M.Sc. BIOTECHNOLOGY
(SEMESTER PATTERN)
CHOICE BASED CREDIT SYSTEM (CBCS)

TWO YEARS FULL TIME PROGRAMME
COURSE OF STUDIES R-20

GIET UNIVERSITY, GUNUPUR
ODISHA

All the precautions have been taken to print the course curriculum accurate. However, mistakes if any will be corrected as and when noticed. The university reserves the right to include/exclude any content at any point of time during the progression of the course.

M.Sc. BIOTECHNOLOGY

Schedule for Instruction and Examination
(Proposed Scheme for Academic year 2020-2021)

I SEMESTER [FIRST YEAR]

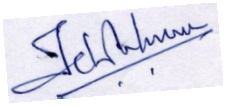
Sl. No.	Course Category	Course Code	Course Title	L	T	P	Credits
THEORY							
1	BTPC	101	Cell Biology and Genetics	4	0	0	4
2	BTPC	102	Biochemistry	3	1	0	4
3	BTPC	103	Biophysical Techniques	4	0	0	4
4	BTPC	104	Bioinformatics and Biostatistics	3	1	0	4
PRACTICAL / SESSIONAL							
5	BTPC	105	Practical (pertaining to theory papers 101,102,103&104)	0	0	6	4
TOTAL				**14**	**2**	**6**	**20**

II SEMESTER [FIRST YEAR]

Sl. No.	Course Category	Course Code	Course Title	L	T	P	Credits
THEORY							
1	BTPC	201	Molecular Biology	3	1	0	4
2	BTPC	202	Microbiology	4	0	0	4
3	BTPC	203	Molecular Immunology	3	1	0	4
4	BTPC	204	Enzyme Technology	4	0	0	4
PRACTICAL / SESSIONAL							
5	BTPC	205	Practical (pertaining to theory papers 201, 202 & 203)	0	0	6	4
6	BTEC	206	Seminar and Technical Writing	0	0	2	2
TOTAL				**14**	**2**	**8**	**22**

BoS Members: 1. Dr. Manoja Das 2. Prof. (Dr). Gitanjali Mishra 3. Dr. T.Ch. Behera
4. Mr. G.K. Mohanty 5. Mr. D.K. Achraya 6. Mr. B. Rabi Prasad
7. Mrs. Sagarika Satapathy 8. PW Jaya Kumar 9. Dr. Chaitanya Kumar A

BOS Approved
Date:02/06/2020



III SEMESTER [SECOND YEAR]

Sl. No.	Course Category	Course Code	Course Title	L	T	P	Credits
THEORY							
1	BTPC	301	Genetic Engg.& rDNA Technology	4	0	0	4
2	BTPE	302	Animal Biotechnology	3	1	0	4
		303	Animal Stem Cell Technology				
3	BTPE	304	Plant Biotechnology	3	1	0	4
		305	Agriculture Biotechnology				
4	BTCBOE	306	Food Biotechnology	4	0	0	4
		307	Pharmaceutical Biotechnology				
PRACTICAL / SESSIONAL							
5	BTPC	308	Practical (pertaining to theory papers 301 & 304)	0	0	6	4
6	BTEC	309	Summer Internship	-	-	-	2
TOTAL				**14**	**2**	**6**	**22**

IV SEMESTER [SECOND YEAR]

Sl. No.	Course Category	Course Code	Course Title	L	T	P	Credits
THEORY							
1	BTPC	401	Environmental Biotechnology	4	0	0	4
2	BTPE	402	Bioprocess Engineering and Technology	3	1	0	4
		403	Medical Biotechnology				
	BTOE	404	Ethics & IPR	4	0	0	4
PRACTICAL / SESSIONAL							
5	BTPE	405	Practical (pertaining to theory papers 401 & 402)	0	0	6	4
6	BTEC	406	Major Research Project / Dissertation	0	0	12	10
7	VAC	407	Value added course / MOOCS	-	-	-	-
TOTAL				**11**	**1**	**18**	**26**

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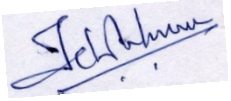

