Kavayitri Bahinabai Chaudhari

NORTH MAHARASHTRA UNIVERSITY, JALGAON (M.S.)

Final Year Engineering

(Biotechnology Engineering)

Faculty of Science and Technology

'A' Grade
NAAC Re-Accredited
3rd Cycle

SYLLABUS STRUCTURE

Semester – VII and VIII

W.E.F. 2021 – 22

Biotechnology Engineering

Syllabus Structure for Fourth Year Engineering (Semester – VII) (w.e.f. 2021 – 22)

Name of the Course	Group	Teaching Scheme				Evaluation Scheme					Credits
						Theory		Practical		Total	
		Theory Hrs / week	Tutorial Hrs / week	Practical Hrs / week	Total	ISE	ESE	ICA	ESE		
Bioinformatics	D	3	-	-	3	40	60	-	-	100	3
Professional Elective Course – III	E	3	-	-	3	40	60	-	-	100	3
Professional Elective Course – IV	E	3	-	-	3	40	60	-	-	100	3
Open Elective Course – III	F	3	-	-	3	40	60	-	-	100	3
LAB Bioinformatics	D	-	-	2	2	-	-	25	25(OR)	50	1
LAB Plant Tissue Culture	D	1	-	2	3	-	-	25	25(OR)	50	2
PROJECT (Stage-I)	G	-	-	12	12	-	-	50	50(OR)	100	6
Essence of Indian Traditional Knowledge		-	-	-	-	-	-	-	-	-	0
		13	**-**	**16**	**29**	**160**	**240**	**100**	**100**	**600**	**21**

ISE: Internal Sessional Examination **ESE: End Semester Examination** **ICA: Internal Continuous Assessment**

Professional Elective Course – III		Professional Elective Course – IV		Open Elective Course – III	
1	Crop Improvement	1	Analytical Methods in Biotechnology	1	Bioprocess Optimization and Plant Design
2	Structural Biology	2	Biochemical Engineering	2	Disaster Management
3	Computational Biology	3	Biosafety & Bioethics	3	Human Values and Professional Ethics
4	Biopharmaceuticals	4	Clinical Trials & Regulatory Affairs	4	Internet of Things

Biotechnology Engineering

Syllabus Structure for Fourth Year Engineering (Semester – VIII) (w.e.f. 2021 – 22)

Name of the Course	Group	Teaching Scheme				Evaluation Scheme					Credits
						Theory		Practical		Total	
		Theory Hrs / week	Tutorial Hrs / week	Practical Hrs / week	Total	ISE	ESE	ICA	ESE		
Bioprocess Industries	D	3	-	-	3	40	60	-	-	100	3
Professional Elective Course – V	E	3	-	-	3	40	60	-	-	100	3
Professional Elective Course – VI	E	3	-	-	3	40	60	-	-	100	3
Open Elective Course – IV	F	3	-	-	3	40	60	-	-	100	3
LAB Downstream Processing	D	2	-	2	4	-	-	25	25(OR)	50	3
LAB Bioprocess Industries	D	-	-	2	2	-	-	25	25(OR)	50	1
PROJECT	G	-	-	6	6	-	-	50	50(OR)	100	3
		14	**-**	**12**	**24**	**160**	**240**	**100**	**100**	**600**	**19**

ISE: Internal Sessional Examination **ESE: End Semester Examination** **ICA: Internal Continuous Assessment**

Professional Elective Course – V		Professional Elective Course – VI		Open Elective Course – IV	
1	Molecular Biology of Cancer	1	Genomics & Proteomics	1	Industrial Organization and Management
2	Molecular Modeling & Drug design	2	Introduction to Biomaterials	2	Bioenergy and Renewable Resources
3	Bioprocess Modeling & Simulation	3	Industrial Biotechnology	3	Agricultural Biotechnology
4	Biotechnology of Waste Treatment	4	Animal Biotechnology	4	Cyber Security

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SYLLABUS STRUCTURE

Semester – VII

W.E.F. 2021 – 22

Bioinformatics					
COURSE OUTLINE					
Course Title:	*Bioinformatics*	**Short Title:**	Bioinfo.	**Course Code:**	

Course description:

This course aims to provide students with a practical and hands-on experience with common bioinformatics tools and databases. The goals of the course are to understand the basic principles of Bioinformatics and their applications in the field of Biotechnology.

Lecture	**Hours/week**	**No. of Weeks**	**Total hours**	**Semester credits**
	03	14	42	03

Prerequisite course(s):- Biology, SE Biotechnology courses

Course objectives: To,

1. Introduce students to the fundamentals of evolution, molecular biology, and molecular evolution.
2. Underlie much of modern bioinformatics, and students will be shown how they apply to the basic predictive methods that are of common use in the field.
3. Train in the basic theory and application of programs used for database searching, protein and DNA sequence analysis, prediction of protein function, and building phylogenetic trees.
4. Specify types of analysis discussed in the course will include but is not limited to: Detection of homology with BLAST.
5. Predict transmembrane segments, multiple alignment of sequences, prediction of protein domains, prediction of protein localization, and building phylogenetic trees.

Course outcomes:

After successful completion of this course the student will be able to:

1. To understand the theoretical basis behind bioinformatics.
2. Search databases accessible on the WWW for literature relating to molecular biology and biotechnology.
3. Manipulate DNA and protein sequences using stand-alone PC programs and programs available on the WWW. Find homologues, analyze sequences, construct and interpret evolutionary trees.
4. View and interpret these biomelecules structures.
5. Understand homology modeling and computational drug design.

COURSE CONTENT

Name of the Subject: Bioinformatics		**Semester:**	VII
Teaching Scheme:		**Examination scheme**	
Lectures:	**3 hours/week**	**End semester exam (ESE):**	**60 marks**
		Duration of ESE:	**03 hours**
		Internal Sessional Exams (ISE):	**40 marks**

Unit–I:	**No. of Lectures: 08 Hours**	**Marks: 12**

Introduction to bioinformatics, bioinformatics and internet, Databases:Introduction, primary and secondary databases, format v/s contents, the Genbank flat files and its format, database at NCBI, Databases : DDBJ, EMBL, Genbank, submitting DNA sequence to database; Structure database: PDB, Molecular modelling database at NCBI, structure file format.

Unit–II:	**No. of Lectures: 08 Hours**	**Marks: 12**

Introduction, types of sequence alignment, Algorithms for sequence alignment: Needlemen-Wunsch and

Smith-Waterman algorithm, Methods of pair wise sequence alignment, Database similarity searching: FASTA, BLAST, Substitution Score and Gap penalties, PAM matrix, Multiple sequence alignment, Hidden markov models and threading methods.

Unit–III:	**No. of Lectures: 09 Hours**	**Marks: 12**

Introduction, Open reading frame based gene prediction, Procedure for gene prediction, Gene prediction in microbial genomes, Gene prediction in eukaryotes, Promoter prediction in E.Coli, Promoter prediction in eukaryotes, Gene finding methods: GRAIL, GENSCAN, PROCRUSTES, Gene parser.

Unit–IV:	**No. of Lectures: 09 Hours**	**Marks: 12**

Introduction, Elements of phylogenetic models, Phylogenic data analysis, Relation between Phylogenetic analysis and multiple sequence alignment, Evolutionary trees, Methods for Phylogenetic prediction: Maximum Parsimony method, Distance methods, Phylogenetic software.

Unit–V:	**No. of Lectures: 08 Hours**	**Marks: 12**

Prediction of RNA structure:

Introduction, Sequence and base pairing patterns for structure prediction, Methods predicting RNA structure: Energy minimization and identification of base covariation, Prediction of protein structure :- Introduction, Protein structure description, Protein structure classification in databases, Structural alignment methods, Protein structure prediction by amino acid sequence: use of sequence patterns, Prediction of secondary structure, Prediction of 3D structure.

Text Books:

1. S.C.Rastogi, N.Mendiratta, P.Rastogi, Bioinformatics: Methods and Applications, PHI.
2. Vittal.R.Srinivas, Bioinformatics: A Modern Approach, PHI.

Reference Books:

1. T.K.Attwood and Parry . Smith D.J, Introduction to Bio Informatics, Pearson Education Ltd, South Asia.
2. Andreas D. Boxevanis, Bioinformatics, Wiley International.
3. David W. Mount, Bioinformatics: Sequence and Genome analysis, Cold Spring Harbour.

Professional Elective Course - III					
Crop Improvement					
COURSE OUTLINE					
Course Title:	*Name of the Subject: Crop Improvement*	**Short Title:**	**CI**	**Course Code:**	

Course description:

This course is aimed at developing the basic knowledge and skills of crop improvement to undergraduate students. The goals of the course are to understand the basic principles of crop improvement techniques and transgenic crops development and their applications in the field of Biotechnology.

Lecture	**Hours/week**	**No. of Weeks**	**Total hours**	**Semester credits**
	03	14	42	03

Prerequisite course(s):- Biology, SE Biotechnology courses

Course objectives: To,

1. Get familiarized with tissue culture.
2. Learn transformation techniques for improvement of crop productivity and quality.
3. Learn different molecular markers for molecular breeding.
4. Learn Modern farming methods- by using hybrid seeds, highly technological equipments.
5. Study Crop rotation- by growing dissimilar types of crop in the field.

Course outcomes:

After successful completion of this course the student will be able to:

1. Students would be able to do transformation of crop plants to increase crop productivity.
2. Apply molecular markers for MAS in breeding.
3. Explain and demonstrate the different molecular markers.
4. Describe the metabolic systems in plants.
5. Study the Biochemistry involved in plant cells.

COURSE CONTENT

Name of the Subject: Crop Improvement		**Semester:**	VII
Teaching Scheme:		**Examination scheme**	
Lectures:	**3 hours/week**	**End semester exam (ESE):**	**60 marks**
		Duration of ESE:	**03 hours**
		Internal Sessional Exams (ISE):	**40 marks**

Unit–I:	**No. of Lectures: 08 Hours**	**Marks: 12**

Plant Breeding and Crop Improvement:

Conventional Plant Breeding strategies, Hybridization, Inbred lines, Pure lines, Heterosis.

Unit–II:	**No. of Lectures: 08 Hours**	**Marks: 12**

Gene Cloning:

Discovery, Cloning of Plant genes, Probe based screening, Genomic and proteomic approaches.

Unit–III:	**No. of Lectures: 09 Hours**	**Marks: 12**
Molecular Markers for Crop Improvement: RAPD, RFLP, AFLP, SSRs, SSCP, SCAR. QTLs: Marker assisted selection, construction of molecular maps, map based cloning.		
Unit–IV:	**No. of Lectures: 09 Hours**	**Marks: 12**
Transgenic Crops I: Secondary Metabolites, Increase in Productivity by manipulation of photosynthesis, Nitrogen fixation, Nutrient uptake efficiency, Post harvest technology.		
Unit–V:	**No. of Lectures: 08 Hours**	**Marks: 12**
Transgenic Crops II: Transgenic plants for quality improvement for lipids & Carbohydrate content, Plantibodies, Edible Vaccines, Therapeutic Proteins.		
Text Books:		
1. Buchanan, B.B. Gruissem, W. and Jones, R.L. , Biochemistry & Moleuclar Biology of Plants. eds. 2000. 2. Yunbi Xu, Molecular Plant Breeding. CABI Publishers, 2010.		
Reference Books:		
1. Bernard R. Glick and John E. Thompson, Methods in Plant Molecular Biology and Biotechnology, CRC Press,		

Professional Elective Course - III					
Structural Biology					
COURSE OUTLINE					
Course Title:	Structural Biology	**Short Title:**	**SB**	**Course Code:**	

Course description:

This course is aimed at developing the basic knowledge and skills of molecular structures of Biomolecules to undergraduate students. The background expected includes a prior knowledge of SE Biotechnology courses. The goals of the course are to make students understand the basic principles of Biological Substances and their applications in engineering.

Lecture	**Hours/week**	**No. of Weeks**	**Total hours**	**Semester credits**
	03	14	42	03

Prerequisite course(s):- SE Biotechnology courses

Course objectives: To,

1. Familiarize students to the importance of structure of biomolecules with respective functions.
2. Understand the impact of interaction of biomolecules such as protein-protein interaction, protein-nucleic acid interaction, receptor-ligand interaction on biological functions.
3. Understand the nucleic acids and genetic makeup.
4. Understand the various analytical techniques for study of Biomolecules.
5. Understand the kinetics involved in Biomolecules.

Course outcomes:

After successful completion of this course the student will be able to:

1. Generate and study the importance of structure of biomolecules using x-ray diffraction and related techniques.
2. Assess the changes of the structure and its effect on the biological function.
3. Distinguish between the type of interaction and its impact on biological system.
4. Explain the kinetics involved in Biomolecules.
5. Demonstrate various analytical techniques for study of Biomolecules.

COURSE CONTENT

Name of the Subject: Structural Biology		**Semester:**	VII
Teaching Scheme:		**Examination scheme**	
Lectures:	**3 hours/week**	**End semester exam (ESE):**	**60 marks**
		Duration of ESE:	**03 hours**
		Internal Sessional Exams (ISE):	**40 marks**

Unit–I:	**No. of Lectures: 08 Hours**	**Marks: 12**

Macromolecular Structure and Intermolecular Forces:

Macromolecular Structure: Levels of structure in biomolecules, size and shape, Molecular chirality and Structural transitions. Forces that determine Protein and Nucleic acid structure, basic problems. Polypeptide chains; geometric, potential energy calculations, hydrogen bonding, hydrophobic interactions and structure of water molecule; ionic interactions, disulphide bonds.

Unit–II:	No. of Lectures: 08 Hours	Marks: 12
Structure Of Nucleic Acids: Nucleic acids; general characteristics of nucleic acid structure, geometric, glycosidic bond rotational isomers, backbone rotational isomers and ribose puckering forces stabilizing ordered forms, base pairing, base stacking; tertiary structure of nucleic acids.		
Unit–III:	**No. of Lectures: 09 Hours**	**Marks: 12**
Protein Folding and Structure: Protein folding**:** Types of proteins and interactions that govern protein folding, protein structure, The protein globule and hydrophilic interactions, organized folds, folding mechanisms, membrane proteins, helix-coil transitions. Prediction of protein structure; Sequence-structure relationships (fundamentals of bioinformatics: sequence homology),		
Unit–IV:	**No. of Lectures: 09 Hours**	**Marks: 12**
Biomolecular Interactions & Kinetics: Molecular recognition, supramolecular interactions, Functional importance of protein-protein and protein-nucleic acid interactions. Specific and nonspecific DNA-protein complexes. Biochemical Kinetics studies, uni-molecular reactions, simple bimolecular multiple intermediates, steady state kinetics, catalytic efficiency relaxation		
Unit–V:	**No. of Lectures: 08 Hours**	**Marks: 12**
Experimental Methods: Size and shape of micro molecules: photons, chromophores, transition dipole moments, absorbance, and concentration. Methods of direct visualization of macromolecules as hydrodynamic particles - macromolecular diffusion, ultra centrifugation, viscometry.		

Text Books:

1. A.M. Lesk, Introduction to Protein Architecture: The Structural Biology of Protein. Oxford University press (2001).
2. Vijayan. M. Yathindra. N. and Kolaskar A.S. Perspectives in structural Biology. Indian Academy of Sciences.

Reference Books:

1. Branden and Tooze, Introduction to Protein Structure.
2. Tinoco, I., Jr., Sauer, K., Wang, J. C., & Puglisi, J. D. (2001) Physical Chemistry: Principles and Applications in Biological Sciences, 4th ed. Prentice Hall.
3. Malcolm Campbell, Laurie J. Heyer, Discovering Genomics, Proteomics and Bioinformatics. 2nd Edition, Pearson Publications, 2008.

Professional Elective Course - III					
Computational Biology					
COURSE OUTLINE					
Course Title:	Computational Biology	**Short Title:**	**ComBio**	**Course Code:**	

Course description:

This course is aimed at developing the basic knowledge and skills of computational biology to undergraduate students. The background expected includes a prior knowledge of SE Biotechnology courses. The goals of the course are to make students understand the basic principles of computational biology and their applications in genetic engineering.

Lecture	Hours/week	No. of Weeks	Total hours	Semester credits
	03	14	42	03

Prerequisite course(s):- SE & TE Biotechnology courses

Course objectives: To,

1. Provide an understanding of functional genomics.
2. Study comparative genomics, proteomics and its application in phylogenetic analysis and drug designing.
3. Investigate molecular biology problems from computational perspective.
4. Learn the basics of phylogeny and taxonomy.
5. Learn about drug identification, discovery and designing.

Course outcomes:

After successful completion of this course the student will be able to:

1. Design experiments in the field of Computational Molecular Biology
2. Identify genes and molecular markers.
3. Identify proteins.
4. Determine the different structure of proteins.
5. Design the drugs with various bioinformatics tools.

