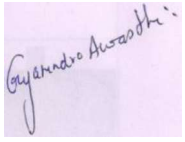




- Perceive recent developments in the field.

Unit	Topic	No. of Hours
Unit I	**Cell Theory and Methods of Study** Microscope and its modifications- Light, phase contrast and interference, Fluorescence, Confocal, Electron (TEM and SEM). **Membrane Structure and Function** Structural models; Composition and dynamics; Transport of ions and macromolecules; Pumps, carriers and channels; Endo- and Exocytosis; Membrane carbohydrates and their significance in cellular recognition.	15
Unit II	**Cellular compartments and intracellular sorting of proteins** Golgi complex, ER & Lysosomes, peroxisomes, mitochondria, synthesis and sorting of proteins. Nuclear transport.	15
Unit III	**Endo-membrane System and Cellular Motility** Organization of nucleus and nuclear membrane, structure and organization of chromatin. Cytoskeleton: Actin filaments and cell cortex, cilliary movements and cytoplasmic microtubules and intermediate filaments.	15
Unit IV	**Cell Communication** General principle, Signal Molecules, Signaling through GPCRs, Second Messengers, Molecular Switches, Cells Sensitivity to a signal, IP3, Jak-STAT pathways, Cam Kinase-II, Receptor Tyrosine Kinase, Signaling in Plants	15





Recommended Readings:

1. Alberts, B., Johnson, A., Lewis, J., Raff, M., Roberts, K., & Walter, P.(2014). **Molecular Biology of the Cell** (6th Ed.). New York: Garland Science
2. Cooper, G. M., and Hausman, R. E. (2013). **The Cell: a Molecular Approach** (6th Ed.). Washington: ASM ; Sunderland.
3. Karp, G. **Cell and Molecular Biology. Concepts and experiments**. John Harris, D., Wiley & sons, NewYork

Note-Latest edition of the text books should be used.

Suggested Continuous Evaluation Methods: In addition to the theoretical inputs the course will be delivered through Assignments, Presentation, Group Discussions.etc

Suggested equivalent online courses: Swayam,Vidyamitra.inflibnet.ac.in, nptel.ac.in literature study-online.com, epg-pathshala, egyankosh.ac.in

DISCIPLINE SPECIFIC ELECTIVES (DSE)- ANALYTICAL TECHNIQUES						
No. of Hours- 60						
CREDIT DISTRIBUTION, ELIGIBILITY AND PRE-REQUISITES OF THE COURSE						
Course Title	**Credits**	**Credit distribution of the Course**			**Eligibility criteria**	**Pre-requisite of the Course (if any)**
		Lecture	**Tutorial**	**Practical/Practice**		
DSE ANALYTICAL TECHNIQUES	**4**	**3**	**1**	**0**	**UG Degree**	**Nil**

Course: DSE	**Course Title: ANALYTICAL TECHNIQUES**
Max. Marks: As per Univ. rules	**Min. Passing Marks: As per Univ. rules**

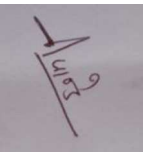
Course Outcomes:

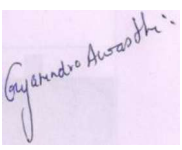
After completing this course the students will be able to:

- The course envisages conceptual and hands on learning of various analytical techniques.
- This course will enable students to perform spectroscopy techniques, enzyme assays, chromatography techniques etc.

Unit	**Topic**	**No. of Hours**

Unit I	**Basic Techniques** Buffers; Methods of cell disintegration; Enzyme assays and controls; Detergents and membrane proteins; Dialysis, Ultrafiltration and other membrane techniques. **Spectroscopy Techniques** Basic Principle, Instrumentation and Biological applications of: UV and Visible light absorption spectroscopy, Spectro fluorometry, CD and ORD, Atomic spectroscopy (Absorption and emission). Infrared spectroscopy, Raman Scattering, Application of FT-IR in the study of biomolecules, Nuclear Magnetic Resonance (NMR) spectroscopy, and EPR; Mass spectroscopy and mass analyzers like ion trap, quadrupole, magnetic sector, time of flight (ToF).	**15**
Unit II	**Chromatography Techniques** TLC and Paper Chromatography; Column chromatography Chromatographic methods for macromolecule separation-Gel permeation, Ion exchange, Hydrophobic, Reverse-phase and Affinity chromatography; HPLC and FPLC. **Electrophoretic Techniques** Theory and application of Polyacrylamide and Agarose gel electrophoresis; Native and SDS-PAGE electrophoresis; Capillary electrophoresis; 2D Electrophoresis; Disc gel electrophoresis; Gradient electrophoresis; Pulsed field gel electrophoresis	**15**
Unit III	**Centrifugation** Basic principles; Mathematics & theory (RCF, Sedimentation Coefficient etc); Types of centrifuge- Micro centrifuge, High speed & Ultracentrifuges; Preparative centrifugation; Differential & density	**10**
	gradient centrifugation; Application (Isolation of cell components); Analytical centrifugation.	
Unit IV	**Radioactivity** Radioactive & stable isotopes; Radioactive decay; Units of radioactivity; Measurement of radioactivity; Geiger-Muller counter; Solid & Liquid scintillation counters (Basic principle, instrumentation & technique); Autoradiography; Applications of isotopes in biochemistry, Clinical application; Radioimmunoassay	**10**
Unit V	**Advanced Techniques** Protein crystallization; Enzyme and cell immobilization techniques	**10**





Recommended Readings:

1. Olaniyan, F. M., (2017) V Edition, Laboratory Instrumentation and Techniques, Create space independent publishing platform
2. Wilson, K., Walker, J. (eds.); Cambridge University Press, Cambridge, 2000, V Edition.
3. Willard, M. H., (2004), VII Edition, Instrumental Methods of Analysis, CBS Publisher and distributor Private Limited.

Suggested online links:

https://nptel.ac.in/courses/102/103/102103044/

Note-**Latest edition of the text books should be used.**

Suggested Continuous Evaluation Methods: Students can be evaluated through class participation, group discussion, group projects, presentations, and practical knowledge assessment to ensure comprehensive and regular learning. Additionally, they can be routinely evaluated through quizzes, assignments, and class-tests etc.

Suggested equivalent online courses: Swayam, Vidyamitra.inflibnet.ac.in, ePG-pathshala, egyankosh.ac.in, https://ocw.mit.edu/, NPTEL etc.

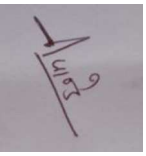
DISCIPLINE SPECIFIC ELECTIVE (DSE) - IMMUNOLOGY AND IMMUNOTECHNOLOGY						
No. of Hours-60						
CREDIT DISTRIBUTION, ELIGIBILITY AND PRE-REQUISITES OF THE COURSE						
Course Title	**Credits**	**Credit distribution of the Course**			**Eligibility criteria**	**Pre-requisite of the Course (if any)**
		Lecture	**Tutorial**	**Practical/Practice**		
DSE IMMUNOLOGY AND IMMUNOTECHNOLOGY	**4**	**3**	**1**	**0**	**UG Degree**	**Nil**
Course: DSE		**Course Title: IMMUNOLOGY AND IMMUNOTECHNOLOGY**				
Max. Marks: As per Univ. rules		**Min. Passing Marks: As per Univ. rules**				

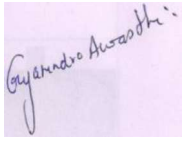
Course Outcome(s):
The course will enable the students to:

- To understand the basics of immunology and facilitate the application of core immunology for healthy and diseases free nation.
- Evaluation of molecular and cellular basis of the development and function of the immune system in states of health and diseases.
- Correlate the theoretical immunology with clinical decision-making cancer diagnosis and treatment.
- Understanding the mechanisms of disease and therapeutic implications of vaccines and its development.