SCHEME OF INSTRUCTION SUMMARY

SL. NO.	COURSE WORK - SUBJECTS AREA	CREDITS / SEMESTER				TOTAL CREDITS	%
		I (500 marks)	II (550 marks)	III (550 marks)	IV (500 marks)	Total (2200 marks)	
1	Professional Course (PC)	20	20	8	4	52	58
2	Professional Electives (PE)	-	-	8	8	16	18
3	Choice Based Open Electives (CBOE)/ Open Electives (OE)	-	-	4	4	8	9
4	Project Work, Seminar and/or Internship in Industry or elsewhere(EC)	-	2	2	10	14	15
5	Value added Courses/MOOCS	-	-	-	-	-	-
	TOTAL	**20**	**22**	**22**	**26**	**90**	**100**

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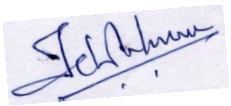

M.Sc. BIOTECHNOLOGY SYLLABUS STRUCTURE

(Credits-Hours - Marks System-2020-21)

Semester	Course	Course Title	Hrs per week L-T-P	Credit L-T-P	Exam Hrs L-T-P	Marks		Total
						Mid Sem	End Sem	
I	BTPC101	Cell Biology and Genetics	4	4	3	30	70	100
	BTPC102	Biochemistry	4	4	3	30	70	100
	BTPC103	Biophysical Techniques	4	4	3	30	70	100
	BTPC104	Bioinformatics and Biostatistics	4	4	3	30	70	100
	BTPC105	**Practical**	6	4	6	0	100	100
			22	**20**				**500**
II	BTPC201	Molecular Biology	4	4	3	30	70	100
	BTPC202	Microbiology	4	4	3	30	70	100
	BTPC203	Molecular Immunology	4	4	3	30	70	100
	BTPC204	Enzyme Technology	4	4	3	30	70	100
	BTPC205	**Practical**	6	4	6	0	100	100
	BTEC206	Seminar and Technical Writing	**2**	**2**	**-**	**0**	**50**	**50**
			24	**22**				**550**

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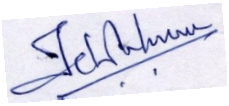

(Credits-Hours - Marks System-2020-21)

Semester	Course	Course Title	Hrs per week L-T-P	Credit L-T-P	Exam Hrs L-T-P	Marks		Total
						Mid Sem	End Sem	
III	BTPC301	Genetic Engg.& rDNA Technology	4	4	3	30	70	100
	BTPE302	Animal Biotechnology	4	4	3	30	70	100
	BTPE303	Animal Stem Cell Technology						
	BTPE304	Plant Biotechnology	4	4	3	30	70	100
	BTPE305	Agriculture Biotechnology						
	BTCBOE306	Food Biotechnology	4	4	3	30	70	100
	BTCBOE307	Pharmaceutical Biotechnology						
	BTPC308	**Practical**	6	4	6	0	100	100
	BTEC309	Summer Internship	**2**	**2**	**0**	**0**	**50**	**50**
			24	**22**				**550**
IV	BTPC401	Environmental Biotechnology	4	4	3	30	70	100
	BTPE402	Bioprocess Engineering and Technology	4	4	3	30	70	100
	BTPE403	Medical Biotechnology						
	BTOE404	Ethics & IPR	4	4	3	30	70	100
	BTPE405	**Practical**	6	4	6	0	100	100
	BTEC406	Major Research Project / Dissertation	**12**	**10**	**6**	**0**	**200**	**200**
	VAC407	Value added course/MOOCS	**-**	**-**	**-**	**-**	**-**	**-**
			30	**26**				**600**
		Grand Total	**100**	**90**				**2200**

Note: Practical are pertaining to Theory papers

PC---Professional Courses, PE---Professional Elective , CBOE---Choice Based Open Elective, OE--- Open Elective, EC---Elective Courses, VAC –Value Added Course, L----Lectures, T---Tutorial, P--Practical

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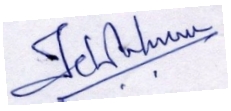

SEMESTER-I

Course Code:	BTPC101	No. of Credits:	4
Course Name:	CELL BIOLOGY AND GENETICS	Sem End Exam & Cycle Test:	70+30

Course Educational Objectives
This course enables the students:

CEO1: To impart knowledge of structural and functional aspects of cells as unit of living systems and transport of information & matter across cell membrane.

CEO2: To provide students with a deep insight about the motility of the cell with emphasis on the molecular motors, cell adhesions, molecular biology involved in the movement process involved in movement of Cilia and Flagella.

CEO3: To acquire in-depth knowledge of the molecular events involved in cell division which includes mitosis, meiosis, cell cycle and its regulation.

