(Bachelor of Science)
(B.Sc) (Biotechnology) Semester VI

Course Code	US06CBIT51	Title of the Course	Environmental Biotechnology
Total Credits of the Course	4	Hours per Week	4

Course Objectives:	To bring an enthusiasm on environmental protection and it should give the contribution of biotechnology techniques to keep the environment clean and healthy. To highlight on the economic aspects in the application of biotechnology in protecting the environment from pollution. To aquaint students to various wastewater treatment processes to improve quality of waste water. To teach students measurement of water pollution. To familiarize students to Biosensors

Course Content		
Unit	Description	Weightage* (%)
1.	Pollution- Definition & types, Xenobiotic compounds in the environment, Biomagnification, Global environmental problems- The Greenhouse effect, Ozone depletion & Acid Rain,Nuclaer waste and its impact, Air pollution and its control measure	25%
2.	Microbiology of waste water treatment, Measurement of pollutant (BOD, COD, TOC, Acidity, Alkalinity & bacterial measurement) of wastewater , Treatment of waste water:- aerobic process - activated sludge, oxidation ponds, trickling filter, rotating discs. Anaerobic process - anaerobic digestion, anaerobic filters. Treatment schemes for waste waters of dairy and tannery industries	25%
3.	Biodegradation – Definition, Mechanism , Biodegradation of Aromatic hydrocarbon & n-alkanes. Bioremediation (Microbial & phytoremediation) Bioleaching - General properties of microorganisms involved in it. Type, Mechanism, factors affecting the process of bioleaching ,Copper bioleaching	25%
4.	Biosensor: types, principle, applications and limitations. Bioplastic Introduction, technology and applications, Biofertilizer (Microorganisms used as biofertilizers) , Biomethanation- Production & factors affecting biogas yield, Biofuel- Production & advantages,	25%

Teaching-Learning Methodology	Class room lectures and use of chalk & blackboard. ICT tools involving smart boards, power point presentations,videos, animations &models.

Evaluation Pattern		
Sr. No.	Details of the Evaluation	Weightage
1.	Internal Written / Practical Examination (As per CBCS R.6.8.3)	15%
2.	Internal Continuous Assessment in the form of Practical, Viva-voce, Quizzes, Seminars, Assignments, Attendance (As per CBCS R.6.8.3)	15%
3.	University Examination	70%

Course Outcomes: Having completed this course, the learner will be able to	
1.	Recognize the global environmental concerns
2.	Understand the process of wastewater treatment and control measures of air pollution
3..	Understand the principle and application of Biosensor
4.	Understand the role of microorganism in reducing pollution and extraction of metals.
5.	Explain the importance of biofertilizer, biomethanation, biofuel

Suggested References:	
Sr. No.	References
1.	Environmental pollution control engineering - C S Rao
2.	Industrial microbiology - Whitaker
3	Industrial microbiology - A H Patel
4.	Biotechnology- Expanding horizon- B.D Singh

5.	A text book of biotechnology – R C Dubey
6.	Environmental biotechnology –Indu Shekhar Thakur
7.	Biotechnology – U Satyanarayan

On-line resources to be used if available as reference material
On-line Resources

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((Bachelor of Science)
(B.Sc) (Biotechnology) Semester VI

Course Code	US06CBIT52	Title of the Course	Fermentation Technology
Total Credits of the Course	4	Hours per Week	4

Course Objectives:	1. To understand the Basic concept of Fermentation technology. 2. To understand Fermentation Products used for human welfare. …