COURSE CONTENT

Name of the Subject: Computational Biology		**Semester:**	VII
Teaching Scheme:		**Examination scheme**	
Lectures:	**3 hours/week**	**End semester exam (ESE):**	**60 marks**
		Duration of ESE:	**03 hours**
		Internal Sessional Exams (ISE):	**40 marks**

Unit–I:	**No. of Lectures: 08 Hours**	**Marks: 12**

Introduction To Computational Biology:

Introduction to active areas of research in Computational Molecular Biology, Functional Genomics, Comparative Genomics, Dynamic Programming, Graphical representation of biochemical systems, S-systems equations, steady state analysis, Model refinements

Unit–II:	**No. of Lectures: 08 Hours**	**Marks: 12**

Genomics:

DNA Sequence assembly and gene identification. Homology based gene prediction. Gene expression profiling, Identification of SNPs, SNP arrays, Role of SNP in Pharmacogenomics, other applications. Methods of studying gene expression, EST approach, Human Genome Project.

Unit–III:	No. of Lectures: 09 Hours	Marks: 12
Proteomics: Protein identification, structure and function determination. Structure comparison methods. Prediction of secondary structure from sequence. Protein homology modeling, Protein threading. Protein structure prediction. Protein design emphasis on structural Bioinformatics.		
Unit–IV:	**No. of Lectures: 09 Hours**	**Marks: 12**
Taxonomy and Phylogeny: Basic concepts in systematics, taxonomy and phylogeny; Nature of data used in taxonomy and phylogeny; Molecular evolution, Definition and description of Phylogenetic trees and types of trees, Dendograms and its interpretation		
Unit–V:	**No. of Lectures: 08 Hours**	**Marks: 12**
Drug Design: Drug discovery process, Role of Bioinformatics in drug design, Target identification and validation, lead optimization and validation.		
Text Books:		
1. Jonathan Pevsner, Bioinformatics and Functional Genomics. A Jhon Wiely & Sons, Inc., Publication 2. E.O.Voit Computational Analysis of Biochemical systems, Cambridge University Press 2000.		
Reference Books:		
1. Bernhard Haubold and Thomas Wiehe, Introduction to computational biology, An Evalutionary Approach. Spinger India publications. India (2006). 2. Moody P C E and A J Wilkinson. Protein Engineering. IRL Press.		

Professional Elective Course - III					
Biopharmaceuticals					
COURSE OUTLINE					
Course Title:	**Biopharmaceuticals**	**Short Title:**	**Biopharma**	**Course Code:**	

Course description:

This course is aimed at developing the basic knowledge of biopharmaceuticals to undergraduate students. The background expected includes a prior knowledge of Biotechnology courses. The goals of the course are to understand the basic principles of pharmaceuticals study and their applications in engineering.

Lecture	Hours/week	No. of Weeks	Total hours	Semester credits
	03	14	42	03

Prerequisite course(s):- SE & TE Biotechnology courses

Course objectives: To,

1. Understand the difference between pharmaceuticals vs biopharmaceuticals.
2. Understand importance of properties of drugs.
3. Understand doses and absorbance rates in hosts (Pharmacokinetics).
4. Understand some biopharmaceuticals which are presently in use.
5. Understand basics of drug designing.

Course outcomes:

After successful completion of this course the student will be able to:

1. Evaluate different pharmaceutical parameters of current biotechnology products.
2. Determine parameters related to stability and formulation of biopharmaceutical products.
3. Discuss quality control procedures related to biopharmaceutical products.
4. Discuss novel formulation methods for better delivery of biotechnology derived drugs.
5. Discuss the delivery of biopharmaceutical products by the parenteral, oral, transdermal and nasal routes of administration.

COURSE CONTENT

Name of the Subject: Biopharmaceuticals		**Semester:**	VII
Teaching Scheme:		**Examination scheme**	
Lectures:	**3 hours/week**	**End semester exam (ESE):**	**60 marks**
		Duration of ESE:	**03 hours**
		Internal Sessional Exams (ISE):	**40 marks**

Unit–I:	**No. of Lectures: 08 Hours**	**Marks: 12**

Introduction to Pharmaceuticals:

History & Definition of Drugs. Sources of Drugs - Plant, Animals, Microbes and Minerals. Different dosage forms. Routes of drug administration; Biotech drugs in Development, Recent FDA Approvals.

Unit–II:	**No. of Lectures: 08 Hours**	**Marks: 12**

Drug Discovery and Drug Design:

Drug Research based on Computers and Biotechnology, Antibodies in Rational Drug Designing, Classes of Therapeutic Targets in the Living Cell, Drug Development in Past and Role of Biotechnology Today, Drug Designing Softwares (AUTODOCK, ARGUSLAB etc.,)

Unit–III:	No. of Lectures: 09 Hours	Marks: 12
Pharmacokinetics: Pharmacokinetics- Drug absorption, factors that affect the absorption of drugs, Distribution of drugs, Biotransformation of drugs, Bioavailability of drugs and drug metabolism, Pharmacogenomics.		
Unit–IV:	**No. of Lectures: 09 Hours**	**Marks: 12**
Transgenics & Gene Therapy: Transgenic Production of Biopharmaceuticals: Animals of Interest for Transgenesis, Challenges & Issues,Advantages, Transgenic Plants for Production, Human Gene Therapy: Examples; Ethics; Gene transfer with Viral & Non-viral Vectors.		
Unit–V:	**No. of Lectures: 08 Hours**	**Marks: 12**
Biopharmaceutical Products: Production of Therapeutic Proteins, Blood Products, Monoclonal Antibodies, Hormone Therapy, Role of Biopharmaceuticals in treatment of various health disorders		
Text Books:		
1. S.N.Jogdand, Biopharmaceuticals , Himalaya Publishing House		
Reference Books:		
1. Gary Walsh , Biopharmaceuticals: Biochemistry & Biotechnology. John Wiley & Sons Ltd. 2. Remington's Pharmaceutical sciences, Mark Publications & Company eston PA. 3. Leon Lachman, Lea & Febiger, Theory & Practice of Industrial Pharmacy.		

Professional Elective Course - IV					
Analytical Methods in Biotechnology					
COURSE OUTLINE					
Course Title:	*Analytical Methods in Biotechnology*	**Short Title:**	**AMB**	**Course Code:**	

Course description:

This course is aimed at developing the basic knowledge and analytical methods in biotechnology to undergraduate students. The background expected includes a prior knowledge of Biotechnology courses. The goals of the course are to understand the basic principles of analytical instruments/equipments and their applications in biotechnology.

Lecture	**Hours/week**	**No. of Weeks**	**Total hours**	**Semester credits**
	03	14	42	03

Prerequisite course(s):- SE Biotechnology courses

Course objectives: To,

1. Understand various Analytical Methods in Biotechnology.
2. Understand Electro-analytical methods.
3. Understand types of microscopy.
4. Understand Methods of structural determination and separation techniques.
5. Understand various types of spectroscopy.

Course outcomes:

After successful completion of this course the student will be able to:

1. Interpret electromagnetic spectrums.
2. Handle various spectroscopic techniques.
3. Perform various elctroanalytical methods.
4. Handle various types of microscopes.
5. Determine structures of biomolecules .

COURSE CONTENT

Name of the Subject: Analytical Methods in Biotechnology		**Semester:**	VII
Teaching Scheme:		**Examination scheme**	
Lectures:	**3 hours/week**	**End semester exam (ESE):**	**60 marks**
		Duration of ESE:	**03 hours**
		Internal Sessional Exams (ISE):	**40 marks**

Unit–I:	**No. of Lectures: 08 Hours**	**Marks: 12**

Introduction:

Electromagnetic Spectrum, Interaction of Electromagnetic radiation with matter and transition between molecular energy levels, Jablonski diagram, Types of molecular energies, classification of Instrumental methods. Errors, precision and accuracy: Types of errors, Significant figures, Precision and accuracy, Methods of Expressing accuracy and Precsion, Confidence limits, Sensitivity and detection limit for instruments.

Unit–II:	**No. of Lectures: 08 Hours**	**Marks: 12**

Radioactivity:

Electroanalytical methods: Potentiometry, Polarography, voltametry and Amperometry, Types of Radioactivity,Units of Radioactivty,Types of Radioactive rays and their properties,Types of Radioactive decay,Detection and measurement of Radioactivity–GM

counters, Scintillation counters, Applications of Radioisotopes.		
Unit–III:	**No. of Lectures: 09 Hours**	**Marks: 12**
Microscopy: Bright field, Dark field, Fluorescent, Phase contrast, confocal microscopy, SEM & TEM Microscopy, Flow Cytometry.		
Unit–IV:	**No. of Lectures: 09 Hours**	**Marks: 12**
Spectroscopy: Beer – Lambert's Law and apparent deviations, UV - VIS Spectrophotometer, Spectrofluorimeter, Principle and applications of Atomic absorption & Atomic emission spectroscopy.		
Unit–V:	**No. of Lectures: 08 Hours**	**Marks: 12**
Methods of Structural Determination and Separation Techniques: X-ray Diffraction, NMR. Sedimentation, Centrifugation and Filtration, Electrophoresis of proteins and nucleic acids, 1D and 2D Gels, Types of Electrophoretic techniques (Capillary and Pulse field). Basics of Chromatography:Paper, Column, TLC, GC, HPLC and GPC – Principles and applications, Capillary columns, Detectors, Solvent extraction and ion – exchange techniques.		
Text Books:		
1. Upadhya & Upadhya, Biophysical Chemistry Principles & Techniques by 4th edition, Himalaya Publishing House, 2012. 2. Gurudeep R.Chatwal Sham K Anand,Instrumental methods of chemical analysis Himalaya Publishing house, ISBN		
Reference Books:		
1. Hobert H Willard D. L. Merritt & J. R. J. A. Dean, Instrumental Methods of Analysis, CBS Publishers & Distributors. 2. Pranb kumar Banerjee,Introduction to Biophysics, S.chand Publications,2008. 3. K. Wilson & J.Walker, Principles & Techniques of Practical Biochemistry 5th edition. Cambridge University Press, 2000.		

Professional Elective Course - IV

Biochemical Engineering

COURSE OUTLINE

Course Title:	**Biochemical Engineering**	**Short Title:**	**BCE**	**Course Code:**	

Course description:

The course consists of study of Biological Material & Energy Balances for bioprocesses & unit operations used in the bioprocesses. It also includes Enzyme Engineering. Immobilization of enzymes and kinetic study of the enzyme catalyzed reactions. Study of microbial kinetics, various models, different types of Bioreactors with material balances are the integral part of this course. Sterilization reactors, air sterilization, O2 transport in bioprocesses, recovery of the fermentation products followed by instrumentation and control are also included in the course.

Lecture	**Hours/week**	**No. of Weeks**	**Total hours**	**Semester credits**
	03	14	42	03

Prerequisite course(s):- SE & TE Biotechnology courses

Course objectives: To,

1. Study the biological materials to obtain various chemicals from them and Energy and Material balances for the bioprocesses and Unit operations involved in these processes.
2. Study the application of controls and instrumentations in bioprocesses.
3. Study kinetics of microbial growth, various models and different reactor configurations for the growth of microorganisms.
4. Study sterilization of liquids and air, O_2 transport through cell and determination of oxygen transfer coefficients.
5. Study the unit operations for the recovery of fermentation products.

Course outcomes:

After successful completion of this course the student will be able to:

1. Apply a knowledge and understanding of various biochemical processes for the recovery of many important chemicals and biochemical's.
2. Utilize the principles of hygiene.
3. Follow the basic concepts of Material Balances in Bioprocess Engineering.
4. Apply the various techniques of Downstream processing for fermented products.
5. Study the reactor configurations.

COURSE CONTENT

Name of the Subject: Biochemical Engineering		**Semester:**	VII
Teaching Scheme:		**Examination scheme**	
Lectures:	**3 hours/week**	**End semester exam (ESE):**	**60 marks**
		Duration of ESE:	**03 hours**
		Internal Sessional Exams (ISE):	**40 marks**

Unit–I:	No. of Lectures: 08 Hours	Marks: 12
Enzymes. History. Enzyme nomenclature and classification. Applications of enzymes. Enzyme substrate complex and enzyme action. Effect of Temperature and pH on enzyme activity. Kinetics of enzyme catalyzed reaction; simple enzyme kinetics with one and two substrates; Michaelis Menten kinetics. Evaluation of parameters of Michaelis Menten equation. Kinetics of reversible enzyme catalyzed reaction. Enzyme inhibition. Types of enzyme inhibition. Kinetics of competitive, uncompetitive and noncompetitive enzyme inhibition. Substrate activation and inhibition. Immobilization of enzymes and their applications.		
Unit–II:	**No. of Lectures: 08 Hours**	**Marks: 12**
Characteristics of Biological material. Types of microorganisms; general physical properties of cells and chemical composition of cells; requirement for growth of cells and formulation of media; reproduction cycles in microorganisms; changes in composition of cells with age and with growth rate; effect of substrate limiting growth on the composition of cells; strain breeding; Maintenance of pure cultures. Material Balances in bioprocesses, Application of material balances to bioprocesses. Energy balances in bioprocesses, Heat of reaction for processes with biomass production. Unsteady state energy and material balances in bioprocesses.		
Unit–III:	**No. of Lectures: 09 Hours**	**Marks: 12**
Recovery of fermentation products, Disruption of cells, mechanical methods, ultrasonic vibrations, grinding and mechanical shear, shearing by pressure, induction by lysis. Reverse Osmosis: Ultra filtration, Instrumentation and Control: Introduction, methods of measuring process variables; temperature measurement and control, pressure measurement and control, foam sensing and control, weight of fermenter and estimation of microbial biomass, dissolved oxygen measurement and control, inlet and exit gas analysis, pH measurement and control, bioprocess economics.		
Unit–IV:	**No. of Lectures: 09 Hours**	**Marks: 12**
Microbial Kinetics: Monod's growth kinetics. Environmental effects on growth kinetics. Balanced growth kinetics, Transient growth kinetics, Unstructured batch growth model, Growth of filamentous organisms, Product formation kinetics. Unstructured model. Reactor Configurations: Batch growth of microorganisms, Stirred tank reactor with recycle of biomass, Continuous stirred tank fermenters in series, plug flow fermenter, fed batch fermenter, Numericals on these, multiphase reactors such as packed bed reactors, bubble column reactors,mfluidized bed reactors and trickle bed reactors.		
Unit–V:	**No. of Lectures: 08 Hours**	**Marks: 12**
Sterilization: Importance of Sterilization. Batch Sterilization of liquids, continuous sterilization of liquids, sterilization of air. Aeration and Agitation: Mass transfer and Microbial respiration, bubble aeration and mechanical agitation, correlation between oxygen transfer coefficient and operating variables, effect of temperature, organic substances, surface active agents, mycelium and types of sparger on oxygen transfer coefficient. Measurement of oxygen transfer coefficient, Scale up.		
Text Books:		
1. James E. Bailey & David F. Ollis, Biochemical Engineering. Fundamentals; McGraw Hill Publication. 2. P.F.Stanbury, A. Whitaker & S,J.Hall, Principles of Fermentation Technology; Aditya Books Ltd; New Delhi. 3. Doran Pauline M. Bioprocess Engineering Principles, Academic Press. An Imprint of Elsevier. 4. Shular Michael and Kargi Fikret, Bioprocess Engineering Basic Concepts, Prentice		

Hall of India
5. Editors: J.F. Richardson, D.G. Peacock, Coulson's & Richardson's Chemical Engineering, (Vol-III) Asian Books Pvt. Ltd. New Delhi
6. J.H. Backhurst & J.H.Harker, Coulson's & Richardson's Chemical Engineering (Vol-V) Asia Books Pvt. Lt

Reference Books:

1. Shuichi Aiba, Arthur E.H. & Nancy F.M., Biochemical Engineering; University of Tokyo Press.

Professional Elective Course - IV					
Biosafety and Bioethics					
COURSE OUTLINE					
Course Title:	*Biosafety and Bioethics*	**Short Title:**	**BB**	**Course Code:**	

Course description:

This course is aimed at developing the basic knowledge ethical issues in biotechnology. The background expected includes a prior knowledge of Biotechnology courses. The goals of the course are to understand the basic principles of bioethics and Biosafety and its applications in biotechnology.

Lecture	**Hours/week**	**No. of Weeks**	**Total hours**	**Semester credits**
	03	14	42	03

Prerequisite course(s):- TE Biotechnology Courses

Course objectives: To,

1. Understand Biosafety guidelines.
2. Understand the concept of Bioethics.
3. Understand Biosafety regulation and guidelines.
4. Understand Bioethical issues related to GMO.
5. Understand basics of IPR.

Course outcomes:

After successful completion of this course the student will be able to:

1. Implement the Biosafety guidelines.
2. Categorize various Biosafety levels in research involving organisms.
3. Convince society on ethical conflicts in Biotechnology.
4. Secure their ideas through IPR.
5. Follow GMP and GLP.