Unit	Topic	No. of Hours
Unit I	**Immunology- fundamental concepts and anatomy of the immune system** Components of innate and acquired immunity; Phagocytosis; Complement and Inflammatory responses; haematopoesis; Organs and cells of the immune system- primary and secondary lymphoid organs; Lymphatic system; Lymphocyte circulation; Lymphocyte homing; Mucosal and Cutaneous associated Lymphoid tissue. (MALT & CALT); Mucosal Immunity; Antigens and antigenicity – immunogens and immunogenicity, Immune modulators: Adjuvants, hapten- carrier system; Toxins and Toxoids. Major Histocompatibility Complex – MHC genes, MHC and immune responsiveness and disease susceptibility.	**15**
Unit II	**Immune responses generated by B and T lymphocytes** Immunoglobulins- basic structure, classes & subclasses of immunoglobulins, antigenic determinants (Epitopes); Antigen-Antibody interaction, affinity, cross reactivity, specificity, Multigene organization of immunoglobulin genes; B-cell receptor; Immunoglobulin superfamily; Basis of self –non-self-discrimination; Generation of antibody diversity; T-cell receptors; Functional T Cell Subsets; Cell-mediated immune responses, ADCC Antigen processing and presentation- endogenous antigens, exogenous antigens, Hypersensitivity – Type I-IV; Autoimmunity; Types of autoimmune diseases; Treatment of autoimmune diseases.	**15**
Unit III	**Antigen-antibody interactions** Precipitation, agglutination and complement mediated immune reactions; Antibodies as in-vitro and in-vivo probes; Advanced immunological techniques – RIA, ELISA, Western blotting, ELISPOT assay.	**15**

Unit IV	**Vaccine Technology** Principles of Immunization, Techniques for analysis of immune response. General Idea of Active and passive immunization; Live, killed, attenuated, sub unit vaccines; recombinant DNA and protein based vaccines, plant-based vaccines, reverse vaccinology; Peptide vaccines, conjugate vaccines; Hybridoma, antibody engineering - chimeric and hybrid monoclonal antibodies.	**15**





SUGGESTED READINGS:

1. Punt J, Stranford S, Jones P., Owen JA, (2018). Kuby Immunology.(8th edition) New York: W.H.Freeman.
2. Hay FC, Westwood OMR.(2008). Practical Immunology.(4th Edition). Wiley Blackwell
3. Delves P J, Martin SJ, Burton DR, and Roitt IM. (2017). Roitt's Essential Immunology.(13th edition). Wiley-Blackwell.
4. Hay FC, Westwood OMR.(2008). Practical Immunology.(4th Edition). Wiley Blackwell.
5. Murphy K, and Weaver C, (2016). Janeway's Immunobiology. (9th edition) New York: GarlandScience.

Suggested Continuous Evaluation Methods: Students can be evaluated through class participation, group discussion, group projects, presentations, and practical knowledge assessment to ensure comprehensive and regular learning. Additionally, they can be routinely evaluated through quizzes, assignments and class-tests etc.

Suggested equivalent online courses: Swayam, Vidyamitra.inflibnet.ac.in, ePG-pathshala, egyankosh.ac.in, https://ocw.mit.edu/, NPTEL etc.

DISCIPLINE SPECIFIC ELECTIVE (DSE) – EXPERIMENTAL BIOTECHNIQUES-VI

No. of Hours-60

CREDIT DISTRIBUTION, ELIGIBILITY AND PRE-REQUISITES OF THE COURSE

Course Title	Credits	Credit distribution of the Course			Eligibility criteria	Pre-requisite of the Course (if any)
		Lecture	Tutorial	Practical/Practice		
DSE EXPERIMENTAL BIOTECHNIQUES-VI	4	0	1	3	UG Degree	Nil

Course: DSE	**Course Title: EXPERIMENTAL BIOTECHNIQUES-VI**
Max. Marks: As per Univ. rules	**Min. Passing Marks: As per Univ. rules**

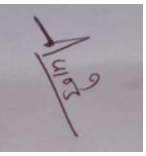
Course Outcome(s):

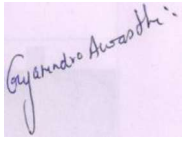
The course will enable the students to:

- To understand the basics of immunology and facilitate the application of core immunology for healthy and diseases free nation.
- Evaluation of molecular and cellular basis of the development and function of the immune system in states of health and diseases.
- The course envisages conceptual and hands on learning of various analytical techniques.
- This course will enable students to perform spectroscopy techniques, enzyme assays, chromatography techniques etc.

Unit	Topic	No. of Hours

Unit I	**Analytical Techniques Practical:** • Paper chromatography of amino acids • TLC of fatty acids • Absorption spectra of $KMNO_4$	**30**





GENERIC ELECTIVE COURSE (GE)– WASTE MANAGEMENT STRATEGIES						
No. of Hours-60						
CREDIT DISTRIBUTION, ELIGIBILITY AND PRE- REQUISITES OF THE COURSE						
Course Title	Credits	Credit distribution of the Course			Eligibility criteria	Prerequisite of the Course (if any)
		Lecture	Tutorial	Practical/Practice		
GE: WASTE MANAGEMENT STRATEGIES	4	3	1	0	UG Degree	

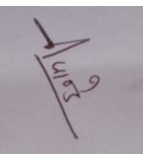
	• Verify Lambert Beer law • Extraction and purification of proteins from plant/bacterial cells • Protein Estimation • SDS PAGE of BSA and extracted proteins	
Unit II	**Immunology Practical:** • Preparation of human blood smear and identification of cells. • Determination of blood groups • Determination of Rh antigen. • Estimation of antiserum by Mancini method • Estimation of antiserum by Ouchterlony method • Antiserum titer determination by ELISA. • DOT ELISA for the presence of specific antigen	**30**

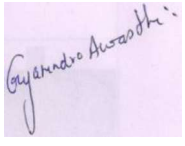
SUGGESTED READINGS:

- Hay, Frank C., and Olwyn M. R. Westwood. Practical Immunology. 4th ed. Oxford: Blackwell Science, 2002.
- Detrick, Barbara, John L. Schmitz, and Robert G. Hamilton. Manual of Molecular and Clinical Laboratory Immunology. 8th ed. Washington, DC: ASM Press, 2016.
- Balakrishnan, Senthilkumar, Karthik Kaliaperumal, and Senbagam Duraisamy. Practical Immunology: A Laboratory Manual. Chennai: Notion Press, 2018.
- Talwar, G. P., and Sudarshan K. Gupta. A Handbook of Practical and Clinical Immunology. 2nd ed. New Delhi: CBS Publishers, 1992.
- Plummer, David T. An Introduction to Practical Biochemistry. 3rd ed. New Delhi: Tata McGraw-Hill, 1988.
- Rudra, Tapash, editor. Laboratory Manual: Biophysics. Selangor Darul Ehsan, Malaysia: Lincoln University College, 2018.
- Gopakumar, P. K., and R. Elumalai. Laboratory Manual for Biochemical Analysis. New Delhi: NPH India, 2021.

Suggested Continuous Evaluation Methods: Students can be evaluated through class participation, group discussion, group projects, presentations, and practical knowledge assessment to ensure comprehensive and regular learning. Additionally, they can be routinely evaluated through quizzes,

assignments and class-tests etc.
Suggested equivalent online courses: Swayam, Vidyamitra.inflibnet.ac.in, ePG-pathshala, egyankosh.ac.in, https://ocw.mit.edu/, NPTEL etc.





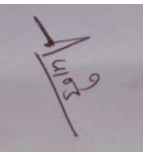
Course: GE	WASTE MANAGEMENT STRATEGIES
Max. Marks: As per Univ. rules	**Min. Passing Marks: As per Univ. rules**

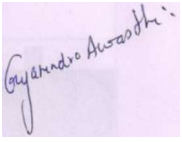
Course Outcomes:

After completing this course the students will be able to:

- Develop ability to identify various types of wastes and their sources
- Understanding biotechnological options in solid and liquid waste management.
- Developing potential to recover products from waste

Unit	Topic	No. of Hours
Unit I	Major types of waste: their sources, composition of solid wastes, effect on biodiversity. Concept of Waste management, Sustainable development and potential role of environmental biotechnology Green Biotechnology strategies employed for reducing, recycling, reuse of Bio Agro-industrial waste, municipal waste, wealth from waste concept.	15
Unit II	Solid waste management methods - Sanitary land filling, Recycling, Bioventing & Biosparging, Biocomposting, Vermi-composting. Energy recovery from organic waste: incineration, Biofuels- biohydrogen, biogas.	10
Unit III	Liquid , Effluent Waste Management: Sources, generation, classification & composition of liquid wastes, Sewage and waste water treatments systems; Primary, secondary and tertiary treatments. Biological effluent treatment - aerobic versus anaerobic treatments, fermentation technology and role of bioreactors - Activated Sludge, Trickling Filters, Rotating Biological Contactors (RBCs), Anaerobic Filters, etc Development of new biocatalysts to be applied in wastewater biotechnology.	15
Unit IV	Hazardous Waste Management: Sources, types (Radioactive waste, Biohazardous waste, urea, phenols), Examples of biotechnological applications to hazardous waste management (microbial biodegradation of xenobiotic waste). Health and environmental effects, safety precautions during handling and transport, approved disposal methods. Bioleaching, bioremediation, Phytoremediation of contaminated Soil and ground water at hazardous waste sites Waste management strategies using biologicals- Biotransformation, bioconversion, bioremediation, phytoremediation, bioaccumulation,etc Waste management by bio-substitution; bioplastics, biopolymer composites; Bio-Waste-Based Materials Genetically Modified Organisms (GMOs) in waste management	20