CEO4: To understand classical genetics comprising Mendelian laws of inheritance and their significance in genetic diseases.

Course Outcomes
Towards the end of the course, a student should be able to:

CO1: acquire knowledge about the organizational and functional aspects of both prokaryotic & eukaryotic cell and cell organelles.

CO2: learn about the interactions of the cells with outside environment through exchange of information and transport of molecules.

CO3: Identify, formulate, and solve problems arisen due to the inefficient functioning of the various life processes like cell to cell communication, cell cycle regulation, and movement processes of a cell or system.

CO4: learn about the classical genetics and transmission of characters from one generation to the next which will make foundation for the advanced genetics and develop innovative research ideas for curing genetic disorders in humans.

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	-	2	2	1							
CO2	1	2	2	2	-							
CO3	1	3	3	3	-							
CO4	1	2	2	1	-							

COURSE CONTENT

Unit – I: Membrane Structure and Function [12 Hours]

General organization of Prokaryotic and Eukaryotic cells. Cell Wall and Cell Membranes: Cell wall of Eubacteria, lipopolysachharides, Peptidoglycans and related molecules. Prokaryotic cell inclusions: Endospores and gas vesicles, Eukaryotic cell wall and plasma membrane (composition and dynamics, membrane carobohydrates and their role in cell recognition).Social context of cells: Cell junction, cell adhesion and extra-cellular matrix. Cell motility: Cilia and flagella of prokaryotes and eukaryotes. Cytoskeleton: Microtubules, intermediate filaments and microfilaments.

Unit – II: Nucleus [12 Hours]

Nucleus: Structure and function of nuclear envelope, nucleolus, Chromatin organization and its packaging, role of nuclear matrix in chromosome organization and function, matrix binding proteins. Global structure of chromosome: Lampbrush chromosome, Polytene chromosome, Interphase chromatin, Euchromatin and Heterochromatin. Cell cycle: Molecular models and events, Regulators and checkpoints in cell cycle (Cyclin and CDKs). Molecular mechanisms of cell division, Mitosis and Meiosis. Cell signaling: Endocrine, Exocrine & Synaptic signaling; Extracellular Messengers & their receptors; G-protein- Coupled receptors; Second messengers and their mode of action.

Unit – III: Cellular Organelles [10 Hours]

Mitochondria: Structure, function, mitochondrial DNA, origin and evolution of mitochondria, Chloroplast: Structure, function, chloroplast DNA and its significance, chloroplast biogenesis, origin and evolution. Intracellular compartments-I: Golgi apparatus and endoplasmic reticulum (structure & function). Intracellular compartments-II: Lysosomes, Ribosomes and peroxisomes (structure and function). Macromolecular trafficking into and out of nucleus. Protein sorting: Transport of proteins into mitochondria, chloroplast and lysosomes.

Unit – IV: Genetics [12 Hours]

Mendel's laws of inheritance and chromosomal theory of heredity. Neo-mendelism, Linkage, crossing over and recombination, Chromosomal mapping. Gene interaction, Cytoplasmic inheritance, Structural and numerical changes in chromosome (including polyploidy).The origin of genetic variability through mutation (Spontaneous and chemical, Frame-shift mutation, point mutations and chromosomal abberations). Principles of population genetics and Hardy-Weinberg Law. Human chromosomes, Genetic diseases and syndromes.

Text Books

1. Molecular biology of the cell. By Alberts. et al.
2. Molecular cell biology. By Lodish et al.
3. Cell, a molecular approach. By Cooper.
4. Cell Biology. By De Robertes and De Robertes.
5. Genetics by Strickberger.
6. Genetics by Gardner.

Reference Books

1. Smith & Wood, Cell Biology, 2nd Edition, Chapman & Hall, London.
2. Watson et al., Molecular Biology of the gene, 5th Edition, Pearson Prentice Hall. USA.
3. Benjamin Lewin, Gene X, 10th Edition, Jones and Barlett Publishers.
4. Gerald Karp, Cell and Molecular Biology: Concepts and Experiments, 7th Edition.

Course Code:	BTPC102	No. of Credits:	4
Course Name:	BIOCHEMISTRY	Sem End Exam & Cycle Test:	70+30

COURSE EDUCATIONAL OBJECTIVES:

CEO1: To focus on various bonding associated with biomolecule and their structures and functions.

CEO2: To study the bioenergetics principle and metabolism of various biomolecules.