COURSE CONTENT

Name of the Subject: Biosafety and Bioethics		**Semester:**	VII
Teaching Scheme:		**Examination scheme**	
Lectures:	**3 hours/week**	**End semester exam (ESE):**	**60 marks**
		Duration of ESE:	**03 hours**
		Internal Sessional Exams (ISE):	**40 marks**

Unit–I:	**No. of Lectures: 08 Hours**	**Marks: 12**

Biosafety:

Introduction, objectives of Biosafety guidelines, risk assessment, risk regulation, containment, planned introduction of genetically modified organism, Biosafety during industrial production, Biosafety levels: experiment with microorganism, research involving plants, research involving animals, Good manufacturing and Good Laboratory practices.

Unit–II:	**No. of Lectures: 08 Hours**	**Marks: 12**

Introduction to Bioethics:

Bioethics: Legality, morality and ethics, principle of bioethics: autonomy, human rights, beneficence, privacy, justice, equity etc; Biotechnology and society: Introduction to science, technology and society, public acceptance issues in biotechnology Ethical conflicts in biotechnology: Fear of unknown, black face of biotechnology? When transgenes wander, should we worry? BT cotton creating resistance to biotechnology? Conflicts of BT cotton,

some case studies, unequal distribution of risk and benefit of biotechnology.

Unit–III:	No. of Lectures: 09 Hours	Marks: 12

Biosafety regulation and guidelines:

Biosafety guidelines and regulation, biosafety guidelines in India, National and International guidelines with regard to rDNA technology, transgenic science, GM crops, hazardous material from bioprocess, pharmaceutical product; GM food debate, Biosafety assessment procedures for Biotech food and related products, ecological safety assessment of recombinant organism and transgenic crops, Bioterrorism and convention on biological weapons.

Unit–IV:	No. of Lectures: 09 Hours	Marks: 12

Bioethics in animal genetic engineering:

Introduction, Issues concern to use of animals, case studies, Animal as a tennis ball? Gene therapy and transgenic animal. Should animal be patentable? Bioethics in plant genetic Engineering, bioethics and moral concern, Gene flow in crops, BT-cotton case studies, transgenic plants are not absolutely safe, Public education of biotechnology. Bioethics in Microbial Technology.

Unit–V:	No. of Lectures: 08 Hours	Marks: 12

Intellectual property rights:

Introduction, IPR in India, intellectual property , protection of IPR : Trade secret, Patent, Copyright, Plant variety protection , International Harmonization of patent laws: Trips, India and Trips ,WTO-GATT; methods of application of patent, protection of biological inventions, plant breeders right ,examples of patents in biotechnology, choice of IPR protection, management of IPR, benefits and problems from IPR, Indian response to the IPR upheaval.

Text Books:

1. M.K.Sateesh, Biosafety and Bioethics. I.K.International Publishing House Pvt. Ltd.
2. Thomas J A Fucnh . Biotechnology and Safety Assessment. Academic Press.
3. Fleming D A, Hunt D L, Biological Safety Principles and Practices, Assm Press Washington.

Reference Books:

1. Singh K ,Intellectual Property Rights on Biotechnology, BCIL New Delhi.
2. Moo-Young ,Compressive Biotechnology Vol.4, Elsevier Publisher.
3. B. D. Singh , Biotechnology, Kalyani Publishers.
4. S. S. Purohit, Text book of Biotechnology, Agro Bios.

Professional Elective Course - IV					
Clinical Trials and Regulatory Affairs					
COURSE OUTLINE					
Course Title:	*Clinical Trials and Regulatory Affairs*	**Short Title:**	**CTRA**	**Course Code:**	

Course description:

This course is aimed at developing the basic knowledge clinical and regulatory trials. The background expected includes a prior knowledge of Biotechnology courses. The goals of the course are to understand the basic principles of clinical and regulatory affairs and its applications in biotechnology.

Lecture	**Hours/week**	**No. of Weeks**	**Total hours**	**Semester credits**
	03	14	42	03

Prerequisite course(s):- TE Biotechnology courses

Course objectives: To,

1. Impart the knowledge of the best practices adopted for clinical trials.
2. Get acquainted with the regulatory bodies with in India and at the global level.
3. Explain roles and responsibilities in clinical research.
4. Exhibit recent developments of research and clinical trials.
5. Demonstrate ethical issues in health care sectors.

Course outcomes:

After successful completion of this course the student will be able to:

1. Explain about Licensing authorities-roles and responsibilities.
2. Perform SOP in their respected disciplines.
3. Describe the latest developments in ICH.
4. Explain regulatory affairs for studies in human subjects.
5. Clarify the ethics in all aspects of health care.

COURSE CONTENT

Name of the Subject: Clinical Trials and Regulatory Affairs		**Semester:**	VII
Teaching Scheme:		**Examination scheme**	
Lectures:	**3 hours/week**	**End semester exam (ESE):**	**60 marks**
		Duration of ESE:	**03 hours**
		Internal Sessional Exams (ISE):	**40 marks**

Unit–I:	**No. of Lectures: 08 Hours**	**Marks: 12**

Introduction:

Licensing authorities-roles and responsibilities, ICH GCP,FDA, EU Clinical Trial; Directive, Data Protection Act & Regulations relating to electronic; signatures, Declaration of Helsinki 2000 amendment and financial disclosure; Regulation of drug preparation and Law, guidelines and codes of practice. packaging, EMEA, European directives and MRECs.

Unit–II:	**No. of Lectures: 08 Hours**	**Marks: 12**

Regulatory Requirements:

Definitions of GCP, auditing , monitoring and inspection; GCP auditing requirements from a regulatory perspective; GCP compliance and audit certificates; GCP auditor training; GCP audit team structure and SOPs; GCP audit planning; GCP audit conduct; Reporting GCP

audit findings; Follow – up to GCP audit reports.
Roles and responsibilities in clinical research according to ICH GCP; Sponsor; Monitor; Investigator; IRB / IEC; Essential documentation. The INDIAN / USA / EU Directives on GCP in Clinical Trials: Purpose: How will the introduction affect clinical research; Extracts from the guidance documents. Possible sanctions for non- compliance (a) Legal and regulatory (b) Commercial and (c) Professional.

Unit–III:	No. of Lectures: 09 Hours	Marks: 12

Recent Developments:
Latest developments in ICH; Purpose; Implications; Guidance notes; Inspections. INDIAN / USA / EU Ethics approval system: Overview; Recent developments. Current issues in Clinical research: Confidentiality issues; Medicines for human use (clinical trials) regulations 2003: Other relevant issues

Unit–IV:	No. of Lectures: 09 Hours	Marks: 12

Regulatory Affairs:
History of regulatory affairs; Main concepts QSE; Sources of information; Regulatory affairs for studies in human subjects; What data is needed; Current and future European requirements and procedures; US perspective; Recognizing why clinical research has to meet the needs of regulatory Affairs. Regulatory submissions for new products; What data is needed?; Requirements for gaining approval; US perspective; Regulation and control of marketing and sales of medical products; Regulations Codes of practice; Promotional materials.

Unit–V:	No. of Lectures: 08 Hours	Marks: 12

Ethical Issues:
Ethics in all aspects of health care; Historical cases; Negligence , informed consent, mental competence; Up – to – date cases: cloning, human embryos and IVF; Shared responsibilities for decisions and understanding of risk.

Text Books:

1. Good Clinical Practices ,Central Drugs Standard Control Organisation, Govt. of India
2. Lawrence M. Friendman, Curt D. Furberg, David L. DeMets, Fundamentals of clinical trials. Third Edition. Springer International Edition. (2009).

Reference Books:

1. Dominique P.Brunier and Gerhardt Nahler, International Clinical Trial, Volume 1 &2 Interpharm Press, Denver, Colorado.
2. Code of Federal Regulation by USFDA – Download.
3. Biosafety issues related to genetically modified organism , Biotech Consortium India Limited, New Delhi.

Open Elective Course - III					
Bioprocess Optimization and Plant Design					
COURSE OUTLINE					
Course Title:	*Bioprocess Optimization and Plant Design*	**Short Title:**	**BOPD**	**Course Code:**	

Course description:

This course is aimed at developing the basic knowledge and skills of bioprocess optimization to undergraduate students. The background expected includes a prior knowledge of SE Biotechnology courses. The goals of the course are to understand the basic principles of plant designs & its process and their applications in engineering trade.

Lecture	**Hours/week**	**No. of Weeks**	**Total hours**	**Semester credits**
	03	14	42	03

Prerequisite course(s):- SE & TE Biotechnology courses

Course objectives: To,

1. Demonstrate process economics and optimization using various statistical and non statistical approaches.
2. Impart the knowledge basics of designing a bioreactor.
3. Exhibit basics of designing a heat exchanger.
4. Showcase community factors and other factors affecting investment.
5. Explain statistical and Non statistical approach of Bioprocess optimization.

Course outcomes:

After successful completion of this course the student will be able to:

1. Optimize various bioprocesses
2. Conduct technical feasibility survey
3. Utilize Statistical and Non statistical approach for Bioprocess optimization
4. Apply various optimization techniques in the design of fermenter.
5. Evaluate of heat load for any fermentation process

COURSE CONTENT

Name of the Subject: Bioprocess Optimization and Plant Design		**Semester:**	VII
Teaching Scheme:		**Examination scheme**	
Lectures:	**3 hours/week**	**End semester exam (ESE):**	**60 marks**
		Duration of ESE:	**03 hours**
		Internal Sessional Exams (ISE):	**40 marks**

Unit–I:	**No. of Lectures: 08 Hours**	**Marks: 12**

Basic Concepts:

Overview of experimental design in biological process, understanding of variables in biological processes. Introduction to optimization of bioprocesses.

Unit–II:	**No. of Lectures: 08 Hours**	**Marks: 12**

General Design Consideration:

Technical feasibility survey, process development, principles of equipment design and specification. Project consideration: Marketability of product, availability of technology, raw materials, equipment, human resources, land and utilizations. Other consideration: Site characteristics, waste disposal, government regulation and other legal restriction, community factors and other factors affecting investment.

Unit–III:	No. of Lectures: 09 Hours	Marks: 12
Optimization Approaches: Statistical and numerical optimization, fundamental theory. First order and second order designs, differences in approaches, general response surface analysis. Statistical experimental procedures for Placket – Burman designs; Method of Ridge analysis, Nelder – Mead simplex method; Optimization of multi – response biological systems. **Non statistical approach:** Self directing optimization, case-studies with simple response and multi-response analysis.		
Unit–IV:	**No. of Lectures: 09 Hours**	**Marks: 12**
Design of Bioreactors: Bioreactor: Application of mass and energy balances in the design, evaluation of size and related features of the fermenter. Application of optimization techniques in the design of fermenter in terms of size, cost and project		
Unit–V:	**No. of Lectures: 08 Hours**	**Marks: 12**
Design of Heat Exchangers: Evaluation of heat load for any fermentation process, design of heat exchanger using energy balance equation. Application of optimization techniques in the design of a heat exchanger in terms of heat transfer area, temperature differences, cost and project economics.		
Text Books:		
1. B. Volesky and J. Votrubla. Modeling optimization of fermentation process. Elsevier, Amsterdam. 2. Peters and Timmerhaus. Plant design and economics and for chemical engineers. Mc Graw-Hill. 4th Edition.		
Reference Books:		
1. Rudd and Watson. Strategy of process engineering. Wiley. 2. D.C. Montgomery. Design and Analysis of Experiments. 5th edition. Wiley India (P) Ltd., New Delhi.		

Open Elective Course - III					
Disaster Management					
COURSE OUTLINE					
Course Title:	**Disaster Management**	**Short Title:**	**DM**	**Course Code:**	

Course description:

This course is aimed at developing the basic knowledge and skills of environmental hazards and management to undergraduate students. The goals of the course are to understand the basic principles of environmental hazards and their applications in engineering trade.

Lecture	Hours/week	No. of Weeks	Total hours	Semester credits
	03	14	42	03

Prerequisite course(s):- 12th Biology, SE Biotechnology courses

Course objectives: To,

1. Demonstrate types of Environmental hazards.
2. Showcase concepts of Human ecology & its application.
3. Accustom chemical hazards.
4. Familiarize with endogenous Hazards.
5. Explain cumulative atmospheric hazards.

Course outcomes:

After successful completion of this course the student will be able to:

1. Prevent Man induced hazards & Disasters.
2. Prepare themselves for Pre- disaster stage.
3. Plan Post Disaster stage-Rehabilitation.
4. Undertake Flood control measures and Drought control measures.
5. Contribute in managing problems created due to chemical release, nuclear explosions and soil erosion.

COURSE CONTENT

Name of the Subject: Disaster Management		**Semester:**	VII
Teaching Scheme:		**Examination scheme**	
Lectures:	**3 hours/week**	**End semester exam (ESE):**	**60 marks**
		Duration of ESE:	**03 hours**
		Internal Sessional Exams (ISE):	**40 marks**

Unit–I:	**No. of Lectures: 08 Hours**	**Marks: 12**

Types of Environmental hazards & Disasters:

Natural hazards and Disasters - Man induced hazards & Disasters - Natural Hazards- Planetary Hazards/ Disasters - Extra Planetary Hazards/ disasters - Planetary Hazards- Endogenous Hazards - Exogenous Hazards –

Unit–II:	**No. of Lectures: 08 Hours**	**Marks: 12**

Environmental Hazards & Disasters:

Meaning of Environmental hazards, Environmental Disasters and Environmental stress. Concept of Environmental Hazards, Environmental stress & Environmental Disasters. Different approaches & relation with human Ecology - Landscape Approach - Ecosystem Approach - Perception approach - Human ecology & its application in geographical researches.

Unit–III:	No. of Lectures: 09 Hours	Marks: 12
Emerging approaches in Disaster Management- Three Stages 1. Pre- disaster stage (preparedness) 2. Emergency Stage 3. Post Disaster stage-Rehabilitation Chemical hazards/ disasters:— Release of toxic chemicals, nuclear explosion- Sedimentation processes Sedimentation processes:- Global Sedimentation problems- Regional Sedimentation problems- Sedimentation & Environmental problems- Corrective measures of Erosion & Sedimentation Biological hazards/ disasters:- Population Explosion.		
Unit–IV:	**No. of Lectures: 09 Hours**	**Marks: 12**
Endogenous Hazards - Volcanic Eruption – Earthquakes – Landslides - Volcanic Hazards/ Disasters - Causes and distribution of Volcanoes - Hazardous effects of volcanic eruptions - Environmental impacts of volcanic eruptions - Earthquake Hazards/ disasters - Causes of Earthquakes - Distribution of earthquakes - Hazardous effects of - earthquakes - - Earthquake Hazards in India - - Human adjustment, perception & mitigation of earthquake.		
Unit–V:	**No. of Lectures: 08 Hours**	**Marks: 12**
Infrequent events: Cyclones – Lightning – Hailstorms Cyclones: Tropical cyclones & Local storms - Destruction by tropical cyclones & local storms (causes, distribution human adjustment, perception & mitigation) Cumulative atmospheric hazards/ disasters : - Floods- Droughts- Cold waves- Heat waves Floods:- Causes of floods- Flood hazards India- Flood control measures (Human adjustment, perception & mitigation) Droughts:- Impacts of droughts- Drought hazards in India- Drought control measures- Extra Palnetary Hazards/ Disasters- Man induced Hazards / Disasters- Physical hazards/ Disasters-Soil Erosion Soil Erosion:— Mechanics & forms of Soil Erosion- Factors & causes of Soil Erosion- Conservation measures of Soil Erosion		
Text Books:		
1. Pardeep Sahni , Disaster Mitigation: Experiences And Reflections. 2. Donald Hyndman & David Hyndman Natural Hazards & Disasters Cengage Learning		
Reference Books:		
1. R.B.Singh (Ed) Environmental Geography, Heritage Publishers New Delhi,1990 2. Savinder Singh Environmental Geography, Prayag Pustak Bhawan, 1997 3. Kates,B.I & White, G.F The Environment as Hazards, oxford, New York, 1978 4. R.B. Singh (Ed) Disaster Management, Rawat Publication, New Delhi, 2000 5. H.K. Gupta (Ed) Disaster Management, Universiters Press, India, 2003.		

Open Elective Course - III					
Human Values and Professional Ethics					
COURSE OUTLINE					
Course Title:	*Human Values and Professional Ethics*	**Short Title:**	**HVPE**	**Course Code:**	

Course description:

This course is aimed at developing the basic knowledge of human values and professional ethics to undergraduate students. The background expected includes a prior knowledge of Biotechnology courses. The goals of the course are to understand the basics of Human Values and Professional Ethics and their applications in engineering trade.

Lecture	**Hours/week**	**No. of Weeks**	**Total hours**	**Semester credits**
	03	14	42	03

Prerequisite course(s):- Biology, TE Biotechnology courses

Course objectives: To,

1. Help the students to understand the difference between 'VALUES' and 'SKILLS'.
2. Facilitate the development of a Holistic perspective among students towards life, profession and happiness, based on a correct understanding of the Human reality and the rest of Existence.
3. Highlight plausible implications of such a Holistic understanding in terms of ethical human conduct, trustful.
4. Mutually satisfy human behavior and mutually enriching interaction with Nature.
5. Know about holistic perspective forms the basis of Value based living in a natural way.