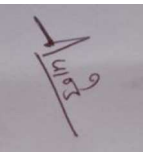


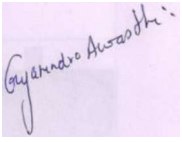


Recommended Readings:

- Solid Waste Technology & Management,Thomas Christensen, (2011)., John wiley&sons, USA
- . Waste Management Practices: Municipal, Hazardous and Industrial, John Pichtel (2014)., 2nd Ed., CRC Press, USA
- Hand Book of Solid Waste Management, Tchobanoglous G., Frank Kreith., (2002)., 2nd Ed., McGraw Hill, USA
- Waste to Wealth: The Circular Economy Advantage Peter Lacy, Jakob Rutqvist, 2015.
- Environmental biotechnology: principles and applications. Rittmann, B. E., & McCarty, P. L., Tata McGraw-Hill Education, 2020, 2nd Edition.
- Microbial biodegradation and bioremediation, Surajit Das, Elsevier, 2014, 1st Edition.
- Environmental Microbiology, Ian L. Pepper, Charles P. Gerba and Terry J Gentry, Academic Press, 2014, 1st Edition.

Note - **Latest edition of the text books should be used.**

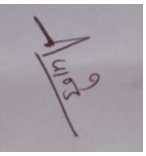


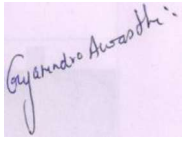


Suggested Continuous Evaluation Methods: In addition, the theoretical inputs the course will be delivered through Assignments, Presentation, Group Discussions

Suggested equivalent online courses: Swayam,Vidyamitra.inflibnet.ac.in,literature- study-online.com, epg-pathshala, egyankosh.ac.in, nptel.ac.in

GENERIC ELECTIVE COURSE(GE) –WATER QUALITY ANALYSIS						
No. of Hours-60						
CREDIT DISTRIBUTION,ELIGIBILITY AND PRE-REQUISITES OF THE COURSE						
Course Title	Credits	Credit distribution no of the Course			Eligibility criteria	Pre-requisite of the Course(if any)
		Lecture	Tutorial	Practical/Practice		
GE: Water quality analysis	4	3	1	0	UG Degree	Nil
Course: GE		Course Title: Water quality analysis				
Max. Marks: As per Univ. rules		Min. Passing Marks: As per Univ. rules				





Course Outcomes:

After completing this course, the students will be able to

- understand different terms related to water and water pollution.
- Development of practical, job-oriented skills in water quality assessment and spectrophotometric detection of water contaminants.
- Knowledge of various treatment technologies and analysis of water quality parameters.

Unit	Topic	No. of Hours
Unit I	Physical, chemical, and biological properties of water, types of water sources, occurrence, and importance. Water pollution: source, types (Ground water, fresh water, surface water, marine pollution), and management.	12
Unit II	Water quality parameters: Physical parameters, chemical parameters, bacteriological parameters. Microbiological analysis of Drinking water -coliform testing.	12
Unit III	Wastewater: Introduction, characteristics of waste water. Wastewater treatment – Treatment of water for domestic purposes: Pre-Treatment, Removal of suspended impurities, Method of disinfection of water.	12
Unit IV	Dissolved oxygen, Biological Oxygen Demand (BOD), Chemical Oxygen Demand (COD), the salinity of the given water sample, turbidity of various water sample.	12
Unit V	Water quality analysis: Determination of Total alkalinity, total hardness of the water sample, pH of ground and waste water, detection and measurement of various contaminant using a spectrophotometric method such as nitrate, chloride, fluoride, iron, micro-pollutants.	12

Recommended Readings:

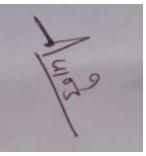
1. R.Shangi, M.M.Srivatsava,"GreenChemistry",NarosaPublishers,NewDelhi,2003.
2. P.T.Anasta, GreenChemistry:Theory&Practice,OxfordUniversityPress,2000.
3. A.E.Marteel-Parrish, M.A.Abraham,Green Chemistry and Engineering: A Pathway to Sustainability, Wiley, 2014.
4. V.K.Ahluwalia, GreenChemistry:ATextbook,AlphaScienceInternational,2012.
5. MikeLancaster.GreenChemistry:AnIntroductoryText,RoyalSocietyofChemistry,2010.

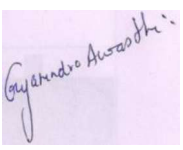
Note-Latest edition of the text books should be used.

Suggested Continuous Evaluation Methods: In addition to the theoretical inputs the course will be delivered through Assignments, Presentation, Group Discussions.etc

Suggested equivalent online courses: Swayam,Vidyamitra.inflibnet.ac.in, nptel.ac.in literature study-online.com, epg-pathshala, egyankosh.ac.in

SEMESTER IX





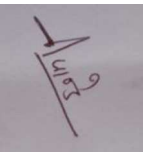
DISCIPLINE SPECIFIC CORE – Genetic Engineering						
No. of Hours-60						
CREDIT DISTRIBUTION, ELIGIBILITY AND PRE-REQUISITES OF THE COURSE						
Course Title	**Credits**	**Credit distribution of the Course**			**Eligibility criteria**	**Pre-requisite of the Course (if any)**
		Lecture	**Tutorial**	**Practical/Practice**		
DSC- 21 Genetic Engineering	**4**	**3**	**1**	**0**	PG diploma /UG honors with research	**Nil**
Course: DSC 21		**Course Title: Genetic Engineering**				
Max. Marks: As per Univ. rules		**Min. Passing Marks: As per Univ. rules**				

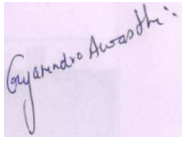
Course Outcome(s):

The course will enable the students to:

- Develop of theoretical and practical knowledge on concepts of genetic engineering.
- Get basic idea of cloning vectors, PCR, restriction enzymes and DNA sequencing.

Unit	Topic	No. of Hours
Unit I	**Basics Concepts** DNA structure and properties; Restriction enzymes; DNA ligase, Klenow enzyme, T4 DNA polymerase, Polynucleotide kinase, Alkaline phosphate, cohesive and blunt end ligation; Linkers; Adaptors; Homopolymer tailing, Labeling of DNA, Hybridization technique: Northern, southern and colony hybridization, fluorescence in situ hybridization; Chromatin Immunoprecipitation; DNA Protein Interactions; electrophoretic shift assay.	**12**
Unit II	**Cloning Vectors** Plasmids; M13 mp vector; PUC19 and Bluescript vectors, Phagemids, Lambda vectors; Cosmids; Artificial chromosome vectors (YACs; BACs); Mammalian expression vectors & retroviral vectors; Prokaryotic Expression vectors with GST-, His- and MBP- tags; Affinity purification of recombinant fusion proteins; Inclusion bodies; Methodologies to reduce formation of inclusion bodies.	**12**





Unit III	**Cloning Methodologies** Bacterial Transformation; Isolation of mRNA and total RNA; cDNA and genomic libraries; cDNA and genomic cloning; Expression cloning; Phagedisplay	**12**
Unit IV	**PCR and its Applications** Primer design; Fidelity of thermo stable enzymes; DNA polymerases; Types of PCR- reverse transcriptase, real time PCR, hot start PCR, colony PCR, cloning of PCR products; T-vectors; Proof reading enzymes; PCR in site specific mutagenesis; PCR in molecular diagnostics; Viral and bacterial detection.	**12**
Unit V	**DNA Sequencing and Silencing** Enzymatic DNA sequencing; Automated DNA sequencing; Chemical Synthesis of oligonucleotides; Introduction of DNA into mammalian cells; Transfection techniques; Gene silencing techniques; RNA interference and siRNA Gene knockouts and Gene Therapy	**12**

SUGGESTED READINGS:

- Principles of Gene Manipulation by R.W.Old and S.B.Primrose Third Edition Blackwell Scientific Publication
- Genes VI by B. Lewin
- From Genes to Clones by E. L. Winnecker.
- Brown, T. A. (2006). **Gene Cloning and DNA Analysis: an Introduction.** Oxford: Blackwell Pub.
- Slater, A., Scott, N. W., & Fowler, M. R. (2003). **Plant Biotechnology: The Genetic Manipulation of Plants**. Oxford: Oxford University Press

Suggested Continuous Evaluation Methods: Students can be evaluated through class participation, group discussion, group projects, presentations, and practical knowledge assessment to ensure comprehensive and regular learning. Additionally, they can be routinely evaluated through quizzes, assignments and class-tests etc.