Course Content		
Unit	Description	Weightage* (%)
1.	Introduction to fermentation, chronological development of fermentation industries, ranges of fermentation Process, Introduction to Batch, Fed-batch and continuous fermentation process. Ideal characteristic of Production strain, Screening (Primary and secondary), Concepts of strain improvement (mutation, Recombination ,R-DNA technology), Preservation of strain (storage of reduced temperature, storage in dehydrated form).	25
2.	Inoculum development, Production Media (synthetic and crude) , Raw material used as Production Media (Carbon and Nitrogen sources). Sterilization of Production Media. Definition of fermentor and bioreactor, Characteristic and design of ideal fermenter (fabrication, agitation aeration sampling). Types of fermentor (CSTF, Tower fermenter, Air lift fermenter).	25
3.	Downstream processing: introduction to downstream processing, Recovery Process- Filtration, precipitation, Centrifugation, cell disruption, solvent recovery. Brief introduction to Disposal of effluents. Microbial Assay (growth factors and growth inhibitor) Introduction to Scale up and scale down. Concept of fermentation Economics.	25
4.	Production- Antibiotic (Penicillin), Solvent (ethanol), SCP (yeast), Dairy product (Cheese), Beverage (Beer), Spoilage and preservation of food. Biotransformation. Introduction to Probiotics.	25
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Teaching-Learning Methodology	

Evaluation Pattern		
Sr. No.	Details of the Evaluation	Weightage
1.	Internal Written / Practical Examination (As per CBCS R.6.8.3)	15%
2.	Internal Continuous Assessment in the form of Practical, Viva-voce, Quizzes, Seminars, Assignments, Attendance (As per CBCS R.6.8.3)	15%
3.	University Examination	70%

Course Outcomes: Having completed this course, the learnerwill be able to	
1.	
2.	
3.	
…	

Suggested References:	
Sr. No.	References
1.	Principles of Fermentation technology , whittaker & Stanbury
2.	Industrial Microbiology , L E J R Casida
3	Industrial Microbiology , A H Patel

On-line resources to be used if available as reference material
On-line Resources
Nptel.ac.in
inflibnet

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((Bachelor of Science)
(B.Sc) (Biotechnology) Semester VI

Course Code	US06CBIT53	Title of the Course	Development Biology
Total Credits of the Course	4	Hours per Week	4

Course Objectives:	Be familiar with the events that lead up to and comprise the process of gametogenesis and fertilization To understand the concept of early embryonic development To understand the types of eggs & extra embryonic membranes. To enhance their knowledge and develop their research interest in the field of developmental biology

Course Content		
Unit	Description	Weightage* (%)
1.	Definition, scope & historical perspective of development Biology, Gametogenesis , Parthenogenesis, Spermatogenesis, Oogenesis, Fertilization - Definition, mechanism, types of fertilization. Different types of eggs on the basis of yolk.	25%
2.	Cleavage: Definition, types, patterns & mechanism Morula & Blastulation: Process, types & mechanism Gastrulation: Morphogenetic movements– epiboly, emboly, extension, invagination, convergence, de-lamination. Formation & differentiation of primary germ layers, Fate Maps in early embryos.	25%
3.	Neurulation, notogenesis, extraembryogenic membranes of anamniotes & amniotes, characteristics of cleidoic egg, Feotal membranes, the amnion & chorion, the allantois, allantois of the chick, allantois in mammals, Yolk sac, origin of yolk sac, Yolk sac in frog, reptiles & birds, Yolk sac in mammals, Functional significance of foetal membranes.	25%

4.	Pattern of growth and development in plant , seed formation & germination, seed dormancy, Initiation and regulation of shoot apical meristem & root apical meristem, leaf development ,shoot branching, overview of plant growth regulators, Transition from vegetative to reproductive stage of flower development, floral whorl specification	25%

Teaching-Learning Methodology	Class room lectures and use of black/green/white board. ICT tools involving smart boards, power point presentations, videos, animations &models.

Evaluation Pattern		
Sr. No.	Details of the Evaluation	Weightage
1.	Internal Written / Practical Examination (As per CBCS R.6.8.3)	15%
2.	Internal Continuous Assessment in the form of Practical, Viva-voce, Quizzes, Seminars, Assignments, Attendance (As per CBCS R.6.8.3)	15%
3.	University Examination	70%

Course Outcomes: Having completed this course, the learner will be able to	
1.	Understand the process of Gametogenesis and Fertilization
2.	Explain early embryonic development
3.	Understand the types of eggs and extra embryonic membranes
4.	Explain various stages of plant development including embryogenesis, shoot, root and floral development.