Course outcomes:

After successful completion of this course the student will be able to:

1. Demonstrate the need for human values and personal ethics.
2. Illustrate basic concept of human relationship.
3. Apply professional ethics.
4. Apply concept of co-existence.
5. Showcase harmony in human being.

COURSE CONTENT

Name of the Subject: Human Values and Professional Ethics		**Semester:**	VII
Teaching Scheme:		**Examination scheme**	
Lectures:	**3 hours/week**	**End semester exam (ESE):**	**60 marks**
		Duration of ESE:	**03 hours**
		Internal Sessional Exams (ISE):	**40 marks**

Unit–I:	**No. of Lectures: 08 Hours**	**Marks: 12**

Course Introduction:

Need, Basic Guidelines, Content and Process for Value Education: Understanding the need, basic guidelines, content and process for Value Education. Self Exploration–what is it? - its content and process; 'Natural Acceptance' and Experiential Validation- as the mechanism for self exploration. Continuous Happiness and Prosperity- A look at basic Human Aspirations. Right understanding, Relationship and Physical Facilities- the basic requirements for

fulfillment of aspirations of every human being with their correct priority. Understanding Happiness and Prosperity correctly- A critical appraisal of the current scenario.

Unit–II:	No. of Lectures: 08 Hours	Marks: 12

Understanding Harmony in the Family and Society:
Harmony in Human - Human Relationship: Understanding harmony in the Family- the basic unit of human interaction. Understanding values in human relationship; meaning of Nyaya and program for its fulfillment to ensure Ubhay-tripti; **Trust (Vishwas) and Respect (Samman) as the foundational values of relationship.** Understanding the meaning of Vishwas; Difference between intention and competence. Understanding the meaning of Samman, Difference between respect and differentiation; the other salient values in relationship. Understanding the harmony in the society (society being an extension of family): Samadhan, Samridhi, Abhay, Sah-astitva as comprehensive Human Goals.

Unit–III:	No. of Lectures: 09 Hours	Marks: 12

Implications of the above Holistic Understanding of Harmony on Professional Ethics:
Natural acceptance of human values. Definitiveness of Ethical Human Conduct. Basis for Humanistic Education, Humanistic Constitution and Humanistic Universal Order. Competence in professional ethics:
a) Ability to utilize the professional competence for augmenting universal human order,
b) Ability to identify the scope and characteristics of people-friendly and eco-friendly production systems,
c) Ability to identify and develop appropriate technologies and management patterns for above production systems.

Unit–IV:	No. of Lectures: 09 Hours	Marks: 12

Understanding Harmony in the Human Being:
Harmony in Myself! : Understanding human being as a co-existence of the sentient ‘I’ and the material ‘Body’. Understanding the needs of Self (‘I’) and ‘Body’ - Sukh and Suvidha. Understanding the Body as an instrument of ‘I’ (I being the doer, seer and enjoyer). Understanding the characteristics and activities of ‘I’ and harmony in ‘I’. Understanding the harmony of I with the Body: Sanyam and Swasthya; correct appraisal of Physical needs, meaning of Prosperity in detail. Programs to ensure Sanyam and Swasthya.

Unit–V:	No. of Lectures: 08 Hours	Marks: 12

Understanding Harmony in the Nature and Existence:
Whole existence as Co-existence: Understanding the harmony in the Nature. Interconnectedness and mutual fulfillment among the four orders of nature recyclability and self-regulation in nature. Understanding Existence as Coexistence (Sah-astitva) of mutually interacting units in all-pervasive space. Holistic perception of harmony at all levels of existence.

Text Books:

1. R R Gaur, R Sangal, G P Bagaria, 2009, A Foundation Course in Human Values and Professional Ethics.
2. Prof. KV Subba Raju, 2013, Success Secrets for Engineering Students, Smart Student Publications,3rd Edition.

Reference Books:

1. Ivan Illich, 1974, Energy & Equity, The Trinity Press, Worcester, and HarperCollins, USA
2. E.F. Schumacher, 1973, Small is Beautiful: a study of economics as if people mattered, Blond & Briggs, Britain.
3. A Nagraj, 1998, Jeevan Vidya ek Parichay, Divya Path Sansthan, Amarkantak.
4. Sussan George, 1976, How the Other Half Dies, Penguin Press Reprinted 1986, 1991
5. PL Dhar, RR Gaur, 1990, Science and Humanism, Commonwealth Purblishers.

Open Elective Course – III					
Internet of Things					
COURSE OUTLINE					
Course Title:	*Name of the Subject: Internet of Things*	**Short Title:**	**IOT**	**Course Code:**	

Course description:

This course develops a foundation of concepts and solutions that supports the project planning & management concepts. Describe how to managing development of project by applying project management concepts. Project risk management provides students with an organized approach for managing the uncertainties that can lead to undesirable project outcomes. Course topics include: Project procurement management and post project analysis.

Lecture	**Hours/week**	**No. of weeks**	**Total hours**	**Semester credits**
	3	14	42	3

Prerequisite course(s):

Course objectives:

1. Understand about internet of things and design principles for connected devices.
2. Learn the design principles for web connectivity and internet connectivity principles.
3. Accustom about data acquiring, organizing, processing and analytics and data collection, storage and computing using cloud platform.
4. Display the skill about sensors, participatory sensing, RCIDs, and wireless sensor networks and prototyping the embedded devices for IoT and M2M.
5. Identify formulating, providing the prototyping and designing the software for LoT applications and LoT privacy, security and vulnerabilities solutions.

Course outcomes:

After successful completion of this course the student will be able to:

1. Understand the design principles for connected devices.
2. Understand the design principles of Internet connectivity.
3. Analyze the concepts of knowledge acquiring, managing and storing.
4. Understand the wide variety of sensors.
5. Design the software for IoT applications.

COURSE CONTENT

Name of the Subject: Internet of Things		**Semester:**	**VII**
Teaching Scheme:		**Examination scheme**	
Lectures:	**3 hours/week**	**End semester exam (ESE):**	**60 marks**
		Duration of ESE:	**03 hours**
		Internal Sessional Exams (ISE):	**40 marks**

Unit–I:	**No. of Lectures: 08 Hours**	**Marks: 12**

Internet of Things: An Overview:

Internet of Things, IoT Conceptual Framework, IoT Architectural View, Technology Behind IoT, Sources of IoT, M2M Communication, Examples of IoT

Design Principles for Connected Devices: IoT/M2M Systems Layers and Designs Standardization, Communication Technologies, Data Enrichment, Data Consolidation and Device Management at Gateway, Ease of Designing and Affordability

Unit–II:	No. of Lectures: 08 Hours	Marks: 12
Design Principles for Web Connectivity: Web Communication Protocols for Connected Devices, Message Communication Protocols for Connected Devices, Web Connectivity for Connected-Device a Network using Gateway, SOAP, REST, HTTP RESTful and Web Sockets **Internet Connectivity Principles:** Internet Connectivity, Internet-Based Communication, IP Addressing in the IoT, Media Access Control, Application Layer Protocols: HTTP, HTTPS, FTP, Telnet and Others		
Unit–III:	**No. of Lectures: 09 Hours**	**Marks: 12**
Data Acquiring, Organizing, Processing and Analytics: Data Acquiring and Storage, Organizing the Data, Transactions, Business Processes, Integration and Enterprise System, Analytics, Knowledge Acquiring, Managing and Storing Processes, **Data Collection, Storage and Computing Using Cloud Platform:** Cloud Computing Paradigm for Data Collection, Storage and Computing, Everything as a Service and Cloud service Models, IoT Cloud-Based Services using the Xively, Nimbits and Other Platforms		
Unit–IV:	**No. of Lectures: 08 Hours**	**Marks: 12**
Sensors, Participatory Sensing, RCIDs, and Wireless Sensor networks: Sensor Technology, Participatory Sensing, Industrial IoT and Automotive IoT, Actuator, Sensor Data Communication Protocols, Radio Frequency Identification Technology, Wireless Sensor Networks Technology **Prototyping the Embedded Devices for IoT and M2M:** Embedded Computing Basics, Embedded Platforms for Prototyping, Things Always Connected to the Internet/Cloud.		
Unit–V:	**No. of Lectures: 09 Hours**	**Marks: 12**
Prototyping and Designing the software for IoT Applications: Prototyping Embedded Device Software, Devices, Gateways, Internet and Web/Cloud Services Software-Development, Prototyping Online Component APIs and Web APIs **IoT Privacy, Security and Vulnerabilities Solutions:** Vulnerabilities, Security Requirements and Threat Analysis, Use Cases and Misuse Cases, IoT Security Tomography and Layered Attacker Model, Identity Management and Establishment, Access Control and Secure Message Communication, Security Models, Profiles and Protocols for IoT		
Text Books:		
1. Raj Kamal, “Internet of Things: Architecture and Design”, McGraw Hill		
Reference Books:		
1. Jeeva Jose, “Internet of Things”, Khanna Publishing House, Delhi		

Lab Bioinformatics

LAB COURSE OUTLINE

Course Title:	***Lab Bioinformatics***	**Short Title:**	**Lab Bioinfo**	**Course Code:**	

Course description:

This course aims to provide students with a practical and hands-on experience with common bioinformatics tools and databases. The goals of the course are to understand the basic principles of Bioinformatics and their applications in the field of Biotechnology.

Lecture	**Hours/week**	**No. of weeks**	**Total hours**	**Semester credits**
Laboratory	02	14	28	01

End Semester Exam (ESE) Pattern:	**Oral (OR)**

Prerequisite course(s): 12th Std. Science and SE Biotechnology Courses.

Course objectives: After completion of the course, students will be able to;

1. Develop the basic knowledge and practical skills in the field of bioinformatics.
2. Utilize various tools of bioinformatics.
3. Study structure of Biomolecules
4. Retrieve Biological information
5. Understand various types of sequence alignment

Course outcomes:

Upon successful completion of lab Course, student will be able to:

1. Apply practical knowledge for information retrieval.
2. Apply the basic knowledge for developing and using tools for sequence analysis of biomolecules.
3. Apply the basic knowledge for developing and using tools for structure analysis of biomolecules.
4. Carry out sequence alignment and analysis.
5. Explore the options for Bioinformatics in higher study

LAB COURSE CONTENT

Lab Bioinformatics		**Semester:**	VII
Teaching Scheme:		**Examination scheme**	
Practical:	**2 hours/week**	**End semester exam (ESE):**	***25 marks***
		Internal Continuous Assessment (ICA):	***25 marks***

List of Experiments (Note: Minimum Eight Experiments from the following)

1. Databases search: NCBI, EMBL
2. Basic Local Alignment Search Tool
3. Multiple sequence alignment.
4. Rasmol
5. Swiss PDB Viewer
6. Homology modelling
7. DS Visualizer
8. ArgusLab
9. Modeller
10. Chemsketch

11. Comparative docking of different HIV Protease inhibitors.
12. Pair wise alignment using Align / EMBOSS
13. Restriction Mapper.
14. Chou-Fasman Structure prediction.

Text Books:

1. Andreas D. Baxevanis and B. F. Francis Ouellette, Bioinformatics A Practical Guide to the Analysis of Genes and Proteins by, Second Edition, a john wiley & sons, inc., publication
2. Arthur M. Lesk, Introduction to Bioinformatics , Oxford University Press Inc., New York
3. Janusz M. Bujnicki, Practical Bioinformatics, SPRINGER (SIE)
4. S. C. Rastogi, Bioinformatics Concepts, Skills and Applications by , CBS; 2 edition.

Guide lines for ICA:

Students must submit ICA in the form of journal. Each practical should be well documented. Faculty in charge will assess the practical continuously and grade or mark each practical on completion date declared for each practical.

Guidelines for ESE:

ESE will be based on the oral examination of laboratory experiments submitted by the students in the form of journal.

Lab Plant Tissue Culture

LAB COURSE OUTLINE

Course Title:	*Lab Plant Tissue Culture*	Short Title:	Lab PTC	Course Code:	

Course description:

This course aims to provide students with a practical and hands-on experience various plant tissue culture techniques. The goals of the course are to understand the basic principles of tissue engineering and their applications in the field of Biotechnology.

Lecture	Hours/week	No. of weeks	Total hours	Semester credits
Laboratory	02	14	28	01

End Semester Exam (ESE) Pattern:	Oral (OR)

Prerequisite course(s): 12th Std. Science and SE Biotechnology Courses.

11^{th}, 12^{th} Science.

Course objectives: To;

1. Provide the basic knowledge of plant tissue culture and animal tissue culture.
2. Showcase various techniques of ATC and PTC.
3. Demonstrate the concept of molecular markers.
4. Explain basics of hardening and green house facility.
5. Impart the knowledge of the basics of primary culturing.

Course outcomes: After completion of the course, students will be able to;

1. Apply the basics of the lab design
2. Utilize various sterilization techniques
3. Apply the knowledge of various PTC techniques
4. Produce the synthetic seeds
5. Understand the genetic engineering approaches related to the course

LAB COURSE CONTENT

Lab Plant Tissue Culture		Semester:	VII
Teaching Scheme:		**Examination scheme**	
Practical:	**2 hours/week**	**End semester exam (ESE):**	***25 marks***
		Internal Continuous Assessment (ICA):	***25 marks***

List of Experiments (Note: Minimum Eight Experiments from the following)

1. Laboratory Setup & Introduction to PTC techniques
2. General Sterilization techniques
3. Preparation of culture medium sterilization of explants
4. Initiation of callus culture
5. Micropropogation/ Multiple shoot induction
6. Embryo culture
7. In-vitro seed germination
8. Meristem culture
9. RAPD (DEMO)
10. Hardening and acclimatization of in vitro raised rooted shoots
11. Encapsulate the shoot buds/ seeds to demonstrate the production of synthetic seeds

Text Books:

1. R.A.Dixon and Gonzales, Plant cell culture : A Practical Approach, IRL Press.
2. S.S.Purohit, Biotechnology Fundamentals and Applications, Agrobios (India), 4th

Edition, 2005.
3. S.S.Bhojwani and M.K.Razdan, Plant Tissue Culture : Theory and Practical, (1996) Elsevier, Amsterdam.
4. S.B Primrose and R.M.Twyman, Principles of Gene Manipulation and Genomics, Blackwell publishing, 7th edition, 2006.
5. A. Slater, N. Scott, M. Fowler, Plant Biotechnology: The genetic manipulation of plants; Published by Oxford University press, New York (2003)

Guide lines for ICA:

Students must submit ICA in the form of journal. Each practical should be well documented. Faculty in charge will assess the practical continuously and grade or mark each practical on completion date declared for each practical.

Guidelines for ESE:

ESE will be based on the oral examination of laboratory experiments submitted by the students in the form of journal.

Project (Stage - I)

LAB COURSE OUTLINE

Course Title:	**Project (Stage – I)**	**Short Title:**	**PROJ-SI**	**Course Code:**	

Course description:

Project (Stage-I) represent the culmination of study towards the Bachelor of Engineering degree. The project (Stage-I) offers the opportunity to apply and extend material learned throughout the program. The emphasis is necessarily on facilitating student learning in technical, project management and presentation spheres.

Laboratory	**Hours/week**	**No. of weeks**	**Total hours**	**Semester credits**
	12	**14**	**168**	**6**

End Semester Exam (ESE) Pattern:	**Oral (OR)**

Prerequisite course(s): SE, TE Biotechnology Courses

Course objectives: To,

1. Understand the basic concepts & broad principles of projects.
2. Understand the value of achieving perfection in project implementation & completion.
3. Apply the theoretical concepts to solve problems with teamwork and multidisciplinary approach.
4. Demonstrate professionalism with ethics; present effective communication skills and relate engineering issues to broader societal context.
5. Develop ability of extracting the material from the different sources and writing comprehensively and exhaustive report on an allotted topic.

Course outcomes:

Upon successful completion of lab Course, student will be able to:

1. Demonstrate a sound technical knowledge of their selected project topic.
2. Undertake problem identification, formulation and solution.
3. Design engineering solutions to complex problems utilizing a systems approach.
4. Conduct an engineering project
5. Demonstrate the knowledge, skills and attitudes of a professional engineer.

LAB COURSE CONTENT

Project (Stage – I)		**Semester:**	**VII**
Teaching Scheme:		**Examination scheme:**	
		End semester exam (ESE):	***50 marks***
Practical:	**12 hours/week**	**Internal Continuous Assessment (ICA):**	**50 marks**

At final year the students shall carry out a project (Stage-I) in a group of maximum up to 5 students. The project work spans both the semesters. By the end of Semester – VII the students shall complete the partial work, and by the end of Semester – VIII the students shall complete remaining part of the project. Assessment for the project shall also include presentation by the students. Each teacher can guide maximum 04 groups of projects.
The students should take project work, as specified in the curriculum, based on the

knowledge acquired by the students during the degree course till Semester – VI. The project may be either fully theoretical / practical or involving both theoretical and practical work to be assigned by the Department. The work may also be Study / Survey / Design.

Project (Stage – I) may involve literature survey, problem identification, design methodology, collection of data etc. The project work shall involve sufficient work so that students get acquainted with different aspects of design and analysis. Approximately more than 50% work should be completed by the end of Semester – VII. Each student group should submit partial project report in the form of thermal bound at the end of Semester –VII.