Suggested equivalent online courses: Swayam, Vidyamitra.inflibnet.ac.in, ePG-pathshala, egyankosh.ac.in, https://ocw.mit.edu/, NPTEL etc.

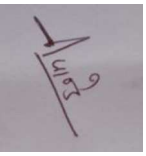
DISCIPLINE SPECIFIC ELECTIVE (DSE) – PLANT BIOTECHNOLOGY						
No. of Hours-60						
CREDIT DISTRIBUTION, ELIGIBILITY, AND PRE-REQUISITES OF THE COURSE						
Course Title	**Credits**	**Credit distribution of the Course**			**Eligibility criteria**	**Pre-requisite of the Course (if any)**
		Lecture	**Tutorial**	**Practical/Practice**		
DSE: PLANT BIOTECHNOLOGY	**4**	**3**	**1**	**0**	**PG diploma /UG honors with research**	**Nil**
Course: DSE		**Course Title: PLANT BIOTECHNOLOGY**				
Max. Marks: As per Univ. rules		**Min. Passing Marks: As per Univ. rules**				

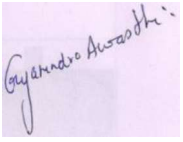
Course Outcomes:

After completing this course the students will be able to:

- Describe the developmental processes operating in plants, hands on training of plant tissue culture & micropropagation methods.
- Evaluate and perform biotechnological tools for genetically modified plants generation in agriculture and industry.
- Understands the basics of sterilization and culture preparation methods and highlights the importance and fundamentals of plant tissue culture.
- To develop basic understanding of need of vectors for plant transformation.
- Create awareness for the suitability of transgenics, in the society, industrialists, and environment. To emphasize the interest in young mind for startup through biotechnology-based industry.

UNIT	TOPICS	No. of Hours
Unit I	**Plant Tissue Culture** Historical perspective; Totipotency; Organogenesis; Somatic embryogenesis; Regulation and applications; Artificial seed production; Micropropagation; Somaclonal variation; Androgenesis and its applications in genetics and plant breeding; Germplasm conservation and cryopreservation. **Protoplast Culture and Somatic Hybridization** Protoplast isolation; Culture and usage; Somatic hybridization – methods and applications; Cybrids and somatic cell genetics.	12
Unit II	**Genetic Transformation** Agrobacterium-plant interaction; Virulence; Ti and Ri plasmids; Opines and their significance; T-DNA transfer; Disarming the Ti plasmid. Agrobacterium-mediated gene delivery; Co integrate and binary vectors and their utility; Direct gene transfer- PEG-mediated, electroporation, particle bombardment and alternative methods; Screenable and selectable markers; Characterization of transgenics; Chloroplast transformation; Marker-free methodologies; Gene targeting.	12
Unit III	**Strategies for Introducing Biotic and Abiotic Stress Resistance/Tolerance** Bacterial resistance; Viral resistance; Fungal resistance; Insects and pathogens resistance; Herbicide resistance; Drought, salinity, thermal stress, flooding and submergence tolerance	12
Unit IV	**Plants as Bio factories** Concept of bio factories; Fermentation and production of industrial enzymes, vitamins and antibiotics and other biomolecules; Cell cultures for secondary metabolite production; Production of pharmaceutically important compounds; Bioenergy generation.	12

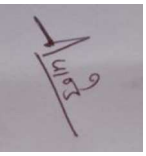


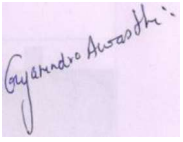


Unit V	**Principals and applications of cryopreservation** Secondary product formation by cell suspension cultures, Culture media and environmental conditions supporting secondary product formation, Biotransformation of terpenoids, alkaloids and steroids by suspension and immobilized plant cell cultures, Biosafety and containment Practices	12

References:

1. Berg, JM Tymoczko, JL. Gatto, GJ., Stryer, L. (2015). Biochemistry. (8th ed.) W H Freeman and Company NewYork.
2. Nelson DL. Cox MM. (2017) Lehninger Principles of Biochemistry (7th ed.). W H Freeman New York.
3. Boyer RF. (2012) Biochemistry laboratory: modern theory and techniques(2nd Edition). Pearson Education, Inc
4. Jain JL. Jain S. Jain N. (2005). Fundamentals of Biochemistry. (6th edition). S Chand and Company Ltd.





5. Satyanarayana U. Chakrapani U. (2013). Biochemistry (4th edition). Elsevier and Books and Allied (P)Ltd
6. Razdan, M. K. (2003). Introduction to Plant Tissue Culture. Enfield, NH: Science
7. Chawla, H. S. (2000). Introduction to Plant Biotechnology. Enfield, NH: Science.
8. Primrose, S. B., & Twyman, R. M. (2006). Principles of Gene Manipulation and Genomics. Malden, MA: Blackwell Pub.
9. Dubey RC. (2014) A Textbook of Biotechnology (5th edition) S Chand and Company Ltd
10. Singh BD. (2015). Biotechnology: Expanding Horizons (4th edition). Kalyani Publishers

DISCIPLINE SPECIFIC ELECTIVE (DSE) – Infection biology

No. of Hours-60

CREDIT DISTRIBUTION, ELIGIBILITY AND PRE-REQUISITES OF THE COURSE

Course Title	Credits	Credit distribution of the Course			Eligibility criteria	Pre-requisite of the Course (if any)
		Lecture	Tutorial	Practical/Practice		
DSE: Infection biology	4	3	1	0	PG diploma /UG honors with research	Nil

Course: DSE	**Course Title: Infection biology**
Max. Marks: As per Univ. rules	**Min. Passing Marks: As per Univ. rules**

Course Outcome(s):

- The course is intended to provide students with a comprehensive understanding of the mechanisms by which pathogens belonging to different life-forms infect humans and plants.
- The course also aims to impart the students with the knowledge required for prevention, diagnosis, and management of infections in both human and plant systems.

Unit	Topic	No. of Hours
Unit I	**Introduction to Infection Biology** • Definition and importance of infection biology. • Types of pathogens: Bacteria, viruses, fungi, protozoa, and parasites. • Impact of infectious diseases on society and agriculture (including historical perspective).	12
Unit II	**Host-Pathogen Interactions in Human infectious diseases** • Mechanisms of pathogenesis: adherence, invasion, and evasion of host defenses. • Overview of diseases caused by: *Mycobacterium tuberculosis*, HIV, *Plasmodium sp., Candida albicans.* • Transmission of human infectious diseases.	12

Unit III	**Host-Pathogen Interactions in Plant infectious diseases** • Mechanisms of plant pathogenesis: penetration, colonization, and suppression of plant defenses. • Overview of diseases caused by: *Phytophthora infestans*, Tobacco Mosaic Virus (TMV), *Ralstonia solanacearum.* • Transmission of infectious diseases of plants.	12
Unit IV	**Disease Development and Progression** • Stages of disease development: incubation period, prodromal phase, acute phase, and convalescence. • Key definitions related to disease biology: Pathogenicity, Virulence, Epidemiology, Disease outbreak, Carrier, and Concept of Disease triangle	12
Unit V	**Diagnosis, Prevention, and Control of Infectious Diseases** • Diagnostic techniques in humans: culture methods, serology, and molecular diagnostics. • Diagnostic techniques in plants: visual inspection, biochemical tests, and molecular diagnostics. • Vaccination, pathogen resistant plant varieties, biocontrol.	12

Recommended Readings:

- Molecular Infection Biology: Interactions Between Microorganisms and Cells; Edited by: by Jörg Hacker & Jürgen Heesemann; Published by: Wiley-Spektrum; ISBN-10: 0471178462; ISBN-13: 978-0471178460
- Molecular Biology of the Cell. 4th edition. By: Alberts B, Johnson A, Lewis J, et al. Published by: New York: Garland Science; ISBN-10. 0815332181 · ISBN-13. 978-0815332183.

Latest edition of the text books should be used.

Suggested Continuous Evaluation Methods: Students can be evaluated through class participation, group discussion, group projects, presentations, and practical knowledge assessment to ensure comprehensive and regular learning. Additionally, they can be routinely evaluated through quizzes, assignments and class-tests etc.

Suggested equivalent online courses: NPTEL, Swayam, Vidyamitra.inflibnet.ac.in, ePG-pathshala, egyankosh.ac.in, https://ocw.mit.edu/ etc.