COURSE OUTCOMES:

Towards the end of the course the students will be able to:

CO1 To know the configuration, bonding in biomolecules as well as the biological buffering system.
CO2 To understand the structure and functions of carbohydrates, lipids, amino acids, proteins and nucleic acids.
CO3 To know the bioenergetics principle and metabolism of carbohydrates and mechanism of photosynthesis.
CO4 To understand the biosynthesis and oxidation of fatty acids, amino acids and nucleotides. .

Mapping of COs with POs and PSOs

COs/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	1											
CO2	1	3	2											
CO3	1	2	1											
CO4	1	2	1											

1–Slight, 2 –Moderate, 3 –Substantial

COURSE CONTENT

Unit – 1 **[10 Hours]**

Chemical basis of life: Chemical composition and bonding, three dimensional structure (configuration and conformation, Isomerism and steriospecificity), Water: Structure of water, water as a solvent, ionization of water, Weak Interactions in aqueous solution (Dipole movement, Van der Waal's, ionic and hydrophobic interactions. Hydrogen bonding). Weak acids, bases, pH and buffers, Blood buffering system.

Unit – 2 **[15 Hours]**

Carbohydrates: Classification and structure of monosaccharides, sugar derivatives, important disaccharides. Structural and storage polysaccharides, Glycosylation of other biomolecules: glucosaminoglycans, proteoglycans, glycoproteins and glycolipids.

Lipids: Classification, Structure, properties and functions of important members of storage and membrane lipids; lipoproteins.

Amino acids: Classification and properties; Acid–base properties, Non-standard amino acids. Peptides: Peptide bond, biologically active peptides. Levels of protein structure. Three dimensional structures of proteins (Secondary, tertiary and quaternary structures, structural patterns: motifs and domains), Ramachandran plot, Protein sequencing, Protein denaturation and Protein folding. Structure and function of Nucleic acids, Vitamins, Minerals and Hormones

Unit – 3 **[15 Hours]**

Metabolism-I
Bioenergetics: Basic principles; Equilibria and concept of free energy; Phosphoryl group transfer and ATP, Biological oxidation-reduction reactions;

Carbohydrate metabolism: Glycolysis, TCA cycle, glyoxalate cycle, pentose-phosphate pathway. Gluconeogenesis, Glycogen Breakdown & Synthesis, biosynthesis of starch and sucrose. electron transport and Oxidative phosphorylation.

Photosynthesis: Electon transfer by chlorophyll, Molecular mechanism of Photosystem I & II.

Unit – 4 **[10 Hours]**

Metabolism-II

Biosynthesis and oxidation of fatty acids. Biosynthesis of Amino acids, Amino acid catabolism (transamination, oxidative deamination and urea cycle), Protein degradation (proteosomal pathway) and Solid phase synthesis of peptides. Biosynthesis and degradation of Nucleotides.

Text Books

1. V.Voet and J.G.Voet, Biochemistry, 4th edition, John Wiley, New York.
2. Lehninger Principle of Biochemistry by D.L. Nelson & M.M. Cox.
3. Biochemistry, U Satyanarayana and Chakrapani

Reference Books:

1. Biochemistry by J.M. Berg, J.L. Tymoczko & Lubert Stryer
2. Fundamentals of Biochemistry by Jain and Jain, S.Chand Publication.
3. Moran et al, Principles of Biochemistry

Course Code:	BTPC103	No. of Credits:	4
Course Name:	BIOPHYSICAL TECHNIQUES	Sem End Exam & Cycle Test:	70+30

Course Educational Objectives
This course enables the students:

CEO1: To provide the Students with the understanding of various analytical techniques used in biotechnology based research and industry.

CEO2: TO acquaint with various instruments, their configuration and working principle, operating procedures, data generation and its analysis.

CEO3:To provide an overview of the instruments used in isolation, separation and analysis of various molecules.

CEO4:To develop the skills to understand the theory and practice of bioanalytical techniques this will enable the students to apply these tools and techniques in different fields of Biotechnology.

Course Outcomes
Towards the end of the course, a student should be able to:

CO1: Apply basic principles of different analytical techniques and able to use microscopy, spectroscopy and centrifugation.

CO2: Apprehend the functioning, maintenance and safety aspects of the apparatus used in a Biotechnology lab.

CO3: Assimilate the principles and applications of electrophoresis, blotting, chromatography and spectroscopy in research and related experiments.