Each student group is required to maintain separate log book for documenting various activities of the project.

Suggestive outline for the partial project report is as follows.

Abstract
Chapter 1. Introduction
Chapter 2. Literature Survey
Chapter 3. Methodology
Chapter 4. Results & Discussion
Chapter 5. Conclusion
Bibliography
Index
Appendix

Guide lines for ICA:

The Internal Continuous Assessment (ICA) for project shall be based on continuous evaluation of students' performance, active participation, knowledge / skill acquired throughout semester and presentation by the students. The assessment shall be done jointly by the guide and departmental committee. A three-member departmental committee including guide, appointed by Head of the department, shall be constituted for the assessment. The assessment for Project (stage – I) in Semester – VII shall be as per the guidelines given in Table – A.

Table – A

		Assessment by Guide					Assessment by Departmental Committee		
Sr. No.	Name of the Student	Attendance / Participation	Problem Identification / Project Objectives	Literature Survey	Methodology / Design	Report	Depth of Understanding	Presentation	Total
	Marks	5	5	5	5	5	10	15	50

Guidelines for ESE:

In End Semester Examination (ESE), the student may be asked for presentation / demonstration and questions on Project. Evaluation will be based on answers given by students in oral examination.

Essence of Indian Traditional Knowledge

Course objective:
The course aims at imparting basic principles of thought process, reasoning and inferencing; sustainability is at the core of Indian traditional knowledge system connecting society and nature. Holistic life style of yogic science and wisdom capsules in Sanskrit literature are also important in modern society with rapid technological advancements and societal disruptions. The course focuses on introduction to Indian knowledge systems, Indian perspective of modern scientific world-view, and basic principles of yoga and holistic health care system, Indian artistic tradition.

Outcomes:
Ability to understand, connect up and explain basics of Indian traditional knowledge in modern scientific perspective.

Course Contents:
Introduction to:

1. Ayurveda, Charaka Samhita, Sushruta Samhita
   Principles and Terminology: Vatha, Pitha, Kapha, Ether, Earth, Water, fire and Air Tatva, Influence of these on human health.
2. Architecture: Temple Architecture, Indo – Islamic Architecture, Mughal Architecture, Indian Rock Cut Architecture, Vastu Shastra.
3. Importance of Yoga for Physical and Mental health, Yoga Sutras of Patanjali, Meditation, International day of Yoga.
4. Indian Classical Music, Hindustani and Carnatic Music, Raga, Tala, Dhrupad, Khyal, Tarana and Thumri, Sangitaratnakara, Work of Tansen, Purandara Dasa, Bhimsen Joshi, Ustad Bismillah Khan, Bal Gandharva etc.
   Folk Music and Dances such as Rajasthani, Marathi, Gujrati, Punjabi etc.
5. Indian Classical Dances: Shastriya Nritya, Natya Shastra, Bharatanatyam, Kathak, Kuchipudi, Odissi, Kathakali, Sattriya, Manipuri, Mohiniyattam and Chhau dance forms.

References:

1. Amit Jha, “Traditional knowledge system in India”, Atlantic Publisher, ISBN 978812691223
2. Basanta Kumar Malhotra, “Traditional Knowledge System and Technology in India”, Pratibha Prakashan, ISBN 8177-023101
3. Nitin Singhania, “Indian Art and Culture”, McGraw Will Publication.
4. Dr. Bramhand Tripathi, “Charak Sanhita”, Chaukhambha Surbharti Prakashan, ISBN: 9381-4847-59
5. Dr. Anantram Sharma, “Sushrut Samhita”
6. Valiatham M.S., “An Introduction to Ayurveda” Orient Bkackswan Publication.
7. Valiathan M.S., “The legacy of Charaka” University Press.
8. Valiathan M.S., “The legacy of Susruta” University Press.
9. Garg Maheshwari, “Ancient Indian Architecture”, CBS Publisher and Distributors
10. Sharmin Khan, “History of Indian Architecture”, CBS Publisher and Distributors.
11. Bindia Thapar, Surat ku. Manto, Suparana Bhalla, “Introduction to Indian Architecture”, Periplus Editions Ltd.
12. Vijay Prakash Singh, “An Introduction to Hindustani Classical Music”, Lotus Publisher

13. Leeta Venkataraman, Avinash Pasricha, “Indian Classical Dance” Lustre Publisher
14. Shovana Narayan, “Indian Classical Dances” New Dawn Press
15. Kapila Vatsyayan, “Indian Classical Dance”, Ministry of Information and Broadcasting, Govt of India.
16. Mahadevan Ramesh, “A Gentle introduction to Carnatic Music”, Oxygen books Publisher.

Kavayitri Bahinabai Chaudhari

NORTH MAHARASHTRA UNIVERSITY, JALGAON (M.S.)

Final Year Engineering

(Biotechnology Engineering)

Faculty of Science and Technology

कवयित्री बहिणाबाई चौधरी उत्तर महाराष्ट्र विद्यापीठ
अंतरी पेटवू ज्ञानज्योत
1990
'A' Grade
NAAC Re-Accredited
3rd Cycle

SYLLABUS STRUCTURE

Semester – VIII

W.E.F. 2021 – 22

Bioprocess Industries					
COURSE OUTLINE					
Course Title:	**Bioprocess Industries**	**Short Title:**	**BPI**	**Course Code:**	

Course description:

This course is aimed at introducing the fundamentals of industrial bioprocess engineering. The basics of bioreactor designing have also been incorporated in the course.

Lecture	**Hours/week**	**No. of Weeks**	**Total hours**	**Semester credits**
	03	14	42	03

Prerequisite course(s):- 11th, 12th Biology, SE Biotechnology courses

Course objectives: To,

1. Provide the basic knowledge of bio processes and its industrial application.
2. Familiarize various aspects of bioreactors.
3. Understand the media requirements and working conditions for profitable run of bioprocess industries with the help of data analysis.
4. Understand the concepts of Pilot plant operations.
5. Learn the fermentation process of biomolecules through rDNA Technology.

Course outcomes:

After successful completion of this course the student will be able to:

1. Apply knowledge of chemical and mechanical engineering for design of biological system in biotech industries.
2. Get the knowledge of properties of materials and its view in designing bioprocess equipment within the standards prescribed by regulating authority in India and world.
3. Design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability and sustainability.
4. Work in an industrial or research position within the bioprocess or related fields.
5. Demonstrate the technology behind Biotransformation.

COURSE CONTENT

Name of the Subject: Bioprocess Industries		**Semester:**	VIII
Teaching Scheme:		**Examination scheme**	
Lectures:	**3 hours/week**	**End semester exam (ESE):**	**60 marks**
		Duration of ESE:	**03 hours**
		Internal Sessional Exams (ISE):	**40 marks**

Unit–I:	**No. of Lectures: 08 Hours**	**Marks: 12**

Pilot plant units:

General aspects regarding purpose and function, size and location, organization personnel, programming operation, sampling reporting of results and safety costs budgeting.

Unit–II:	**No. of Lectures: 08 Hours**	**Marks: 12**

Pilot plant operations:

Pilot plant designs, ducts and flow pass as age, Power per unit volume of liquid, Volumetric mass (oxygen)- transfer coefficient, mixing time concept, design example of scale-up.

Unit–III:	**No. of Lectures: 09 Hours**	**Marks: 12**

Bioreactor Operation:

Choosing the cultivation method, design and operation of a typical aseptic, aerobic

fermentation process, alternate bioreactor configurations, Environmental requirements for animal cell cultivations, reactors for large scale production using animal cell, plant cell cultivation and bioreactor considerations in immobilized cell.

Unit–IV:	No. of Lectures: 09 Hours	Marks: 12

Biopharmaceuticals and Biotransformation:
Production of penicillin, B-Lactum antibiotics, Streptomycin, Cephalosporins, Aminoglycoside, Tetracyclines, Steroid Biotransformation.

Unit–V:	No. of Lectures: 08 Hours	Marks: 12

Important products through r-DNA technology:
Hepatitis B, vaccine, interferons, Insulin, somatotrophic hormone, therapeutic proteins Vaccines.Production of biodiesel and biogas, Biological production of hydrogen and biofuel cellsBiological waste treatment (utilization of mixed culture).

Text Books:

1. Johnstone and Thring: Pilot Plant Models and Scale up Methods in Chemical Engineering. McGraw Hill Book Co.1987.
2. Aiba.S, Humphery A.E and Millis.N.F, Biochemical Engineering,Academic Press,1965.
3. Shuler, M.L. and Kargi,F. Bioprocess Engineering - Basic concepts – 2 nd ed., Prentice Hall of India Pvt. Ltd., 2005

Reference Books:

1. Peter F. Stanbury, Stephen J. Hall & A. Whitaker, Principles of Fermentation Technology, 2 nd ed., Butterworth – Heinemann An Imprint of Elsevier India Pvt. Ltd., 2005.
2. Bailey and Ollis, “Biochemical Engineering Fundamentals”, 2 nd ed.,McGraw Hill, 1986.
3. Pauline M. Doran, “Bioprocess Engineering Calculation”, Blackwell Scientific Publications.

Professional Elective Course - V

Molecular Biology of Cancer

COURSE OUTLINE

Course Title:	*Molecular Biology of Cancer*	**Short Title:**	**MBC**	**Course Code:**	

Course description:

This course is aimed at developing the basic knowledge and skills of molecular biology of cancer to undergraduate students. The goals of the course are to understand the basic principles of cancer biology.

Lecture	**Hours/week**	**No. of Weeks**	**Total hours**	**Semester credits**
	03	14	42	03

Prerequisite course(s):- SE & TE Biotechnology courses

Course objectives: To,

1. Familiarize the students with an understanding of the molecular mechanisms of cancer,
2. Study of development types of cancer by various factors such as physical, chemical, diet and retroviruses etc.
3. Study the effect of mutations involving anti and pro apoptotic genes and defects in DNA repair mechanisms along with strategies for cancer treatment.
4. Demonstrate the concepts of immunotherapy.
5. Understand the concept regarding detection of cancer.

Course outcomes:

After successful completion of this course the student will be able to:

1. Understand the types of cancer.
2. Understand the metabolism of carcinogenesis.
3. Study the about the different types of Oncogenes.
4. Understand various techniques for detection of cancer.
5. Apply the knowledge of various types of cancer therapy.

COURSE CONTENT

Name of the Subject: Molecular Biology of Cancer		**Semester:**	VIII
Teaching Scheme:		**Examination scheme**	
Lectures:	**3 hours/week**	**End semester exam (ESE):**	**60 marks**
		Duration of ESE:	**03 hours**
		Internal Sessional Exams (ISE):	**40 marks**

Unit–I:	**No. of Lectures: 08 Hours**	**Marks: 12**

Fundamentals of Cancer Biology:

Regulation of Cell cycle, mutations that cause changes in signal molecules, effects on receptor, signal switches, Different forms of cancer – Classification: Epidemiology of cancer.

Unit–II:	**No. of Lectures: 08 Hours**	**Marks: 12**

Principles of Carcinogenesis:

Principles of Physical Carcinogenesis, X - Ray radiation, UV – mechanism of radiation Carcinogenesis; Chemical Carcinogenesis, Metabolism of Carcinogenesis, Natural History of Carcinogenesis, Targets of Chemical Carcinogenesis, Diet & Cancer.

Unit–III:	No. of Lectures: 09 Hours	Marks: 12
Molecular Cell Biology of Cancer: Oncogenes, Identification of Oncogenes, Viruses and Cancer, Detection of Oncogenes, Growth Factor and Growth Factor receptors that are Oncogenes. Oncogenes / Proto Oncogene activity. Growth factors related to transformations. Signal transduction and aberrant cell growth. **Principles of cancer metastasis:** Clinical significances of invasion, heterogeneity of metastatic phenotype, Metastatic cascade, Basement Membrane disruption, Three-step theory of Invasion, Proteinases and tumour cell invasion.		
Unit–IV:	**No. of Lectures: 09 Hours**	**Marks: 12**
Detection of Cancer: Detection of Cancers, Prediction of aggressiveness of Cancer, Advances in Cancer detection.		
Unit–V:	**No. of Lectures: 08 Hours**	**Marks: 12**
Tumor Suppression and Cancer Therapy: Tumor suppressor genes, modulation of cell cycle in cancer. Different forms of therapy, Chemotherapy- new molecules, radiation Therapy, and Immunotherapy: advantages and limitations.		
Text Books:		
1. L.M. Franks, N.M. Teich. An Introduction to Cellular and Molecular Biology of Cancer, New Edition, Oxford Medical publications. 2. Raymond. W. Ruddon, Text book of Cancer Biology, Oxford University press.		
Reference Books:		
1. Dunmock N.J and Primrose.S.B., Introduction to modern Virology, Blackwel.		

Professional Elective Course - V					
Molecular Modeling and Drug Design					
COURSE OUTLINE					
Course Title:	*Molecular Modeling and Drug Design*	**Short Title:**	**MMDD**	**Course Code:**	

Course description:

This course is aimed at developing the basic knowledge and skills of Molecular Modeling and Drug Design to undergraduate students. The goals of the course are to understand the basic principles of Drug Design.

Lecture	Hours/week	No. of Weeks	Total hours	Semester credits
	03	14	42	03

Prerequisite course(s):- Chemistry, SE Biotechnology courses

Course objectives: To,

1. Demonstrate quantum chemistry for Modeling of small molecules.
2. Showcase force fields for molecular modeling.
3. Familiarize protein-protein interactions and DNA conformation.
4. Explain basic concepts of drug designing.
5. Accustom various methods followed in molecular modeling and drug design.

Course outcomes:

After successful completion of this course the student will be able to:

1. Do mathematical modeling of bioprocess engineering system.
2. Do computer aided design of various equipments used in bioprocess industries.
3. Do mathematical modeling of biological system.
4. Do simulation of bioprocess equipment.
5. Learn the software for modeling and simulation.

COURSE CONTENT

Name of the Subject: *Molecular Modeling and Drug Design*		**Semester:**	VIII
Teaching Scheme:		**Examination scheme**	
Lectures:	**3 hours/week**	**End semester exam (ESE):**	**60 marks**
		Duration of ESE:	**03 hours**
		Internal Sessional Exams (ISE):	**40 marks**

Unit–I:	**No. of Lectures: 08 Hours**	**Marks: 12**

Quantum chemistry for Modeling of small molecules: Variation method and Time independent Perturbation theory. Ab initio methods for molecules: Hartree-Fock SCF method. Common basis sets.

Unit–II:	**No. of Lectures: 08 Hours**	**Marks: 12**

Introduction to semi-empirical methods: Huckel molecular orbital theory. Pariser-Parr-Pople method. CNDO, AM1 and PM3.

Unit–III:	**No. of Lectures: 09 Hours**	**Marks: 12**

Force fields for molecular modeling: Choice of functional form. Parametrization of a force field. Anharmonicity. Distributed multipole and polarizable forcefields. The hydrogen bond. Hydrophobic effect and solvation energy. Potentials of mean force.

Unit–IV:	**No. of Lectures: 09 Hours**	**Marks: 12**

Conformational analysis: Geometry optimization using steepest descent and conjugate gradients. Restrained and constrained molecular dynamics. Distance geometry. Case studies: Prediction of protein-protein interactions. DNA conformation.		
Unit–V:	**No. of Lectures: 08 Hours**	**Marks: 12**
Principles of ligand based drug design: SAR, QSAR and 3D-QSAR. Receptor based drug design: Principles of receptor based de novo ligand design. Rigid body molecular Docking.		
Text Books:		
1. Andrew Leach. Molecular modeling: principles and applications. 2nd ed. Pearson Education. 2001.		
Reference Books:		
1. Atkins and Friedman. Molecular quantum mechanics. Oxford University Press. 4th ed. 2005.		

Professional Elective Course - V					
Bioprocess Modeling and Simulation					
COURSE OUTLINE					
Course Title:	*Bioprocess Modeling and Simulation*	**Short Title:**	**BPMS**	**Course Code:**	

Course description:

This course is aimed at developing the basic knowledge and skills of Bioprocess Modeling and Simulation to undergraduate students. The goals of the course are to understand the basic principles of Bioprocess Modeling and Simulation.

Lecture	Hours/week	No. of Weeks	Total hours	Semester credits
	03	14	42	03

Prerequisite course(s):- SE & TE Biotechnology courses

Course objectives: To,

1. Explain conservation principle, model representation, types of modeling equations, types of mathematical models, computer simulation, use of simulated process model.
2. Demonstrate knowhow the process and the model – Process description, mathematical model, application of control algorithm for batch reactor, semi batch reactor, CSTR and Bioreactor.
3. Showcase the process and the model – Process description, mathematical model for compartmental distillation, ideal binary distillation and activity coefficient model.
4. Study the module for binary batch distillation column, binary continuous distillation column and development of soft-sensor for distillation column.
5. Demonstrate skill of the module consideration for multicomponent batch distillation column, equilibrium flash vaporization and adiabatic flash.