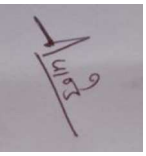
DISCIPLINE SPECIFIC ELECTIVE (DSE) – EXPERIMENTAL BIOTECHNIQUES-VII				
No. of Hours-60				
CREDIT DISTRIBUTION, ELIGIBILITY AND PRE-REQUISITES OF THE COURSE				
		Credit distribution of the Course	**Eligibility**	**Pre-requisite of**

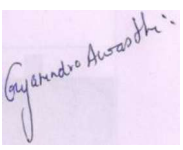
Course Title	Credits	Lecture	Tutorial	Practical/Practice	criteria	the Course (if any)
DSE EXPERIMENTAL BIOTECHNIQUES-VII	**4**	**0**	**1**	**3**	**PG diploma /UG honors with research**	**Nil**
Course: DSE			**Course Title: EXPERIMENTAL BIOTECHNIQUES-VII**			
Max. Marks: As per Univ. rules			**Min. Passing Marks: As per Univ. rules**			

Course Outcome(s):
The course will enable the students to learn the:

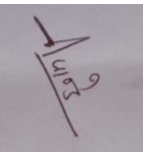
- Experiments related to handling, identification and characterization of microorganisms
- Familiarization of equipments used in Microbiological laboratory, safety precautions, Microscopy
- Preparation of culture media
- Understand the nutritional needs of microbes dehydrated-selective differential autotrophic / heterotrophic microbes
- Isolation of pure microbial flora from natural and extreme environments
- Biochemical characterization of bacteria

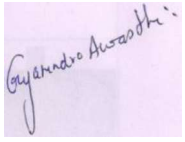
Unit	Topic	No. of Hours
Unit I	**Plant Biotechnology Practicals** • Introduction to SOPs of PTC related equipment's: Laminar air flow cabinet, tissue culture room, autoclave, green-house, biological grade water purification • Sterilization techniques in PTC • Media Preparation • Explant selection and sterilization • Callus induction • Induction of rooting and shooting	**30**





Unit II	**Genetic Engineering Practicals** • Preparation of plasmid DNA from E.coli and gel analysis. • Restriction digestion of vector (gel analysis) with Restriction endonucleases • Transformation in E.coli • Plasmid isolation and confirming recombinant by PCR and RE digestion. • PCR amplification of bacterial/plant/animal-cell genomic region and analysis by agarose gel electrophoresis. • Protein separation and visualization by SDS-PAGE.	**30**





SUGGESTED READINGS:

- Parija, Subhash Chandra. Textbook of Practical Microbiology. New Delhi: Ahuja Publishing House.
- Cappuccino, Jeanne G., and Natalie Sherman. Microbiology: A Laboratory Manual. 11th ed. San Francisco: Pearson, 2017.
- Benson, Harold J. Microbiological Applications: A Laboratory Manual in General Microbiology. 10th ed. New York: McGraw-Hill, 2002.
- Ananthanarayan, R., and C.K. Jayaram Paniker. A Textbook of Microbiology. 10th ed. New Delhi: Universities Press, 2013.

Suggested Continuous Evaluation Methods: Students can be evaluated through class participation, group discussion, group projects, presentations, and practical knowledge assessment to ensure comprehensive and regular learning. Additionally, they can be routinely evaluated through quizzes, assignments and class-tests etc.

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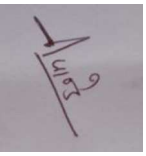
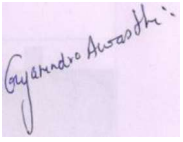




GENERIC ELECTIVES (GE) : Bioprocess Engineering and Technology						
No. of Hours-60						
CREDIT DISTRIBUTION, ELIGIBILITY AND PRE-REQUISITES OF THE COURSE						
Course Title	**Credits**	**Credit distribution of the Course**			**Eligibility criteria**	**Prerequisite of the Course (if any)**
		Lecture	**Tutorial**	**Practical/Practice**		
GE: Bioprocess Engineering and Technology	**4**	**3**	**1**	**0**	**PG diploma /UG honors with research**	**Nil**
Course: GE			**Course Title: Bioprocess Engineering and Technology**			
Max. Marks : As per Univ. rules			**Min. Passing Marks: As per Univ. rules**			

Course Outcomes:

After completing this course the students will be able to:

- To learn the basics of different types of fermentors and its accessories.
- Learning sterilization procedures, practical aspects of microbial growth kinetics, production kinetics, and inhibition models, types of bioreactor, its configurations and operation modes based upon the nature of natural products.
- To solve problems and seek practical solutions for large scale implementation.

Unit	Topic	No. of Hours
Unit I	**Basic principle of Biochemical engineering** Isolation, screening and maintenance of industrially important microbes; Microbial growth; Strain improvement for increased yield and other desirable characteristics.	12
Unit II	**Concepts of basic mode of fermentation processes** Bioreactor designs; Types of fermentation and fermenters; Concepts of basic modes of fermentation – Batch, fed batch and continuous; Conventional fermentation v/s biotransformation; Solid substrate, surface and submerged fermentation; Fermentation media; Measurement and control of bioprocess parameters; Scale up and scale down process.	12

Unit III	**Downstream processing** Bioseparation- filtration, centrifugation, sedimentation, flocculation; Cell disruption; Storage and packaging; Treatment of effluent and its disposal.	12
Unit IV	**Applications of enzymes in food processing** Mechanism of enzyme function and reactions in process techniques; Enzymic bioconversions e.g. starch and sugar conversion processes; High-Fructose Corn Syrup; Production, recovery and scaling up of enzymes and their role in food and other industries; Immobilization of enzymes and their industrial applications.	12
Unit V	**Applications of Microbes in food process operations and production** Fermented foods and beverages; Food ingredients and additives prepared by fermentation and their purification; fermentation as a method of preparing and preserving foods; Microbes and their use in pickling, producing colors and flavors, alcoholic beverages and other products; Process wastes-whey, molasses, starch substrates and other food wastes for bioconversion to useful products; Bacteriocins from lactic acid bacteria – Production and applications in food preservation.	12

Recommended Readings:

1. Stanbury P F and Whitaker, A. (2010). Principles of Fermentation Technology. Oxford: Pergamon Press
2. Shuler M L and Kargi F. (2002). Bioprocess Engineering: Basic Concepts. Upper Saddle River, NJ: Prentice Hall.
3. Glazier AN and Nikaido H (2007).Microbial Biotechnology – Fundamental & Applied Microbiology – Second Edition. Cambridge University Press.
4. Casida LE (2019) Industrial Microbiology. Second Edition, New Age International Publisher.
5. Bailey J E and Ollis D F. (1986). Biochemical Engineering Fundamentals. New York: McGraw-Hill.

Note-Latest edition of the text books should be used.

Suggested Continuous Evaluation Methods: In addition to the theoretical inputs the course will be delivered through Assignments, Presentation, Group Discussions.etc

Suggested equivalent online courses: Swayam,Vidyamitra.inflibnet.ac.in, nptel.ac.in literature study-online.com, epg-pathshala, egyankosh.ac.in

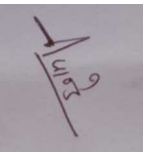
GENERIC ELECTIVE (GE) - Biodiversity Conservation						
No. of Hours-60						
CREDIT DISTRIBUTION, ELIGIBILITY AND PRE-REQUISITES OF THE COURSE						
Course Title	**Credits**	**Credit distribution of the Course**			**Eligibility criteria**	**Pre-requisite of the Course (if any)**
		Lecture	**Tutorial**	**Practical/Practice**		
GE-Biodiversity Conservation	**4**	**3**	**1**	**0**	PG diploma /UG honors with research	**Nil**
Course: GE		**Course Title: Biodiversity Conservation**				
Max. Marks: As per Univ. rules		**Min. Passing Marks: As per Univ. rules**				

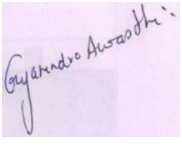
Course Outcome(s):

The course will enable the students to:

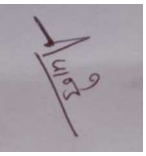
- Will be able to define biodiversity, distinguish its genetic, species, and ecosystem components, and understand its ecological, social, and economic significance.
- Students will understand the significance of in-situ and ex-situ conservation methods, restoration ecology, community-based initiatives, and current regulations at national and international levels.
- Students will be able to design and execute biodiversity surveys
- Students will relate biotechnological tools (e.g., DNA barcoding, molecular markers) to conservation challenges and propose sustainable solutions.