Suggested References:	
Sr. No.	References
1.	Gilbert, S. F. (2006). Developmental Biology, VIII Edition, Sinauer Associates, Inc., Publishers, Sunderland, Massachusetts, USA.
2.	Balinsky, B.I. (2008). An introduction to Embryology, International Thomson Computer Press.
3	Embryology-M. P Arora
4	Plant physiology- Tiaz & Zeiger,Sinauer Associate Inc. Publisher
5	Biochemistry & Molecular biology of plants – Buchanan , Grussem & Jones ,ASPB publisher
6	Plant physiology- S.K Singh
7	A textbook of plant physiology, Biochemistry and Biotechnology-Dr. S.K Verma & Mohit Verma ,S. Chand

On-line resources to be used if available as reference material
On-line Resources
Nptel.ac.in
inflibnet

((Bachelor of Science)
(B.Sc) (Biotechnology) Semester VI

Course Code	US06CBIT54	Title of the Course	Applications of Biotechnology
Total Credits of the Course	4	Hours per Week	4

Course Objectives:	1. To educate the students in applications of agricultural and animal tissue culture 2. To teach the students scopes of bioethics and biosafety

Course Content		
Unit	Description	Weightage* (%)
1.	Agriculture biotechnology- modification of plant nutrition content, (golden rice), disease resistance (BT cotton), herbicide resistance plants as bioreactors, edible vaccine	25%
2.	Transformation and Evolution of continuous cell line. Hybridoma technology introduction and steps for construction of Hybridoma cell lines. Screening of Hybridoma cell lines. Methods for production of monoclonal antibodies through hybridoma cell lines and Genetic engineering. Introduction to transgenic animals-process to create transgenic animals and their application (mice). Introduction to nuclear transfer technology (Dolly sheep), Process to create knock-out mice and its significance.	25%
3.	Wildlife Conservation and management - the need for conservation – in situ conservation; Sanctuaries, National parks, biosphere reserves– ex-situ conservation, Zoological parks, gene banks and cryopreservation – Role of indigenous people in conservation – Sacred species, sacred groves; the role of remote sensing in biodiversity conservation; Biodiversity conservation – human-animal conflicts.	25%
4.	Biotechnology: risks &ethics: Biosafety: guidelines and regulations, intellectual property rights (IPR) and protection. Forms of protection – patents introduction, process and patenting strategies, significance of patent, Patenting of biological materials. Patenting status in India. A brief overview for copy rights, trade secrets and trademarks. Plant variety protection; World intellectual property organization (WIPO) general agreement on tariffs and trade (GATT) and trade related IPR (TRIPS).	25%

Teaching-Learning Methodology	Chalk board, Power point presentation,quizzes, Videos available on NPTEL and BISAG

Evaluation Pattern		
Sr. No.	Details of the Evaluation	Weightage
1.	Internal Written / Practical Examination (As per CBCS R.6.8.3)	15%
2.	Internal Continuous Assessment in the form of Practical, Viva-voce, Quizzes, Seminars, Assignments, Attendance (As per CBCS R.6.8.3)	15%
3.	University Examination	70%

Course Outcomes: Having completed this course, the learnerwill be able to	
1.	Understand about the methodologies and uses of various procedures used in Agricultural biotechnology
2.	Understand the applications of animal tissue culture and animal cloning
3.	Understand the need of biodiversity and biopreservation techniques
4.	Understand the bioethics of Biotechnology and various patenting laws and agencies controlling biotechnology in India.

Suggested References:	
Sr. No.	References
1.	Biotechnology- Expanding Hoirizon- B D Singh
2.	Culture of Animal Cell- Freshney
3	Text book of Biotechnology- R C Dubey
	Introduction to Plant Biotechnology- H.S.Chawla

On-line resources to be used if available as reference material
On-line Resources
Nptel.ac.in
SANDHAN BISAG you tube

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