Course outcomes:

After successful completion of this course the student will be able to:

1. Do mathematical modeling of bioprocess engineering system.
2. Do computer aided design of various equipments used in bioprocess industries.
3. Do mathematical modeling of biological system.
4. Do simulation of bioprocess equipment.
5. Learn the software for modeling and simulation.

COURSE CONTENT

Name of the Subject: Bioprocess Modeling and Simulation		**Semester:**	VIII
Teaching Scheme:		**Examination scheme**	
Lectures:	**3 hours/week**	**End semester exam (ESE):**	**60 marks**
		Duration of ESE:	**03 hours**
		Internal Sessional Exams (ISE):	**40 marks**

Unit–I:	**No. of Lectures: 08 Hours**	**Marks: 12**

Introduction of modeling and simulation:

Definition, conservation principle, model representation, types of modeling equations, types of mathematical models, computer simulation, use of simulated process model.

Numerical Methods: Interative convergence methods – Bisection method (Interval halving), Secant method, Newton-Raphson Method , Muller method

Unit–II:	No. of Lectures: 08 Hours	Marks: 12
Batch reactor : The process and the model – Process description, mathematical model, application of control algorithm Semi-batch rector : Mathematical model,Continuous stirred tank react : The process and the model – Process description, mathematical model Multi steady states: Representative process,, steady state solution, Multi steady states behavior pH Neutralization rector: Process description, mathematical model Bioreactor: Chemical engineering in bioprocess industry, operation stages in a bioprocess, Biochemical reactor, Continuous stirred tank bio reactor: Process description, mathematical model		
Unit–III:	**No. of Lectures: 09 Hours**	**Marks: 12**
Compartmental distillation model : Introduction, an overview, Process description, mathematical model Ideal binary distillation column : Introduction, the process and the model – Process description, mathematical model Activity coefficient models: Introduction, Activity coefficient models for liquid mixtures – The Margules model, The Van Laar model, The Wilson model		
Unit–IV:	**No. of Lectures: 09 Hours**	**Marks: 12**
Binary batch distillation column: Introduction, features of batch distillation column, start up procedure of a batch column – simulation procedure for the initial filling An example of process and model ; Material and energy balance equations, entahlphy calculation, tray hydraulics, murphree vapour-phase tray efficiency, molecular weight and density of the tray liquid and vapour-liquid equilibrium, Software sensor : Development of soft-sensor for distillation column Binary continuous distillation column: Introduction, The process and the model – Material and energy balance		
Unit–V:	**No. of Lectures: 08 Hours**	**Marks: 12**
Biological Models. Modeling of gene regulation, Modeling of signal transduction in prokaryotes and eukaryotes, Models for inheritance, Genetic inbreeding model, Simple logistic models, Simple prey predator models, Microbial population models (growth model, product formation), Pharmaceutical models.		
Text Books:		
1. Amiya K.Jana, Chemical process modeling and simulation, PHI Learning Private Limited, Delhi Second Edition. 2. R.W.Gaikwad, Dr.Dhirendra, Process Modelling and Simulation, Central Techno Publication, Nagpur. First Edition.		
Reference Books:		
1. W. L. Luyben , Process Modeling Simulation and Control for Chemical Engineers; McGraw Hill 1988. 2. B.C. Bhattacharya, C. M. Narayan, Computer Aided Design of Chemical Process Equipment: 1st Edition, 1992, New Central Book Agency (P) Ltd. Calcutta.		

Professional Elective Course - V					
Biotechnology of Waste Treatment					
COURSE OUTLINE					
Course Title:	*Biotechnology of Waste Treatment*	**Short Title:**	**BWT**	**Course Code:**	

Course description:

This course is aimed to develop the basic knowledge and operations of waste water treatment processes to undergraduate students. The goals of the course are to understand the basic principles of treatment processes and their applications in engineering trade.

Lecture	**Hours/week**	**No. of Weeks**	**Total hours**	**Semester credits**
	03	14	42	03

Prerequisite course(s):- Biology, SE & TE Biotechnology courses

Course objectives: To,

1. Acquire basic knowledge and skills of waste treatment processes,
2. Biochemistry of Waste Treatment
3. Adopt suitable techniques for waste treatment
4. Understand physical, chemical and biological waste treatment processes
5. Understand the Biological Degradation processes for complex compounds.

Course outcomes:

After successful completion of this course the student will be able to:

1. Implement Engineering strategy for designing the models for waste treatment programmes.
2. Apply the theoretical concepts for designing the experiments for studying the metabolism of various compounds present in waste water.
3. Apply the knowledge for modeling the systems for waste water treatment which will be beneficial for environment and human kind.
4. Explain the advantages behind utilization of waste water treatment via biological way rather than chemical method.
5. Identify, formulate and solve the problems arises due to waste.

COURSE CONTENT

Name of the Subject: Biotechnology of Waste Treatment		**Semester:**	VIII
Teaching Scheme:		**Examination scheme**	
Lectures:	**3 hours/week**	**End semester exam (ESE):**	**60 marks**
		Duration of ESE:	**03 hours**
		Internal Sessional Exams (ISE):	**40 marks**

Unit–I:	**No. of Lectures: 08 Hours**	**Marks: 12**

Introduction:

Introduction to waste treatment, Site surveys for waste treatment programme, Strengths of fermentation waste, Disposal of effluents, Treatment process(physical, chemical and biological), Bacterial growth and factors affecting growth kinetics, Important biological reactions: Aerobic heterotrophic reaction, Nitrification, Denitrification, Anaerobic digestion.

Unit–II:	**No. of Lectures: 08 Hours**	**Marks: 12**

Biochemistry of Waste Treatment:

Introduction, Oxygen uptake, Dissolved oxygen, Enzymes, Nitrogen metabolism, Phosphorus

and sulphur, Elements and growth factors, Fate of individual chemicals, Structure activity relationships, Multisubstrate and species interactions, Biochemical indicators, Precipitation in waste treatment, Coagulation in waste treatment.		
Unit–III:	**No. of Lectures: 09 Hours**	**Marks: 12**
Waste Treatment Processes: Characteristics of activated sludge, Theory of activated sludge process, Design, Operation and control, Operation and design features of trickling filters, Rotating biological contractor, Aerated lagoons, Anaerobic digestion, Packed beds, Land farming.		
Unit–IV:	**No. of Lectures: 09 Hours**	**Marks: 12**
Nitrification and Denitrification and Anaerobic Treatment: Introduction, Forms of nitrogen, Nitrifying and denitrifying bacteria, Stoichiometry of nitrification and denitrification, Process variables in nitrification and denitrification process, Nitrification processes: Plug flow v\s complete mix, Single stage v\s two stage systems, Biofilm nitrification, Denitrification using methanol, Organic matter and thiosulfate and sulfide, Anaerobic reactor system.		
Unit–V:	**No. of Lectures: 08 Hours**	**Marks: 12**
Biological Degradation: Introduction, Determination of biological degradability, Pilot studies: PCB (polychlorinated biphenols) biodegradation, Methylethyl ketone, Aerobic biodegradation: TCE (trichloro ethane) Degradation, Polycyclic aromatic hydrocarbon degradation, Oil degradation, phenanthrene degradation.		
Text Books:		
1. Nicholas P.Cheremisinoff, Biotechnology for waste water treatment,Eastern Economy edition. 2. Bruce E Rittmann, Rurry L.Mc carty, Environmental Biotechnology:Principles and Applications, Mcgraw Hill international. 3. A.K.Chatterji, Introduction to environmental biotechnology,Eastern Economy		
Reference Books:		
1. Murray Moo - Young, Comprehensive biotechnology, vol 4- Pergamon Press. 2. P. F. Stanbury, A. Whitaker and S. J. Hall, Principles of fermentation technology Aditya book private limited.		

Professional Elective Course - VI					
Genomics & Proteomics					
COURSE OUTLINE					
Course Title:	*Genomics & Proteomics*	**Short Title:**	**G&P**	**Course Code:**	

Course description:
This course is introduced for learning the science of genomics and proteomics to understand the entire DNA sequence of organisms in order to improve human health or advance agricultural technology and applying the techniques of molecular biology, biochemistry, and genetics to analyzing the structure, function, and interactions of the proteins produced by the genes of a particular cell, tissue, or organism, with organizing the information in databases, and with applications of the data.

Lecture	**Hours/week**	**No. of Weeks**	**Total hours**	**Semester credits**
	03	14	42	03

Prerequisite course(s):- SE & TE Biotechnology courses

Course objectives: To,

1. Study the DNA sequence of organism.
2. Explain various techniques used for the sequencing of DNA.
3. Get acquainted with various techniques used for the protein sequencing.
4. Impart the knowledge of basic concepts of genomics.
5. Discuss basic concepts of proteomics.

Course outcomes:

After successful completion of this course the student will be able to:

1. Sequence the DNA of various organisms.
2. Apply their knowledge in order to improve human health by studying genome sequence.
3. Analyze the interactions of proteins.
4. Use modern techniques of protein sequencing.
5. Use modern techniques of genome sequencing

COURSE CONTENT

Name of the Subject: Genomics & Proteomics		**Semester:**	VIII
Teaching Scheme:		**Examination scheme**	
Lectures:	**3 hours/week**	**End semester exam (ESE):**	**60 marks**
		Duration of ESE:	**03 hours**
		Internal Sessional Exams (ISE):	**40 marks**

Unit–I:	**No. of Lectures: 08 Hours**	**Marks: 12**

Introduction to Genomics:
New science of genomics, orientation and structure of genomes, Introduction to Structural and Functional genomics, assembling a physical map of a genome, Features of prokaryotic eukaryotic & organellar genomes, Genome sizes- C value paradox, Gene counting.

Unit–II:	**No. of Lectures: 08 Hours**	**Marks: 12**

DNA sequencing technique:
Principles of DNA sequencing, Methods of preparing genomic DNA for sequencing, Early

sequencing efforts, DNA sequencing: Sanger Dideoxy method, Automated DNA sequencing, Shotgun sequencing- contig assembl, Fluorescence method.

Unit–III:	No. of Lectures: 09 Hours	Marks: 12

Sequence of organism:

Genome projects on *E.coli*., Arabidopsis and rice; Human genome project and the genetic map. Functional genomics studies with model systems such as Drosophila, Yeast.

Unit–IV:	No. of Lectures: 09 Hours	Marks: 12

Proteomics:

Proteomics and Proteomes, Various tools used in proteomics, Mining proteomes, protein expression profiling, identifying protein – protein Interactions and protein complexes, mapping- protein identification, new directions in proteomics**.**

Unit–V:	No. of Lectures: 08 Hours	Marks: 12

Techniques in Proteomics:

Protein level estimation – Edman protein microsequencing, Protein cleavage,2D gel Electrophoresis, Metabolic labelling, Detection of proteins on SDS gel, Pattern analysis, Mass spectrometry, Principles of MALDI-TOF, Tandem MS-MS, Peptide mass Fingerprinting.

Text Books:

1. Primrose, S.B. and Twyman, R.H., "Principles of Genome Analysis and Genomics"Blackwell Publishing Co., 2003.
2. Liebler, D.C., "Introduction to Proteomics", Humana Press, 2002
3. Arthur M Lesk, Introduction to Genomics Oxford University Press.
4. Sabesan, Genomics & Proteomics, Ane Books.

Reference Books:

1. Pennington, S.R. and Dunn, M.J., "Proteomics", BIOS Scientific Publishers, 2001.
2. Hunt, S.P., Livesey, R. and Livesey, F.J., "Functional Genomics: A Practical Approach" Oxford University Press, 2000.
3. Suhai S., "Genomics and Proteomics: Functional and Computational Aspects", Springer 2000.
4. Cantor, C.R. and Smith, C.L., "Genomics: The Science and Technology Behind the Human Genome Project", Wiley and Sons, 1999.

Professional Elective Course - VI					
Introduction to Biomaterials					
COURSE OUTLINE					
Course Title:	*Introduction to Biomaterials*	**Short Title:**	**IB**	**Course Code:**	

Course description:

This course is aimed to develop the basic knowledge of properties of biomaterials to undergraduate students. The goals of the course are to understand the basic principles of biopolymers, fermentation processes and their applications in engineering.

Lecture	**Hours/week**	**No. of Weeks**	**Total hours**	**Semester credits**
	03	14	42	03

Prerequisite course(s):- Biology, SE & TE Biotechnology courses

Course objectives: To;

1. Study general properties of materials
2. Explain various classes of materials used in medicine
3. Study various classes of biopolymers
4. Demonstrate fermentative production of polyesters
5. Get acquainted with various industrial applications of biomaterials

Course outcomes:

After successful completion of this course the student will be able to:

1. Classify materials used in medicine.
2. Choose suitable biomaterial for utilization.
3. Apply the knowledge of biomaterials in various industrial processes.
4. Classify biopolymers.
5. Carry out Fermentative production of polyesters.

COURSE CONTENT

Name of the Subject: Introduction to Biomaterials		**Semester:**	VIII
Teaching Scheme:		**Examination scheme**	
Lectures:	**3 hours/week**	**End semester exam (ESE):**	**60 marks**
		Duration of ESE:	**03 hours**
		Internal Sessional Exams (ISE):	**40 marks**

Unit–I:	**No. of Lectures: 08 Hours**	**Marks: 12**

General properties of materials, Classes of materials used in medicine: Metals, Polymers, Hydrogels, Bioresorbable and Biodegradable Materials, Ceramics, Natural materials, composites thin films, grafts, Coatings medical fibers and Biological functional materials, Smart materials, Pyrolytic Carbon for long-term medical Implants, textured and Porous materials, non-fouling surfaces.

Unit–II:	**No. of Lectures: 08 Hours**	**Marks: 12**

Application of biocatalyst such as enzymes and microorganisms in biotransformation process, development of polymer precursors using Biotransformation processes Precursors: aromatic hydrocarbons, biological formation of specialty hydroxylated monomers, L homophenylalanine production using membrane bioreactor.

Unit–III:	No. of Lectures: 09 Hours	Marks: 12
Biopolymers: Classification (nucleic acid, protein, polysaccharide), Manufacturing, chemistry and applications of polysaccharide such as dextran, xanthan, gellan, pullalane, chitin, chitosan, etc., structural characterization using protein sequencing by Edman degradation, mass spectrometer, optical tweezer (or atomic force microscopy)		
Unit–IV:	**No. of Lectures: 09 Hours**	**Marks: 12**
Fermentative production of polyesters with special emphasis on polyhydroxyalkanoates, and biodegradable polymers such as polylactic acid, polyglycolide and polycaprolactone, lactoyllactic acid, Structure, physical and chemical properties including production of the above polymers		
Unit–V:	**No. of Lectures: 08 Hours**	**Marks: 12**
Applications of materials in medicine, Dentistry and Biology: Cardiovascular medical devices, Nonthrombogenic treatments and Strategies, Dental implantation adhesive and Sealants, Ophthalmologic applications-intraocular lens implants, Orthopedic biomaterials, Artificial organs and tissues.		
Text Books:		
1. Buddy D. Ratner, Frederick J. Schoen, Allan S. Hoffman, Jack E. Lemons, Biomaterials Science: An Introduction to Materials in Medicine. 2. Hench L L Ethridgc E.C. Biomaterials, an interfacial approach, Academic press 1982		
Reference Books:		
1. Bronzino J D, The biomedical engineering handbook CRC Press		

Professional Elective Course - VI

Industrial Biotechnology

COURSE OUTLINE

Course Title:	*Name of the Subject: Industrial Biotechnology*	**Short Title:**	**InBio**	**Course Code:**	

Course description:

This course is aimed to develop the basic knowledge of industrial biotechnology to undergraduate students. The goals of the course are to understand the basic principles of biomolecules and bioremediation and their applications in engineering.

Lecture	**Hours/week**	**No. of Weeks**	**Total hours**	**Semester credits**
	03	14	42	03

Prerequisite course(s):- Biology, SE & TE Biotechnology courses

Course objectives: To,

1. Impart the knowledge of microbes & microbial processes.
2. Study fermentation and optimization of processes.
3. Get familiarize with basic concepts of industrial microbiology.
4. Discuss various causes of different types pollution.
5. Study various remedial approaches to tackle pollution.

Course outcomes:

After successful completion of this course the student will be able to:

1. Get familiarize with various enzymes used in industry.
2. Gain the knowledge regarding Primary and Secondary metabolites.
3. Apply their knowledge to effectively manage hazardous waste.
4. Apply various strategies of bioremediation.
5. Adopt eco friendly approaches and renewable energy alternatives to minimize the pollution.

COURSE CONTENT

Name of the Subject: Industrial Biotechnology		**Semester:**	VIII
Teaching Scheme:		**Examination scheme**	
Lectures:	**3 hours/week**	**End semester exam (ESE):**	**60 marks**
		Duration of ESE:	**03 hours**
		Internal Sessional Exams (ISE):	**40 marks**

Unit–I:	**No. of Lectures: 08 Hours**	**Marks: 12**

Enzymes and Recombinant Proteins:

Proteases; Lipases; Cellulases; Other commercially important enzymes for food & pharma. Insulin; Interleukin (IL-2); Interferon (IFN-Gamma); Recombinant vaccines (Hepatitis).