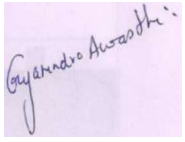
Unit	Topic	No. of Hours
Unit I	**Introduction to Biodiversity and Its Significance** • Definition, levels, and measures of biodiversity (genetic, species, ecosystem) • Values of biodiversity: ecological, genetic, social, economic, ethical, aesthetic • Biodiversity hotspots—global and Indian context • Current status and patterns of biodiversity: local, national, global	**12**
Unit II	**Threats to Biodiversity** • Causes and consequences: habitat destruction, fragmentation, invasive species, overexploitation, pollution, climate change • Endangered and extinct species—case studies of regional plants (*Meizotropis pellita*, *Saussurea obvallata*) • Effects of loss of biodiversity on ecosystem functioning	**12**





Unit III	**Conservation Strategies and Approaches** • In-situ conservation: protected areas, national parks, wildlife sanctuaries, biosphere reserves • Ex-situ conservation: botanical gardens, seed banks, gene banks, captive breeding, tissue culture, cryopreservation • Restoration ecology and rewilding	**12**
Unit IV	**Biodiversity Documentation, Monitoring, and Policy** • Methods of biodiversity assessment and monitoring: quadrats, transects, remote sensing, GIS • IUCN Red List categories and criteria • National and international conservation policies: Overviews of Indian Wildlife Protection Act, Forest Conservation Act, Biodiversity Act • Community participation and traditional conservation practices	**12**
Unit V	**Biodiversity, Biotechnology, and Sustainable Development** • Role of biotechnology in conservation: DNA barcoding, molecular markers, species diagnosis, conservation genetics • Bioprospecting and access–benefit sharing • Case studies in restoration, sustainable utilization, and commercial conservation (ecotourism, NTFPs) • Significance of conservation education and outreach	**12**





SUGGESTED READINGS:

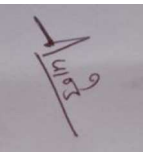
- Primack, Richard B. Essentials of Conservation Biology. 7th ed. Sunderland, MA: Sinauer Associates, 2024.
- Krishnamurthy, K. V. An Advanced Textbook on Biodiversity: Principles and Practice. 3rd ed. New Delhi: Oxford & IBH Publishing, 2020.
- Groom, Martha J., Gary K. Meffe, and C. Ronald Carroll. Principles of Conservation Biology. 4th ed. Sunderland, MA: Sinauer Associates, 2022.
- Singh, J. S. Ecology, Environmental Science and Conservation. 2nd ed. New Delhi: S. Chand Publishing, 2021.

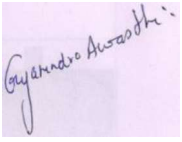
Suggested Continuous Evaluation Methods: Students can be evaluated through class participation, group discussion, group projects, presentations, and practical knowledge assessment to ensure comprehensive and regular learning. Additionally, they can be routinely evaluated through quizzes, assignments and class-tests etc.

Suggested equivalent online courses: Swayam, Vidyamitra.inflibnet.ac.in, ePG-pathshala, egyankosh.ac.in, https://ocw.mit.edu/, NPTEL etc.

SEMESTER X

DISCIPLINE SPECIFIC CORE - Molecular Genetics						
No. of Hours-60						
CREDIT DISTRIBUTION, ELIGIBILITY AND PRE-REQUISITES OF THE COURSE						
Course Title	Credits	Credit distribution of the Course			Eligibility criteria	Pre-requisite of the Course (if any)
		Lecture	Tutorial	Practical/Practice		
DSC-22 Molecular Genetics	4	3	1	0	PG diploma /UG honors with research	Nil
Course: DSC-22		Course Title: Molecular Genetics				
Max. Marks: As per Univ. rules		Min. Passing Marks: As per Univ. rules				



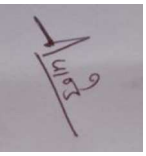


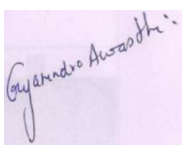
Course Outcome(s):

The course will enable the students to:

- Learn basic concepts in molecular genetics.
- Explain genetic inheritance, discuss chromosome organization and sex determination so that students are able to relate genetic makeup of different organisms.
- Understand the relationship between mutation and evolution.

Unit	Topic	No. of Hours
Unit I	**Bacterial Mutants and mutations** Types of mutations (base pair changes; frameshift; insertions; deletion; tandem duplication); Reversion vs. suppression; Mutagenic agents; Molecular Mechanisms of mutagenesis; Assay of mutagenic agents (Ames test) **Gene transfer in bacteria** History; Transduction- generalized and specialized; Conjugation- F, F', HFr; F transfer; Hfr- mediated chromosome transfer; Transformation- natural and artificial transformation; Transposable genetic elements; Insertion sequences; Composite and Complex transposons; Replicative and non-replicative transposition.	**15**
Unit II	**Bacteriophages and Plasmids** Bacteriophage-structure; Lambda phage – genetic map, lysogenic and lytic cycles; Gene regulation; Plasmids – natural plasmids; their properties and phenotypes; Plasmid biology – copy number and its control; Incompatibility; Plasmid survival strategies; Antibiotic resistance markers on plasmids (mechanism of action and resistance).	**15**
Unit III	**Mendelian Genetics** Introduction to human genetics; Background and history; Types of genetic diseases; Human pedigrees; Autosomal dominant; X linked inheritance; Complicating factors – incomplete penetrance; variable expression; Multiple alleles; Co dominance; Sex influenced expression. **Non Mendelian inheritance patterns** Mitochondrial inheritance; Genomic imprinting; Lyon hypothesis; iso disomy; Complex inheritance-genetic and environmental variation;	**15**
Unit IV	**Gene mapping and human genome project** Physical mapping; linkage and association **Population genetics and evolution** Phenotype; Genotype; Gene frequency; Hardy Weinberg law; Factors distinguishing; Hardy Weinberg equilibrium; Mutation selection; Migration; Gene flow; Genetic drift.	**15**



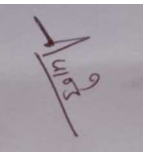


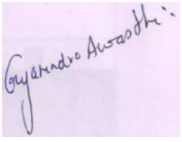
SUGGESTED READINGS:

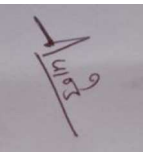
1. Pörtner, R. (2007). Animal Cell Biotechnology: Methods and Protocols. Totowa, NJ: HumanaPress
2. Singh B. Gautam SK (2013). Textbook of animal biotechnology. The Energy and Resources Institute,TERI
3. Gupta PK. (2018) Animal Biotechnology. Rastogi Publications

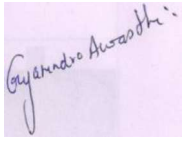
Suggested Continuous Evaluation Methods: Students can be evaluated through class participation, group discussion, group projects, presentations, and practical knowledge assessment to ensure comprehensive and regular learning. Additionally, they can be routinely evaluated through quizzes, assignments and class-tests etc.

Suggested equivalent online courses: Swayam, Vidyamitra.inflibnet.ac.in, ePG-pathshala, egyankosh.ac.in, https://ocw.mit.edu/, NPTEL etc.









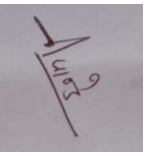
Discipline Specific Elective (DSE) – Molecular Virology						
No. of Hours-60						
CREDIT DISTRIBUTION, ELIGIBILITY AND PRE-REQUISITES OF THE COURSE						
Course Title	**Credits**	**Credit distribution of the Course**			**Eligibility criteria**	**Pre-requisite of the Course (if any)**
		Lecture	**Tutorial**	**Practical/Practice**		
DSE- Molecular Virology	**4**	**3**	**1**	**0**	PG diploma /UG honors with research	**Nil**
Course: DSE		**Course Title: Molecular Virology**				
Max. Marks: As per Univ. rules		**Min. Passing Marks: As per Univ. rules**				

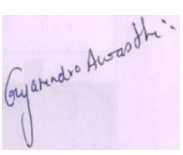
Course Outcome(s):

The course will enable the students to:

- Learn structural and genomic organization of different animal and plant viruses.
- Enable students to take up research in challenging and evolving areas of virology, such as effective diagnostic and treatment of viral infections in plants and animals.