CO4: Understand the strengths, limitations and creative use of techniques for solving industrial and research problems.

Cos /POs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO 12
CO1	1	1	1	1	1							
CO2	1	-	3	3	1							
CO3	-	1	3	2	-							
CO4	2	2	3	2	2							

COURSE CONTENT

Unit – I: Microscopic Techniques [10 Hours]

Microscopy: Magnification and resolution parameters of light, Principle of operation and Instrumentation of Light microscopy (Bright field, Phase-contrast, Fluorescence) and Electron Microscopy (Scanning and transmission).

Unit –II: Spectroscopy Techniques [13 Hours]

Spectrophotometer: laws of absorption of light, Beer-Lambert's Law, Ultraviolet-visible absorption spectroscopy: Principle, Instrumentation and application. Fluorescence spectrophotometry: Principle, Instrumentation and application. MASS (API- Electrospray and MALDI TOF): Principle, Instrumentation and application. Other types (IR, NMR and ESR) of spectrophotometry: Basic principle and application. Elementary idea on X-ray crystallography.

Unit – III: Chromatography Techniques [10 Hours]

Chromatographic techniques: Principles & types of chromatography (Adsorption and Partition chromatography), planar chromatography (Paper and Thin-layer chromatography), Column chromatography (Adsorption chromatography, Gel exclusion/permeation chromatography, Ion-exchange chromatography and Affinity chromatography). Gas chromatography, HPLC and FPLC

Centrifugation: Basic principles of sedimentation (RCF, Sedimentation coefficient etc); Types of centrifuges; Preparative centrifugation; Differential & density gradient centrifugation.

Unit – IV: Electrophoretic techniques [12 Hours]

Theory and application of Agarose gel and Polyacrylamide gel electrophoresis, Immuno electrophoresis; 2D Electrophoresis; Gradient electrophoresis; Pulsed field gel electrophoresis. Polymerase Chain Reaction (PCR), Nucleic acid hybridization: Principle & applications of Southern blotting, Northern blotting and Western blotting.

Radioactivity & Radioisotope techniques: Radioactive & stable isotopes, Nature of radioactivity, Isotopes in biochemistry, Measurement of radioactivity (Geiger-Muller counting and liquid scintillation counting), Autoradiography.

Text Books

1. Physical Biochemistry by David Freifelder
2. Practical Biochemistry by Keith Wilson and John Walker.
3.Modern Experimental Biochemistry by Rodney Boyer.

Reference Books

1. R. Scopes, **Protein Purification - Principles & Practices**.
2. Selected readings from **Methods in Enzymology**, Academic Press.

Course Code:	BTPC104	No. of Credits:	4
Course Name:	BIOINFORMATICS AND BIOSTASTICS	Sem End Exam & Cycle Test:	70+30

COURSE EDUCATIONAL OBJECTIVES:

CEO 1: Objectives of this course focuses on the development of skills of students for a successful career in industry or research. The course emphasizes enough effort on theory and practical applications.

CEO 2: The course emphasizes on the delivery of the state of the art technologies in Genomics, Proteomics, 3-D structure of the protein and its statistical analysis.

COURSE OUTCOMES:

Towards the end of the course the students will be able to :

CO1 Understand the types of biological databases available in open source domain and their uses.

CO2 Acquire knowledge in pair wise, multiple sequence alignments and phylogenetic analysis

CO3 Able to analyze secondary and tertiary structure and its modeling of proteins for drug designing by using bioinformatics tools.

CO4 Understand the use of statistical analysis using different algorithm and their applications.

Mapping of COs with POs and PSOs

COs / POs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO 1	2	3	1		3									
CO 2	2	3	1		1									
CO 3	1	2	2		3									
CO 4	2	3	1											

1–Slight, 2 –Moderate, 3 –Substantial

COURSE CONTENT

Unit-1 **[12 Hours]**

Introduction To Bioinformatics; Concept and importance of Bioinformatics; NCBI Data model; EMBL Database; DDBJ Database; PIR Database; PDB Database; Structural Database(SCOP,CATH); Structural Viewers (RasMol,PyMOL,Cn3D,Swiss PDB Viewer); Metabolic Pathway Database (KEGG, Meta Cyc, EMP).

Unit-2 **[10 Hours]**

Sequence alignment (Local, Global, Multiple); Sequence alignment algorithm (Dot Matrix, Needleman & Wunch, Smith-Waterman, FASTA and BLAST); Substitution matrix (PAM, BLOSUM); Phylogentic analysis; Hidden Markov Model; Algorithms of Non-redundant Sequence Datasets.