Unit–II:	**No. of Lectures: 08 Hours**	**Marks: 12**

Primary and Secondary metabolites:

Organic acids (Citric & Lactic acid); Amino acids (Glutamic acid & Phenyl alanine); Alcohols (Ethanol & Butanol).

Secondary metabolites:

Antibiotics (Beta lactams, Cephalosporins, Streptomycin & Erythromycin); Vitamin B12 ; Overview of steroids (no description of process).

Unit–III:	No. of Lectures: 09 Hours	Marks: 12
Bioremediation and Hazardous Waste Management: Overview & definition of Bioremediation; Strategies of Bioremediation; Types of Bioremediation: *Insitu* & *Exsitu*; Applications of Bioremediation; A case study for bioremediation of Heavy metals like Mercury; Constrains and priorities of Bioremediation. Hazardous Waste Management: Hazardous Waste Characteristics; Sources and types; Biotechnological applications for hazardous waste management.		
Unit–IV:	**No. of Lectures: 09 Hours**	**Marks: 12**
Water pollution and biological treatment of wastewater: Domestic and Industrial wastewater characteristics; Biological process for wastewater treatment; Aerobic system and anaerobic system; Domestic wastewater treatment schemes.		
Unit–V:	**No. of Lectures: 08 Hours**	**Marks: 12**
Novel Biotechnological Applications for environmental management: Biofuels; Biopolymers; Biofertilizers; Biopesticides; Biofilms; Bioleaching.		
Text Books:		
1. John E. Smith, Biotechnology, 5th edition. Cambridge low price editions. 2. S.M.Reddy, S.Ram Reddy, G.Narendra Babu, Basic Industrial Biotechnology. New Age International Publishers, 2012. 1. A. H. Patel, Stanier R. Y., Ingram J.L.,Wheelis M.L., Painter R.R., General Industrial Microbiology.		
Reference Books:		
2. Prescott and Dunn, Microbiology. 3. Glazer, A.N. and Nikaido, H., Microbial biotechnology. W.H. Freeman &Company, New York. 4. Foster C.F., John Ware D.A., Environmental Biotechnology, Ellis Horwood Ltd., 5. Karrely D., Chakrabarty K., Omen G.S., Biotechnology and Biodegradation,		

Professional Elective Course - VI					
Animal Biotechnology					
COURSE OUTLINE					
Course Title:	*Name of the Subject : Animal Biotechnology*	**Short Title:**	**AB**	**Course Code:**	

Course description:
This course is framed to develop the basic knowledge of animal tissue culturing methods in undergraduate students. The background expected includes a prior knowledge of BE Biotechnology courses. The goals of the course are to understand the basic principles of animal tissue culturing and their applications in the field of Biotechnology.

Lecture	**Hours/week**	**No. of Weeks**	**Total hours**	**Semester credits**
	03	14	42	03

Prerequisite course(s):- Fermentation technology, Bioprocess engineering, Genetic Engineering and Molecular Biology.

Course objectives: To,

1. Develop the basic knowledge and skills of animal tissue culturing.
2. Study production of antibodies, hormones, making of genetically modified animals.
3. Study production of value added products which are having commercial value.
4. Demonstrate the Gene transfer technology in animals.
5. Discuss the basics of tissue culture as a screening system.

Course outcomes:

After successful completion of this course the student will be able to:

1. Describe the structure of animal genes and genomes.
2. Describe basic principles and techniques in genetic manipulation and genetic engineering.
3. Describe gene transfer technologies for animals and animal cell lines.
4. Describe techniques and problems both technical and ethical in animal cloning.
5. Explore the options for Food Biotechnology in higher study.

COURSE CONTENT

Name of the Subject: Animal Biotechnology		**Semester:**	VIII
Teaching Scheme:		**Examination scheme**	
Lectures:	**3 hours/week**	**End semester exam (ESE):**	**60 marks**
		Duration of ESE:	**03 hours**
		Internal Sessional Exams (ISE):	**40 marks**

Unit–I:	**No. of Lectures: 08 Hours**	**Marks: 12**

Laboratory requirements for animal cell culture:
Sterile handling area, Sterilization of different materials used in animal cell culture, Aseptic concepts, Instrumentation and equipments for animal cell culture.
Culture medium: natural media, synthetic media, introduction to balanced salt solutions and simple growth medium, Brief discussion on the chemical, physical and metabolic functions of different constituents of culture medium, role of carbon dioxide, serum and supplements.

Unit–II:	**No. of Lectures: 08 Hours**	**Marks: 12**

Types of Cell Cultures:
Different types of cell cultures, Trypsinization, Cell separation, Continuous cell lines, Suspension culture, Organ culture, Development of cell lines, Characterization and maintenance of cell lines, Cryopreservation, Common cell culture contaminants.

Unit–III:	No. of Lectures: 09 Hours	Marks: 12

Stem cell research:
Current status and application in medicine, Application of animal cell culture for *in vitro* testing of drugs; Application of cell culture technology in production of human and animal viral vaccines and pharmaceutical proteins, Production of recombinant hemoglobin, blood substituent's, artificial blood.

Unit–IV:	No. of Lectures: 09 Hours	Marks: 12

Gene transfer technology in animals:
Viral and non-viral methods, Production of transgenic animals and molecular pharming, current status of production of transgenic animals, Animal cloning: Techniques, relevance and ethical issues.

Unit–V:	No. of Lectures: 08 Hours	Marks: 12

Commercial applications of cell culture:
Tissue culture as a screening system; cytotoxicity and diagnostic tests. Mass production of biologically important compounds (e.g. Vaccines), Harvesting of products, purification, and assays, Three dimensional cultures and tissue engineering.

Text Books:

1. B.D.Singh, Biotechnology: Expanding Horizons, Kalyani Publishers, New Delhi, Second Revised Edition, 2008.
2. S.S.Purohit, Biotechnology: Fundamentals and Applications, Agrobios (India), 4th Edition, 2005.
3. Freshney, Culture of Animal Cells, 5th Edition, Wiley-Liss, 2005.

Reference Books:

1. Ed. John R.W. Masters, Animal Cell Culture - Practical Approach, 3rd Edition, Oxford University Press, 2000.
2. Ed. Martin Clynes, Animal Cell Culture Techniques., Springer, 1998.
3. B.Hafez, E.S.E Hafez, Reproduction in Farm Animals, 7th Edition, Wiley- Blackwell, 2000.

Open Elective Course - IV

Industrial Organization and Management

COURSE OUTLINE

Course Title:	*Industrial Organization and Management*	**Short Title:**	**IOM**	**Course Code:**	

Course description:

This course is framed to develop the basic knowledge of industrial management in undergraduate students. The background expected includes a prior knowledge of organizational management and organizational management.

Lecture	**Hours/week**	**No. of Weeks**	**Total hours**	**Semester credits**
	03	14	42	03

Prerequisite course(s):- SE Biotechnology courses

Course objectives: To,

1. Study basic concepts of Industrial organization
2. Discuss basic concepts of Industrial Management
3. Explain basic concepts of stores management
4. Study basic concepts of marketing management
5. Study basic concepts of personnel management

Course outcomes:

After successful completion of this course the student will be able to:

1. Effectively organized their business
2. Effectively manage the inventory and store.
3. Apply concepts of selling and marketing
4. Effectively manage human recourses
5. Get insights of exports and imports

COURSE CONTENT

Name of the Subject: Industrial Organization and Management		**Semester:**	VIII
Teaching Scheme:		**Examination scheme**	
Lectures:	**3 hours/week**	**End semester exam (ESE):**	**60 marks**
		Duration of ESE:	**03 hours**
		Internal Sessional Exams (ISE):	**40 marks**

Unit–I:	**No. of Lectures: 08 Hours**	**Marks: 12**

Management Science:

Management, its growth, concepts of administration and management of organization, Definition of management, functions, authority and responsibility, Unity of command and direction, Decision making in management by objectives

Business Organization: Different forms of organization, their formation and working, Different organization structure- line organization, functional organization, line and staff organization.

Unit–II:	**No. of Lectures: 08 Hours**	**Marks: 12**

Purchase and stores management:

Concepts of quotation, tenders and comparative statement, inspection and quality control,

Inventory, carrying cost and fixed cost of inventory, examples of cost of Inventory, Stores management, functions of storekeeper, methods of inventory : LIFO, FIFO		
Unit–III:	**No. of Lectures: 09 Hours**	**Marks: 12**
Marketing management: Concepts of selling, marketing, definition of marketing, market research and of pricing, penetration, pricing, skimming pricing, distribution of product, advertising and promotion		
Unit–IV:	**No. of Lectures: 09 Hours**	**Marks: 12**
Personnel Management: Manpower planning, sources of recruitment, selection and training of staff, Job evaluation, merit rating, performance appraisal, wage administration and system, of wage payment, incentive, motivations, industrial fatigue, Trade unions – industrial relations		
Unit–V:	**No. of Lectures: 08 Hours**	**Marks: 12**
Export and import management: Concepts of international trade, duties, antidumping duty, cost involved in exporting a product, pricing of export product, Government aids for export promotion, export houses, export promotion counsel, MODVAT, patent and patent rights, Quality Management: TQM, quality circles, ISO systems		
Text Books:		
1. Shama and Banga S.C., Industrial Engineering and Management. Khanna Publishers, 2. O.P.Khanna, Industrial Engineering and Management. Khanna Publishers. 3. Tripathy & Reddy, Principles of Management. Third Edn.,Tata McGraw Hill Publishers.		
Reference Books:		
1. Fred Luthans, Organizational Behaviour, Tenth Edn. Tata McGraw Hill Publications. 2. S.S.Gulshan, G.K.Kapoor, Business Law & Including Company Law, Fourteenth Edn.,New Age International Ltd. 3. V.S.Ramaswamy & S.Namakumari, Marketing Management. MacMillan India Ltd 4. PV.Kulkarni, B.G.Satyaprasad, Financial Management, Thirteenth Edn. Himalaya Publishers Ltd. 5. Everett Adam & R.J.Ebert, Production & Operations Management, Fifth Edn., Pearson Publication.		

Open Elective Course - IV					
Bioenergy and Renewable Resources					
COURSE OUTLINE					
Course Title:	*Bioenergy and Renewable Resources*	**Short Title:**	**BRR**	**Course Code:**	

Course description:

This course is aimed to develop the basic knowledge of Bioenergy and Renewable Resources in undergraduate students. The background expected includes a prior knowledge of Bioenergy, Biofuels production and basic concepts of solar energy.

Lecture	Hours/week	No. of Weeks	Total hours	Semester credits
	03	14	42	03

Prerequisite course(s):- Biology, SE & TE Biotechnology courses

Course objectives: To,

1. Study renewable and non renewable sources of energy.
2. Study biodiesel production and advantages.
3. Explain concepts of solar energy utilization.
4. Demonstrate the concepts of Wind and Geothermal energy.
5. Study the various methods of alcohol production

Course outcomes:

After successful completion of this course the student will be able to:

1. Create awareness regarding renewable energy sources
2. Replace conventional fuels with biodiesel
3. Apply knowledge regarding solar energy and photovoltaic
4. Apply the knowledge of Wind and Geothermal energy
5. Perform the alcohol production by using various sources

COURSE CONTENT

Name of the Subject: Bioenergy and Renewable Resources		**Semester:**	VIII
Teaching Scheme:		**Examination scheme**	
Lectures:	**3 hours/week**	**End semester exam (ESE):**	**60 marks**
		Duration of ESE:	**03 hours**
		Internal Sessional Exams (ISE):	**40 marks**

Unit–I:	No. of Lectures: 08 Hours	Marks: 12

Energy resources and their utilization:

Indian and global energy sources, Energy demand, Energy exploited, Energy planning, Energy parameters (energy intensity, energy-GDP elasticity), Environmental impacts of the conventional and renewable sources, Renewable Energy**:** Introduction to various sources of energy, Solar thermal, Photovoltaic, Water power, Wind energy, Biomass, Ocean thermal, Tidal and wave energy, Geothermal energy, Hydrogen energy systems, Fuel cells, Decentralized and dispersed generation.

Unit–II:	No. of Lectures: 08 Hours	Marks: 12

Biodiesel:

Definition, advantages of biodiesel, properties of biodiesel, feedstocks - jatropha, Karanja, Neem, plantation, Transesterification, process issues, homogeneous and heterogeneous catalysis, biodiesel from microalgae, algae cultivation, types of photobioreactor, Indian perspective.

Unit–III:	No. of Lectures: 09 Hours	Marks: 12
Solar energy and Photovoltaic: Need of solar energy in the world and India, Basics of converting sunlight into electricity, Technologies of producing solar fuels, solar energy collectors, System components, Grid connection and applications, Solar thermal: Technologies and applications of solar thermal energy – Power production and heating applications, Solar heating and solar cooling, Concentrated solar power (CPV and CSP) for utility-scale applications, Domestic and industrial.		
Unit–IV:	**No. of Lectures: 09 Hours**	**Marks: 12**
Wind and Geothermal energy: Wind energy, Characteristics of wind: Effect of density, Frequency variances, Angle of attack, Wind velocity, Principles of wind turbine: operation, siting and control, Process of electricity generation and supply to the grid - wind energy farms, Types of wind machines and their characteristics, Horizontal and Vertical axis wind mills, Elementary design principles, Coefficient of performance of a wind mill rotor, Aerodynamic considerations in wind mill design, Selection of a wind mill, Availability of wind energy in India.		
Unit–V:	**No. of Lectures: 08 Hours**	**Marks: 12**
Alcohol fuels: Feedstock for alcohol fuels, common methods for alcohol production, ethanol production from lignocellulosic materials, pretreatment-dilute acid, hot water, steam explosion, Ammonia; enzymatic hydrolysis, detoxification, fermentation, butanol fermentation, challenges in ethanol and butanol production, case studies, concept of biorefinery.		
Text Books:		
1. Rai G.D, Non-Conventional energy Source, Khanna Publishers, New Delhi, 2004 2. Bansal Keemann, Meliss," Renewable energy sources and conversion technology", Tata Mc Graw Hill. 3. Kothari D.P., Renewable energy resources and emerging technologies, , Prentice Hall of India Pvt. Ltd., 2008		
Reference Books:		
1. John Twidell and Tony Weir, Renewable Energy Resources. 2nd Ed. New York, 2006 2. K M Mital, Non-Conventional Energy Systems, A H Wheeler Publishing Co Ltd , 1999 3. Ramesh R & Kumar K U, Renewable Energy Technologies, Narosa Publishing House, New Delhi,2004 4. Ashok V Desai, Non-Conventional Energy, New Age International (P) Ltd, New Delhi, 2003 5. S. Silveira, Bioenergy: Realizing the Potential, (Ed), Elsevier Science, 2005		

Open Elective Course - IV					
Agricultural Biotechnology					
COURSE OUTLINE					
Course Title:	*Agricultural Biotechnology*	**Short Title:**	**Agri Bio**	**Course Code:**	

Course description:

This course is aimed at developing the basic knowledge and skills of agricultural Biotechnology to undergraduate students. The background expected includes a prior knowledge of Biotechnology courses. The goals of the course are to understand the basic principles of agricultural Biotechnology and their applications in engineering trade.

Lecture	Hours/week	No. of Weeks	Total hours	Semester credits
	03	14	42	03

Prerequisite course(s):- 11th, 12th Biology, SE & TE Biotechnology courses

Course objectives: To,

1. Study basic concepts of agriculture Biotechnology.
2. Explain basic concepts of genetic modification of plants.
3. Demonstrate various techniques in plant tissue culture.
4. Study the basics of advanced technology for crop improvement.
5. Get familiarize livestock management.

Course outcomes:

After successful completion of this course the student will be able to:

1. Formulate various types of medias required in plant tissue culture.
2. Breed various crop varieties.
3. Develop transgenic varieties of crops.
4. Performs tissue culturing of various plants.
5. Apply Advanced technologies available for crop improvement .

COURSE CONTENT

Name of the Subject: Agricultural Biotechnology		**Semester:**	VIII
Teaching Scheme:		**Examination scheme**	
Lectures:	**3 hours/week**	**End semester exam (ESE):**	**60 marks**
		Duration of ESE:	**03 hours**
		Internal Sessional Exams (ISE):	**40 marks**

Unit–I:	No. of Lectures: 08 Hours	Marks: 12

Introduction to Agricultural biotechnology:

Novel features of plant growth and development, Biodiversity, Conventional methods of crop improvement, objectives of plant breeding, Types of breeding, Genetic variation and manipulation of variability, Breeding of selected crops-important cereals, pulses, oil seeds, fibre, sugar and cash crops, Plant Biodiversity, Classical deliberate interbreeding, Intraspecific hybridization, Methods of breeding self-pollinated crops and cross- pollinated crops, Methods of breeding asexually propagated crops, self incompatibility and male sterility in crop breeding, mutation breeding, Ploidy breeding, Innovative breeding methods, Hybrid varieties

Unit–II:	No. of Lectures: 08 Hours	Marks: 12

Plant Molecular Biology:

Recombinant DNA technology-cloning vectors, restriction enzymes, gene cloning, Methods of gene transfer in plants, Development of transgenies for biotic & abiotic stress tolerance, Ribozfore Technology, Ti plasmid based transformation, Agrobacterium biology, crown gall and hairy root disease, Ti and Ri plasmids, T-DNA genes, borders, overdrive, chromosomal and Ti plasmid virulence genes and their functions, vir gene induction, mechanism of T-DNA transfer, Ti pasmid vectors, vir helper plasmid, super virulence and monocot transformation, binary vector, Direct transformation of protoplasts using PEG, electroporation, Transformation by particle bombardment, Assembly of particle gun, Microprojectile preparation and bombardment, Chloroplast transformation by particle bombardment.