Unit	Topic	No. of Hours
Unit I	Structure of animal viruses and plant viruses; Classification of animal and plant viruses; Satellite viruses; Viroids; Virusoids, Prions etc.; Transmission of Viruses; Vectors for Virus transmission, Cell to cell and systemic movement of viruses. Impact of Viruses on Health and Economy: (Diseases causes by animal viruses and plant viruses; Economic loss due to important viruses); Bacterial Viruses: Lysogenic and Lytic Phages, Bacteriophage Typing.	**12**
Unit II	General Genomic organization of animal viruses; Replication and Life cycle of: Poliovirus, Human Immunodeficiency virus (HIV), Influenza Virus, Rabies Virus, Poxvirus, Herpesvirus and Hepatitis viruses; Introduction to Cancer causing viruses and their mechanism of host- cell transformation.	**12**
Unit III	General Genomic organization of plant viruses; Replication and Life cycle of plant viruses: Cauliflower Mosaic Virus (CMV), Tobacco Mosaic Virus (TMV), Rice Dwarf Virus, Citrus triesteza Virus.	**12**
Unit IV	Methods to diagnose animal virus infections: Electron microscopy, Tissue culture growth of viruses and Cytopathic effects, Virus quantitation assays, Viral serology: ELISA, neutralization assays; Molecular methods: hybridization, Real-time PCR, antiviral assays.	**12**
Unit V	Methods to study plant viruses; Infectivity assays – Sap transmission, insect vector transmission, agro infection (using Agrobacterium); serological methods, immune electrophoresis in gels, direct double-antibody sandwich method, Dot ELISA, Immuno sorbent electron microscopy(ISEM),Polymerase chain reaction; Gene silencing, and viral suppressors of gene silencing.	**12**

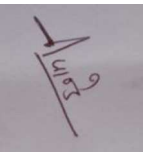


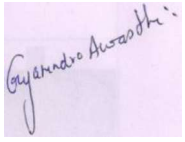


SUGGESTED READINGS:

Acheson, N. H. (2011). Fundamentals of molecular virology (No. Ed. 2). John Wiley & Sons, Inc.

Suggested Continuous Evaluation Methods: Students can be evaluated through class participation, group discussion, group projects, presentations, and practical knowledge assessment to ensure comprehensive and regular learning. Additionally, they can be routinely evaluated through quizzes,





assignments and class-tests etc.
Suggested equivalent online courses: Swayam, Vidyamitra.inflibnet.ac.in, ePG-pathshala, egyankosh.ac.in, https://ocw.mit.edu/, NPTEL etc.

DISCIPLINE SPECIFIC ELECTIVE (DSE) - Animal Biotechnology

No. of Hours-60

CREDIT DISTRIBUTION, ELIGIBILITY AND PRE-REQUISITES OF THE COURSE

Course Title	Credits	Credit distribution of the Course			Eligibility criteria	Pre-requisite of the Course (if any)
		Lecture	Tutorial	Practical/Practice		
DSE Animal Biotechnology	4	3	1	0	PG diploma /UG honors with research	Nil

Course: DSE	**Course Title: Animal Biotechnology**
Max. Marks: As per Univ. rules	**Min. Passing Marks: As per Univ. rules**

Course Outcome(s):
The course will enable the students to:

- Learning methods of gene manipulations in animal cells and embryonic stem cells for development of breeding and conservation approaches in animals.
- Lawfully consideration of the legal and ethical issues related to animal maintenance and experimental uses, that can generate best practices followed during maintenance of cell lines. Apply different recombinant DNA techniques to manipulate the genome of animal cells that can surely formulate ideas for the production of genetically modified organisms.
- Understand different approaches in reproduction technology which also utilize the concept of molecular techniques involved in animal conservation.

Unit	Topic	No. of Hours
Unit I	**Animal cell culture** History of animal cell culture; Basic requirements for animal cell culture; Cell culture media and reagents; Animal cell, tissue and organ cultures; Primary culture, secondary culture; Continuous cell lines; Suspension cultures; Transfection and transformation of cells; Stem cells and their application; Induced Pluripotency, Application of animal cell culture for in vitro testing of drugs; Application of cell culture technology in production of pharmaceutical proteins.	12
Unit II	**Animal health Biotechnology** Recombinant approaches to vaccine production; Hybridoma technology; Phage display technology for production of antibodies; Antigen-antibody based diagnostic assays including radioimmunoassay and ELISA; Immunoblotting; Nucleic acid based diagnostic methods including nucleic acid probe hybridization; PCR, Real time PCR; Branched DNA technology.	12

Unit III	**Animal Reproductive Biotechnology** Cryopreservation of sperms and ova of livestock; Artificial insemination; Superovulation; *in-vitro* fertilization; Culture of embryos; Cryopreservation of embryos; Embryo transfer; Micromanipulation of animal embryos; Transgenic animal technology and its different applications; Different methods of Transgenic animal production; Targeted gene transfer. Animal cloning-basic concepts; Cloning from embryonic cells and adult cells; Ethical, social and moral issues related to cloning; in situ and ex situ preservation of germplasm.	**12**
Unit IV	**Animal genomics** Introduction to animal genomics; Different methods for characterization of animal genomes, SNP, STR, RFLP, RAPD. Genetic basis for disease resistance; Gene knock out technology and animal models for human genetic disorders.	**12**
Unit V	**DNA Forensics** Immunological and nucleic acid based methods for identification of animal species; DNA Barcoding; Detection of adulteration in meat using DNA based methods; Detection of food/feed adulteration with animal protein; Identification of wild animal species using DNA based methods; Microbial forensics; Bioterror agents; Biocrimes and Bioterrorism.	**12**

SUGGESTED READINGS:

1. Pörtner, R. (2007). Animal Cell Biotechnology: Methods and Protocols. Totowa, NJ: HumanaPress
2. Singh B. Gautam SK (2013). Textbook of animal biotechnology. The Energy and Resources Institute,TERI
3. Gupta PK. (2018) Animal Biotechnology. Rastogi Publications

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DISCIPLINE SPECIFIC ELECTIVE (DSE) - Genomics and Proteomics				
No. of Hours-60				
CREDIT DISTRIBUTION, ELIGIBILITY AND PRE-REQUISITES OF THE COURSE				
		Credit distribution of the Course	**Eligibility**	**Pre-requisite of**

Course Title	Credits	Lecture	Tutorial	Practical/Practice	criteria	the Course (if any)
DSE Genomics and Proteomics	**4**	**3**	**1**	**0**	**PG diploma /UG honors with research**	**Nil**

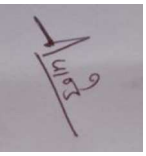
Course: DSE	**Course Title: Genomics and Proteomics**
Max. Marks: As per Univ. rules	**Min. Passing Marks: As per Univ. rules**

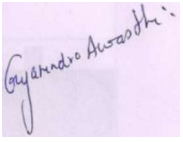
Course Outcome(s):

The course will enable the students to:

- Develop a foundation in the fundamental principles of genomics and Proteomics with the biological importance of protein-protein interaction, modeling and protein database, and their clinical relevance by apply different methods available to study DNA and RNA sequence analyses and to evaluate available genomic data to provide new insights in the fields of functional genomics.
- Study various available data relating to Human Genome Project, with SNP and miRNA techniques using specific databases and bioinformatics tools.

Unit	Topic	No. of Hours
Unit I	**Introduction** Structural organization of genome in prokaryotes and eukaryotes; organelle DNA –mitochondrial, chloroplast; DNA sequencing-principles and translation to large scale projects; Recognition of coding and non-coding sequences and gene annotation; Tools for genome analysis-RFLP, DNA fingerprinting, RAPD, PCR.	**12**
Unit II	**Genome sequencing projects** Brief overview of progress in Genomics of Microbes, plants and animals; Accessing and retrieving genome project information from web; Comparative genomics (Comparing related sequences retrieved from database(s)), Identification and classification of organisms using molecular markers-16S rRNA typing/sequencing, ESTs and DNA-barcode regions.	**12**
Unit III	**Proteomics** Protein analysis (includes measurement of concentration, amino-acid composition, N-terminal sequencing); 2-D electrophoresis of proteins; Micro scale isoelectric focusing in solution, Peptide fingerprinting; LC/MS-MS for identification of proteins and modified proteins; MALDI-TOF; Differential display proteomics, Methods of studying Protein-protein interactions: GST Pull-down assay, Co-immunoprecipitation, Yeast two-hybrid system.	**12**

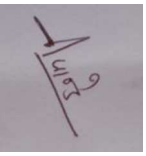


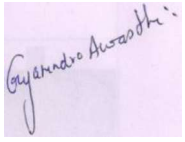


Unit IV	**Pharmacogenomics:** High throughput screening in genome for drug discovery; Identification of Drug- targets, Pharmacogenomics and drug development; Gene-therapy.	**12**
Unit V	**Functional genomics and proteomics** Approaches of analysis of cDNA microarray data; Protein and peptide microarray-based technology; PCR-directed protein in situ arrays (PISA), DNA array to protein array (DAPA).	**12**

SUGGESTED READINGS:

1. Sangeetha, J. (2015). Genomics and Proteomics: Principles, Technologies, and Applications.
2. Genes IX by Benjamin Lewin, Johns and Bartlett Publisher,2006.
3. Modern Biotechnology, 2nd Edition, S.B. Primrose, Blackwell Publishing,1987.
4. Molecular Biotechnology: Principles and Applications of Recombinant DNA, 4th Edition, B.R. Glick, J.J. Pasternak and C.L. Patten,2010.