Unit-3 **[12 Hours]**

Homology Modelling; Threading Modelling; Algorithms of Prediction of 2D structure of protein (Chao-Fasman, Gor, Neural Network); Algorithms of prediction of 3D structure of protein; Protein Stability; Hydrophobicity profile; Protein-Protein interaction Database; Protein-ligand Interaction Database; Computational added drug design.

Unit-4 **[12 Hours]**

Introduction to Biostatistics; Measure of Central tendency (Mean, Median, Mode); Mean Deviation and Standard Deviation; Coefficient of Variation; Analysis of Variation(ANOVA); Test of Significance (t-test, f-test, chi-square test); Correlation and Regression Analysis.

Text Books

1. David W. Mount, Bioinformatics: Sequence and Genome Analysis.
2. Andreas D. Baxevanis, Bioinformatics: A Practical Guide to the Anlysis of Genes and Proteins.
3. John a. Rice, Mathematical Statistics and Data Analysis.
4. P.N. Arora & P.K. Malhan, Biostatistics; Himalaya Publishing House.
5. Wayne W. Daniel, Biostatistics: A foundation for Analysis in the Health Sciences.

Reference Books

1. M. Michael Gromiha, Protein Bioinformatics: From Sequence to Function, Academic Press, 2010.
2. D.E. Krane and M.L. Raymer, Fundamental concepts of bioinformatics, Pearson Education Inc. 2006.
3. S.C Rastogi, Bioinformatics: Methods and Applications Genomics, Proteomics and Drug Discovery.
4. Mishra and Mishra, Introductory Statistics

Course Code:	BTPC105	No. of Credits:	4
Course Name:	PRACTICAL	End Exam:	100

1. Study of stages of mitosis by squashing technique
2. Study of stages of meiosis
3. Karyotype Analysis
4. Preparation of metaphase chromosome.
5. Validation of Beer Lambert's law by UV-Visible spectroscopy.
6. Titration curves of amino acids.
7. Separation of Amino acids by Paper chromatography & TLC.
8. Qualitative Analysis of amino acids, sugars and lipids.
9. Estimation of protein content by Lowry's & Biuret method.
10. Estimation of DNA content in the given sample by Diphenylamine method.
11. Estimation of RNA content by the Orcinol method.
12. Estimation of reducing sugars by DNS method.
13. Isolation and estimation of casein from milk.
14. Estimation of Hemoglobin content in blood.
15. Measurements of Central tendency and their variance.
16. Comparison of two samples by Students''t' test & study of ANOVA.

SEMESTER-II

Course Code:	BTPC201	No. of Credits:	4
Course Name:	MOLECULAR BIOLOGY	Sem End Exam & Cycle Test:	70+30

COURSE EDUCATIONAL OBJECTIVES:

CEO1: To know the genome organisation and genomic diversity of organisms.
CEO2: To study the various mechanism associated with DNA, RNA and proteins.

COURSE OUTCOMES:
Towards the end of the course the students will be able to:

CO1 To study the DNA diversity of DNA structure and Genome organization in prokaryotes and eukaryotes.
CO2 To understand the mechanism of DNA Replication, Repair & Recombination.
CO3 To know the Prokaryotic & Eukaryotic Transcription and Post transcriptional modifications.
CO4 To understand the Prokaryotic and eukaryotic translation and biology of cancer cell.

Mapping of COs with POs and PSOs

COs/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	1	3	3	1										
CO2	2	1	2	1										
CO3	2	1	2	1										
CO4	1	2	2	2										

1–Slight, 2 –Moderate, 3 –Substantial

COURSE CONTENT

Unit – 1 : DNA structure and Genome organization [10 Hours]

Prokaryotic and eukaryotic Genome organization, organelles genomes (mitochondrial and chloroplast genome), Heterochromatin and Euchromatin, DNA re-association kinetics (Cot curve analysis); Repetitive and unique sequences; Satellite DNA, C-Value paradox, Genome complexity, Central dogma, DNA as the genetic material, Gene as recon, muton and cistron, split gene, jumping gene, and over-lapping geneconcepts.