Unit–III:	No. of Lectures: 09 Hours	Marks: 12

Plant tissue culture and its application:

Principles of plant micropropagation, The totipotency concept, Role & composition of Plant tissue culture media, Micropropagation pathways, Callus induction & culture, organogenesis and embryogenesis, Meristem tip culture, Haploid production, Hardening of plants, Techniques of anther, embryo and ovule culture, Protoplast isolation, Somatic hybridization, Cybrids, Somaclones, Artificial seed Technology(synthetic seed), Embryo rescue Cell line selection using selection pressure, Production of secondary metabolites, Cryopreservation and germplasm storage

Unit–IV:	No. of Lectures: 09 Hours	Marks: 12

Animal life stock breeding:

Importance of livestock in agriculture, relationship between plant and animal husbandry, animal breeding, breeds of indigenous and exotic cattle, buffaloes, goats, sheep, pigs and poultries and their potential for milk, egg, meat and wool production, classification of feed and fodder, major contagious diseases affecting cattle and drought animals, poultries and pigs, Sericulture and its applications

Unit–V:	No. of Lectures: 08 Hours	Marks: 12

Advanced technology for crop improvement:

Genetic engineering of crops, Commercial status of transgenic plants, Herbicide resistance, glyphosate, sulfonyl urea, phosphinothricin, atrazine, Pest resistance, B.t. toxin, synthetic B.t. toxin, Bt brinjal, Bt cotton, Protease inhibitor, GNA and other lectins, α-amylase inhibitor, nematode resistance, Improved seed storage proteins, Improving and altering the composition of starch and plant oils, Golden rice for β-carotene accumulation, Production of antibodies and pharmaceuticals in plants, Biofertilizers, Gene flow in plants – Development of mapping population – Molecular marker aided breeding-RFLP maps, Linkage analysis, RAPD markers, microsatellites, SCAR (Sequence Characterized Amplified Region), SSCP(Single strand Conformational Polymorphism), AFLP,QTL, map based cloning , Molecular marker assisted selection(MAS), Mapping genes on specific chromosomes, Gene pyramiding, Transcript mapping techniques

Text Books:

1. Keshavachandran.R and K V Peter. 2008 .Plant Biotechnology: Tissue culture and Genetransfer. Orient and Longman, (Universal Press) Chennai.
2. Gresshoff, Peter M. (Ed). Plant biotechnology and development. 1992.
3. Jones, MGK & Lindsey, K. "Plant Biotechnology".
4. Walker, JM & Gingold, EB (Eds). 2000, Molecular biology and Biotechnology.
5. Kumar H D, Agricultural Biotechnology, India ,2005

Reference Books:

1. Esau's Plant Anatomy, Meristems, Cells, and Tissues of the Plant Body: Their Structure, Function and Development, 3rd Edition, John Wiley & Sons, 2006.

2. R.H.Smith, Plant Tissue Culture: Techniques and Experiments, Academic Press, San Diego. 1992.
3. M. J. Chrispeels and D.F. Sadava (eds), Plants, Genes and Crop Biotechnology, 2nd Edition, Jones and Barlett Press, 2003
4. J.H. Hammond, P. Mcgarvey, and V. Yusibov (eds), Plant Biotechnology, Springer Verlag, Heidelberg. 2000
5. BAREACT, Indian Patent Act 1970 Acts & Rules, Universal Law Publishing Co. Pvt. Ltd., 2007

Open Elective Course – IV					
Cyber Security					
COURSE OUTLINE					
Course Title:	*Name of the Subject: Cyber Security*	**Short Title:**	**CS**	**Course Code:**	

Course description:

Cyber Security course focuses on cyber threats and cyber security that provides the much needed awareness in the times of growing cybercrime episodes.

Lecture	Hours/week	No. of weeks	Total hours	Semester credits
	3	14	42	3

Prerequisite course(s):

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Course objectives: To,

1. Understand Cybercrime and Cyber offenses.
2. Understand Cybercrime through portable devices.
3. Understand tools and methods used in Cybercrime.
4. Understand Phishing and Identity theft.
5. Understand Computer Forensics.

Course outcomes:

After successful completion of this course the student will be able to:

1. Determine the act of Cyber offenses.
2. Determine the Cybercrime through portable devices.
3. Determine the methods used in Cybercrime.
4. Determine Phishing and Identity theft.
5. Describe Computer Forensics.

COURSE CONTENT

Name of the Subject: Cyber Security		**Semester:**	**VIII**
Teaching Scheme:		**Examination scheme:**	
Lectures:	**3 hours/week**	**End Semester Exam (ESE):**	**60 marks**
		Duration of ESE:	**03 hours**
		Internal Sessional Exam (ISE):	**40 marks**

Unit–I:	No. of Lectures: 08 Hours	Marks: 12

Introduction to Cybercrime:

Introduction, Cybercrime: Definition and Origins of the Word, Cybercrime and Information Security, Who are Cybercriminals?, Classifications of Cybercrimes

Cyberoffenses: How Criminals Plan Them:

Introduction, How Criminals Plan the Attacks, Social Engineering, Cyberstalking, Cybercafe and Cybercrimes, Botnets: The Fuel for Cybercrime, Attack Vector, Cloud Computing.

Unit–II:	No. of Lectures: 08 Hours	Marks: 12

Cybercrime: Mobile and Wireless Devices:

Introduction, Proliferation of Mobile and Wireless Devices, Trends in Mobility, Credit Card Frauds in Mobile and Wireless Computing Era, Security Challenges Posed by Mobile Devices, Registry Settings for Mobile Devices, Authentication Service Security, Attacks on Mobile/Cell Phones, Mobile Devices: Security Implications for Organizations, Organizational Measures for Handling Mobile device related security issues, Organizational Security Policies and Measures in Mobile Computing Era, Laptops

Unit–III:	No. of Lectures: 08 Hours	Marks: 12
Tools and Methods Used in Cybercrime: Introduction, Proxy Servers and Anonymizers,, Phishing, Password Cracking, Keyloggers and Spywares, Virus and Worms, Trojan Horses and Backdoors, Steganography, DoS and DDoS Attacks, SQL Injection, Buffer Overflow, Attacks on Wireless Networks		
Unit–IV:	**No. of Lectures: 09 Hours**	**Marks: 12**
Phishing and Identity Theft: Introduction, Phishing, Identity Theft (ID Theft) **Understanding Computer Forensics:** Introduction, Historical Background of Cyberforensics, Digital Forensics Science, The Need for Computer Forensics, Cyberforensics and Digital Evidence, Forensics Analysis of E-Mail		
Unit–V:	**No. of Lectures: 09 Hours**	**Marks: 12**
Computer Forensics: Digital Forensics Life Cycle, Chain of Custody Concept, Network Forensics, Approaching a Computer Forensics Investigation, Computer Forensics and Steganography, Relevance of the OSI 7 Layer Model to Computer Forensics, Forensics and Social Networking Sites: The Security/Privacy Threats, Challenges in Computer Forensics, Special Tools and Techniques, Forensics Auditing, Antiforensics		
Text Books:		
1. Nina Godbole and Sunil Belapure, “Cyber Security”, Wiley India Publication, 2014		
Reference Books:		
1. Nina Godbole , Information Systems Security , Wiley India Publication 2. V.K. Pachghare, Cryptography and Information security, PHI, Second edition		

Lab Downstream Processing					
LAB COURSE OUTLINE					
Course Title:	***Lab Downstream Processing***		**Short Title:**	**Lab BPI**	**Course Code:**

Course description:

In this laboratory, course emphasis is on the understanding of basics techniques of recovery processes. The learner can use this knowledge and apply in allied branches of Biotechnology as required.

Lecture	**Hours/week**	**No. of weeks**	**Total hours**	**Semester credits**
Laboratory	02	14	28	01

End Semester Exam (ESE) Pattern:	**Oral (OR)**

Prerequisite course(s): 12th Std. Science and SE Biotechnology Courses.

11th, 12th Science.

Course objectives:

1. Impart the fundamental knowledge of recovery processes at the research level.
2. Study the analytical techniques for interpreting experimental results.
3. Explain various recovery and purification techniques for bioproducts.
4. Study the analytical techniques in downstream processing.
5. Study the bioproducts and biomolecules quantitatively and qualitatively.

Course outcomes:

Upon successful completion of lab Course, student will be able to:

1. Isolate the biomolecules/bioproducts from the fermentation broths.
2. Recover the intracellular products from the microbial cells by applying the cell disruption techniques.
3. Precipitate the soluble bioproducts from the fermentation broths such as proteins and enzymes.
4. Identify the recovered product quantitatively and qualitatively by applying the analytical techniques on them.
5. Study and estimate the concentration of the recover bioproducts.

LAB COURSE CONTENT

Lab Downstream Processing		**Semester:**	VIII
Teaching Scheme:		**Examination scheme**	
Practical:	**2 hours/week**	**End semester exam (ESE):**	***25 marks***
		Internal Continuous Assessment (ICA):	***25 marks***

List of Experiments (Note: Minimum Eight Experiments from the following)

1. Cell Disruption by Ultrasonication.
2. Cell Disruption by Enzymatic Reaction.
3. Aqueous Two-phase Extraction.
4. Centrifugal Separation- Ultra Centrifugation.
5. Separation & identification of amino acids by paper chromatography.
6. Separation & identification of sugars by paper chromatography.
7. Separation & identification of lipids by thin layer chromatography.
8. Ammonium Sulphate Precipitation of biomolecules.

9. Isoelectric Precipitation.
10. Crystallisation of biomolecules.

Text Books:

1. David Plummer , An introduction to Practical Biochemistry III edition, John Wiley & Sons.
2. Keith John Walker, Principles and Techniques of Biochemistry and Molecular Biology by Cambridge University Press; 6 edition (2005).
3. J. Jayaraman, Kunthala Jayaramanj, Laboratory Manual in Biochemistry, New Age International

Guide lines for ICA:

Internal Continuous Assessment shall be based on continuous evaluation of Student performance throughout semester and practical / assignments submitted by the student in the form of journal

Guidelines for ESE:

End Semester Examination shall be based on practical / oral evaluation of Student performance and practical / assignments submitted by the student in the form of journal.

Lab Bioprocess Industries					
LAB COURSE OUTLINE					
Course Title:	***Lab Bioprocess Industries***	**Short Title:**	**Lab BPI**	**Course Code:**	

Course description:

In this laboratory, course emphasis is on the understanding of basics techniques of industrial bio process. The learner can use this knowledge and apply in allied branches of Biotechnology as required.

Lecture	**Hours/week**	**No. of weeks**	**Total hours**	**Semester credits**
Laboratory	02	14	28	01

End Semester Exam (ESE) Pattern: **Oral (OR)**

Prerequisite course(s): 12th Std. Science and SE Biotechnology Courses.

11^{th}, 12^{th} Science.

Course objectives: To,

1. Study the fundamental knowledge of industrial bioprocess at the research level.
2. Study the analytical techniques for interpreting experimental results.
3. Study the process for development of single cell proteins.
4. Explain the concept of plant and animal tissue engineering.
5. Get familiarize with the basics of immobilization techniques.

Course outcomes: Upon successful completion of lab Course, student will be able to:

1. Demonstrate a detailed knowledge of growth kinetics.
2. Study the effect of substrate and product concentration on biomass yield for baker's yeast production Interpret the significance of Biotechnology in production.
3. Demonstrate a detailed knowledge of therapeutic agents of microbial origin and their production.
4. Demonstrate knowledge of plant tissue culture systems and artificial seed production.
5. Produce single cell protein by fermentation.

LAB COURSE CONTENT

Lab Bioprocess Industries		**Semester:**	VIII
Teaching Scheme:		**Examination scheme**	
Practical:	**2 hours/week**	**End semester exam (ESE):**	***25 marks***
		Internal Continuous Assessment (ICA):	***25 marks***

List of Experiments (Note: Minimum Eight Experiments from the following)

1. Growth kinetics of microorganisms using shake flask method.
2. Determination of specific thermal death rate constant (Ka).
3. Determination of Volumetric oxygen transfer coefficient (KLa), effect of aeration and agitation speed.
4. Preparation of Immobilized enzymes and cells and evaluation of kinetic parameters.
5. Kinetics study of Product formation.
6. Effect of substrate and product concentration on biomass yield for bakers yeast production.
7. Studies on settling characteristics of various microbial cultures.
8. Explant preparation and their inoculation on suitable plant growth media.
9. Callus induction technique and regeneration of plant from callus culture.
10. Artificial seed production.

11. Shake flask studies of plant cell culture.
Text Books:
1. Richards, Introduction to Industrial Sterilization,. 2. S.S.Purohit, Biotechnology: Fundamentals and Applications, Agrobios (India), 4th Edition, 2005. 3. P.F.Stanbury, A.Whitkar and S.J.Hall, Principles of Fermentation Technology, Aditya Book House, New Delhi.
Guide lines for ICA:
Internal Continuous Assessment shall be based on continuous evaluation of Student performance throughout semester and practical / assignments submitted by the student in the form of journal
Guidelines for ESE:
End Semester Examination shall be based on practical / oral evaluation of Student performance and practical / assignments submitted by the student in the form of journal.

Project					
LAB COURSE OUTLINE					
Course Title:	**Project**	**Short Title:**	**PROJ**	**Course Code:**	

Course description:

Project represents the culmination of study towards the Bachelor of Engineering degree. The project offers the opportunity to apply and extend material learned throughout the program. The emphasis is necessarily on facilitating student learning in technical, project management and presentation spheres.

Laboratory	**Hours/week**	**No. of weeks**	**Total hours**	**Semester credits**
	6	**14**	**84**	**3**

End Semester Exam (ESE) Pattern:	**Oral (OR)**

Prerequisite course(s):-- SE & TE Biotechnology Courses

Course objectives:

1. Explain the basic concepts & broad principles of projects.
2. Demonstrate the value of achieving perfection in project implementation & completion.
3. Discuss the theoretical concepts to solve problems with teamwork and multidisciplinary approach.
4. Demonstrate professionalism with ethics; present effective communication skills and relate engineering issues to broader societal context.
5. Get familiarize of extracting the material from the different sources and writing comprehensively and exhaustive report on an allotted topic.

Course outcomes:

Upon successful completion of lab Course, student will be able to:

1. Demonstrate a sound technical knowledge of their selected project topic.
2. Undertake problem identification, formulation and solution.
3. Design engineering solutions to complex problems utilizing a systems approach.
4. Conduct an engineering project
5. Demonstrate the knowledge, skills and attitudes of a professional engineer.

LAB COURSE CONTENT

Project		**Semester:**	**VII**
Teaching Scheme:		**Examination scheme:**	
		End semester exam (ESE):	***50 marks***
Practical:	**6 hours/week**	**Internal Continuous Assessment (ICA):**	**50 marks**

In continuation with Project (Stage – I) at Semester – VII, by the end of Semester – VIII, the student should complete implementation of ideas as formulated in Project (Stage – I). By the end of Semester – VIII the students shall complete the project. Assessment for the project shall also include presentation by the students.

Each student group should submit project report in the form of thermal bound at the end of

Semester –VIII.

Each student group is required to maintain separate log book for documenting various activities of the project.

Suggestive outline for the project report is as follows.

Abstract
Chapter 1. Introduction
Chapter 2. Literature Survey
Chapter 3. Methodology
Chapter 4. Results & Discussion
Chapter 5. Conclusion
Bibliography
Index
Appendix

Guide lines for ICA:

The Internal Continuous Assessment (ICA) for project shall be based on continuous evaluation of students' performance, active participation, knowledge / skill acquired throughout semester and presentation by the students. The assessment shall be done jointly by the guide and departmental committee. A three-member departmental committee including guide, appointed by Head of the department, shall be constituted for the assessment. The assessment for Project in Semester – VIII shall be as per the guidelines given in Table – B.

Table – B

		Assessment by Guide					Assessment by Departmental Committee		
Sr. No.	Name of the Student	Attendance / Participation	Problem Identification / Project Objectives	Literature Survey	Methodology / Design	Report	Depth of Understanding	Presentation	Total
	Marks	5	5	5	5	5	10	15	50

Guidelines for ESE:

In End Semester Examination (ESE), the student may be asked for presentation / demonstration and questions on Project. Evaluation will be based on answers given by students in oral examination.