5.Molecular Cloning: A Laboratory Manual (3rd Edition) Sambrook and Russell Vol. I to III, 1989.
6.Principles of Gene Manipulation 6th Edition, S.B.Primrose, R.M.Twyman and R.W. Old. Blackwell Science,2001.
7.Klug, W.S., Cummings, M.R., Spencer, C.A. (2009). Concepts of Genetics. IX Edition. Benjamin Cummings. 4. Russell, P. J. (2009). Genetics- A Molecular Approach. III Edition. Benjamin Cummings.
8.Glick, B.R., Pasternak, J.J. (2003). Molecular Biotechnology- Principles and Applications of recombinant DNA. ASM Press, Washington.
9.Pevsner, J. (2009). Bioinformatics and Functional Genomics. IIEdition. John Wiley & Sons.

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GENERIC ELECTIVE COURSE (GE) – FORENSIC BIOLOGY TECHNIQUES

No. of Hours-60

CREDIT DISTRIBUTION, ELIGIBILITY AND PRE-REQUISITES OF THE COURSE

Course Title	Credits	Credit distribution of the Course			Eligibility criteria	Pre-requisite of the Course (if any)
		Lecture	Tutorial	Practical/Practice		
GE: Forensic Biology Techniques	4	3	1	0	PG diploma /UG honors with research	Nil

Course: GE	**Course Title: Forensic Biology Techniques**
Max. Marks: As per Univ. rules	**Min. Passing Marks: As per Univ rules**

Course Outcomes:

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

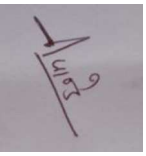
- Understand the basics of forensic science and its scope in research.
- Students will learn about the importance of biological evidence in crime scene investigation.
- Students will learn scientific methods and techniques to analyze biological evidence, such as blood, DNA, and other body fluids.
- Students will be able to apply scientific methods and techniques to analyze bone, hair, and teeth to determine the age, sex, and stature.

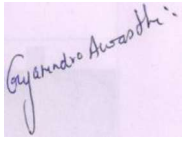
Unit	Topic	No. of Hours
Unit I	Forensic Biology: Introduction, Scope, Biological evidence to aid legal investigations, Characteristics of Blood and Physiological Fluids (Semen, Saliva, Urine, and Other), Identification of blood and Physiological Fluids by biochemical and immunological methods	15
Unit II	Techniques used to analyze biological evidence: PCR, Microscopy, Blood Typing, Chromatography, Enzyme-Linked Immunosorbent Assay (ELISA)	15
Unit III	Hair Examination, Structure of hair, Growth and chemistry of hair, Identification and comparison of hair by microscopic, chemical, biochemical and instrumental methods, Analysis of drugs and elements in hair, DNA typing of hair, Forensic significance in identification.	15
Unit IV	Human osteology: Determination of age, sex, stature, Pathology of bones and its importance in identification, Identification of burnt bones, skeletal remains in accidents, crimes and mass disaster. Forensic Odontology: Structure and types of teeth, Dentition and dental formula, Dental diseases, Determination of age, sex and race from teeth, Role of teeth in mass disaster, Forensic significance in identification	15

Recommended Readings:

1. Robertson, J., ed: Forensic Examination of Fibres. Chichester, West Sussex, England: Ellis Horwood Ltd., (1992)
2. Saferstein, Richard: Criminalistics. An Introduction to Forensic Science, 5thed., Prentice Hall, 1998
3. Robertson, J: Forensic Examination of Hair. Taylor and Francis. (1999)
4. Saferstein, R: Handbook of Forensic Science (Vol 1,2,3)
5. Eckert: An Introduction to Forensic Science
6. Kirk, P: Criminal Investigation, Interscience, 1953
7. James, S. H. and Nordby, J. J: Forensic Science: An Introduction to Scientific and Investigative Techniques, CRC Press, 2003 & 2005
8. Siegel, J. A., Sukoo, R. J, and Knupfer, G. C: Encyclopedia of Forensic Science, Vol I, II and III, Academic Press, 2000.
9. Becker, R. F: Criminal Investigation, Aspen Pub., 2000.
10. Lee, H: Physical Evidence, Elsevier, 2000
11. The Wild Life Protection Act, 1972., Universal Law Publishing
12. Pillay, V.V: Handbook of Forensic Medicine and Toxicology, 12thed., Paras Publication2001.
13. Smith, D.G.V: A Manual of Forensic Entomology and Death: A Procedural Guide, Joyce's Publications (1990)

Suggested Continuous Evaluation Methods: In addition to the theoretical inputs, the course will be delivered through assignments, presentation, and group discussions. This will instill in student a sense of decision making and practical learning.





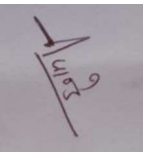
GENERIC ELECTIVE COURSE (GE)–Climate Change and Sustainable Development						
No. of Hours-60						
CREDIT DISTRIBUTION, ELIGIBILITY AND PRE-REQUISITES OF THE COURSE						
Course Title	Credits	Credit distribution of the Course			Eligibility criteria	Pre-requisite of the Course (if any)
		Lecture	Tutorial	Practical/Practice		
GE: Climate change and sustainable development	4	3	1	0	PG diploma /UG honors with research	Nil
Course: GE		Course Title: Climate change and sustainable development				
Max. Marks: As per Univ. rules		Min. Passing Marks : As per Univ. rules				

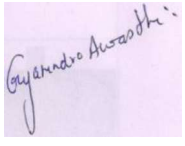
Course Outcomes:

After completing this course, the students will be able to

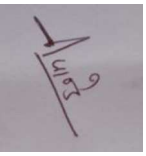
- Gain insight about climate change and its affects on human race, environmental laws and policies.
- To evaluate where we stand and what we can do to reverse the process of climate change to reduce worsening of the present scenario.
- To relate and use latest technologies like AI and drones for monitoring the environmental processes.
- Role of green and circular economy for betterment of the countries environmental conditions.

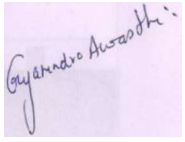
Units	Topic	No. of Hours
Unit I	**Introduction**: Concept of climate change, its root causes, impacts on environment and society. International and National Environmental policies and laws, organizations and programs for the betterment of the planet.	12
Unit II	**Global warming-**,Greenhouse gases, first climate model, the atmosphere and its structure. carbon capture and storage, carbon taxation. carbon and nitrogen cycles. global primary energy. green and clean sources of energy for the future.	12
Unit III	**Climate change and AI-**Monitoring and analyzing the various factors related to climate change (average temperature rise, rainfall etc).Use of drones for real time analysis. monitoring biodiversity and its losses. Data management and processing related to climate.	12





Unit IV	**Environment, Climate Change and Health-** Air quality, Chemicals, radiation, solid waste Most important exposures, health impacts and actions/interventions/policies on chemicals, radiation and solid waste including electronic waste. Health hazards due to various activities by humans in the era of development. Planetary health and future.	12
Unit V	**Climate education and sustainable development-**Concept of mitigation and adaptation, Bioremediation, principles and practices for sustainable development, conservation of biodiversity. idea of green economy and circular economy. risks from disasters and management .ESG	12





Recommended Readings:

- Climate Change: Changing Dimensions of Law And Policy by Stelina jolly and Amit Jain.
- Global Warming in 21st Century: Causes, Effects and Future by K.K.Singh
- AI for climate change and environmental sustainability by Sunita Satpathy, Nidhi Agarwal and Satyasundar Mahapatra

Note-**Latest edition of the text books should be used.**

Suggested Continuous Evaluation Methods: In addition to the theoretical inputs the course will be delivered through Assignments, Presentation, Group Discussions. This will instill in student a sense of decision making and practical learning.

Suggestedequivalentonlinecourses:OnSwayam,Vidyamitra.inflibnet.ac.in,literature- study-online.com, epg-pathshala, egyankosh.ac.in