Unit – 2 : DNA Replication; Repair & Recombination [15 Hours]

DNA Replication: replication origin and replication fork, fidelity of replication, extra chromosomal replicons, prokaryotic and eukaryotic DNA replication, Mechanism of DNA replication (Initiation, elongation and termination), Enzymes and accessory proteins involved in DNA replication. DNA damage and repair mechanisms; Direct repair, Base excision and Nucleotide excision repair; Mismatch correction; SOS repair; Homologous and Site-specific Recombination, Transposition.

Unit – 3 : Prokaryotic & Eukaryotic Transcription, Post Transcriptional Modifications [15 Hours]

Prokaryotic Transcription: Transcription machinery, Transcription process: formation of initiation complex, RNA polymerases (structure and assembly), elongation and Termination of transcription, Principle and mechanism of gene regulation, The Operon concept, (lac-, trp and gal -operon). Eukaryotic transcription and regulation: Eukaryotic promoters and enhancers, Eukaryotic RNA polymerase types, General and specific transcription factors, transcription activator and repressor, mechanism of transcription regulation, Transcriptional and post-transcriptional gene silencing. Post transcriptional modifications (capping and polyadenylation, splicing), RNA editing, RNA transport.

Unit – 4 : Translation and Cancer biology [10 Hours]

Prokaryotic and eukaryotic translation: Translation machinery; genetic code, aminoacylation of tRNA, tRNA-identity, aminoacyl tRNA synthetase, and translational proof-reading, Ribosomes, Mechanism of initiation, elongation and termination; Co- and post-translational modifications, translational inhibitors.
Cancer: Biology of cancer cell, viral and cellular oncogenes, tumor suppressor genes from humans: structure, function and mechanism of action of pRB and p53 tumor suppressor proteins.

Text Books

1. P Khanna **Cell and Molecular Biology**
2. Alberts et al; **Molecular Biology of the Cell**.
3. Moleclar Biology by Frefelder

Reference Books

1. Clark and Pazdernik **Molecular Biology**
2. Gene VII by Benjamin Lewin
3. Molecular Biology of Gene by Watson
4. Genome by TA Brown

Course Code:	BTPC202	No. of Credits:	4
Course Name:	MICROBIOLOGY	Sem End Exam & Cycle Test:	70+30

COURSE EDUCATIONAL OBJECTIVES:

CEO 1: To enhance the student's knowledge on the historical aspects and development of microbiology

CEO 2: To make the students knowledgeable on microbial ecology, interactions, microbial recombination and the various techniques involved.

COURSE OUTCOMES:

Towards the end of the course the students will be able to :

CO1 Knowledge on Landmark discoveries in Microbiology and different domains classification of living organisms..

CO2 To understand about microbial metabolism, growth and energy generation.

CO3 The student will be able to identify common infectious agents and the diseases that they cause.

CO4 Learn the occurrence, abundance and distribution of microorganism in the environment, microbial recombination and mutation.

Mapping of COs with POs and PSOs

COs / POs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO2
CO 1	3		1											
CO 2	2	3	1											
CO 3	1	2	2											
CO 4	2	3	1											

1–Slight, 2 –Moderate, 3 –Substantial

COURSE CONTENT

Unit –1: **[12 Hours]**

Beginning of Microbiology, Milestones in the development of microbiology, spontaneous generation, Classification of microorganisms, Classification of Bacteria according to Bergey's manual, Bacterial cell structure and morphological features (cell wall, outer membrane, flagella, endospores and gas vacuoles), microbes beyond cellular organization (Viruses, viroids, and prions) Microbiology: Sterilization, Culture Media, Pure culture technique, Microbial staining methods.

Unit – 2: **[10 Hours]**

Microbial growth: Growth curve, measurement of growth, growth yields, synchronous growth, continuous culture, growth as affected by environmental factors such as temperature, acidity, alkalinity, water availability and oxygen, Microbial physiology: Physiological adoption and life style; Unicellular Eukaryotes and the Extremophiles, Microbial nutrition, Nitrogen fixation and biofertilizers, Industrial production of biofertilizers.

Unit –3: **[13 Hours]**

Host–Pathogen interactions, Respiratory infections caused by bacteria and viruses: Tuberculosis; Sexually Transmitted diseases, Diseases transmitted by animals: Rabies and Plague; Food and water born diseases, public health and water quality Chemotherapeutic agents and their mechanism of action; Antibiotics: Penicillin and Cephalosporin; Broad- spectrum antibiotics.

Unit – 4: **[10 Hours]**

Microbes on the Earth's Environment and Inhabitants, Genetic recombination in bacteria (Transformation, Conjugation, and Transduction), Plasmid DNA & its replication; Transposable elements in prokaryotes and eukaryotes: IS elements, Composite transposons, Tn3 elements, Microbial mutation.

Text Books

1.Brock Biology of Microorganisms, Maidgan, Martinko and Parker, Prentice HallInc., New York.
2.Microbiology, Prescott., Harley and Klein, William C Brown Press.
3.General Microbiology, S.B.Sullia and V. Santharam, Oxford & IBH, New Delhi.
4.Text book of Microbiology, R.C. Dubey and D.K.Maheswari, S.Cahnd andCompany.
5.Modern concepts of Microbiology, H.D.Kumar and S.Kumar, Vikas Publications.
6.Microbiology: Fundamentals and applications, S.S.Purohit, Agro BotanicalPublications, Jaipur.
7.Microbiology, Pelczar, Chan and Creig, Tata Mc Graw Hill Pub

Reference Books

1.Brook's Biology of Microorganism
2.M.T. Madigan and J.M. Martinko, **Biology of Microorganisms**.

Course Code:	BTPC203	No. of Credits:	4
Course Name:	MOLRCULAR IMMUNOLOGY	Sem End Exam & Cycle Test:	70+30

Course Educational Objectives
This course enables the students:

CEO1: To acquire in-depth knowledge about immunity, human immune system and make students learn about the structural features of the components of the immune system as well as their function.

CEO2: To provide thorough understanding of structure & functions various organs, cells and molecules involved in immune response.

CEO3: To provide students with a deep insight about the immunological reactions with emphasis on the effector mechanisms as well as applications of immunological techniques.

CEO4: To recapitulate the knowledge of immunology and predict about the nature of immune response that develops against bacterial, viral or parasitic infection, and prove it by designing new experiments.

Course Outcomes
Towards the end of the course, a student should be able to:

CO1: explain the role of immune cells, organs and their mechanism in body defense mechanism.

CO2: apply knowledge of immunology in various cellular functions, inculcate knowledge of various issues related to immunological reactions.

CO3: identify, formulate, and solve problems arisen due to the inefficient functioning of the immune system leading to various immunological diseases and to interpret association of immune system with cancer, autoimmunity & transplantation.

CO4: apply the knowledge of immune associated mechanisms in medical biotechnology research, to develop and demonstrate immunological techniques.

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	-	2	2	1							
CO2	1	2	3	3	2							
CO3	1	3	2	3	3							
CO4	1	3	3	2	-							

COURSE CONTENT

Unit –I: Immunology- fundamental concepts [10Hours]

Introduction, Phylogeny of Immune system, Components of innate and acquired immunity, Cells of the Immune system: Haematopoiesis and differentiation, Lymphocytes trafficking, B lymphocytes, T-lymphocytes, Macrophages, Dendritic cells, Natural Killer cells, Lymphokine activated killer cells,Eosinophils, Neutrophils and Mast cells. Organization and Structure of Lymphoid Organs: primary and secondary lymphoid organs.

Unit – II: Immune responses generated by B and T lymphocytes [12 Hours]

Physiology of immune response, Activation and regulation of B and T lymphocytes, Basis of self and non-self-discrimination;Humoral immune response, Cell-mediated immune responses, ADCC; Structure and function of antibody molecule, classes & subclasses of immunoglobulins; Nature and Biology of antigens and super antigens, Cytokines: properties, Production, biological function and therapeutic uses; Major histocompatibility complex and MHC restriction; Antigen processing and presentation.

Unit –III: Antigen-antibody interactions [10Hours]

Antigen – Antibody interaction: Precipitation, agglutination and complement mediated immune reactions; Haptens and adjuvants: structure and properties, Complement system. Advanced immunological techniques: RIA, ELISA, ELISPOT assay; Immunoelectrophoresis; Biotinylation; Avidin-Streptavidin.

Unit – IV: Humoral, Natural and clinical Immunology [13 Hours]

B and T cell maturation, activation and differentiation; B-cell receptor, T-cell receptor. Immunity to Infection: Bacteria, viral, fungal and infections; Hypersensitivity reactions-types (I, II, III, and IV); Autoimmunity; types of autoimmune diseases (Hashimoto's disease, Systemic lupus erythematosus & Multiple sclerosis); Mechanism and role of CD4+ T cells; Transplantation: Immunological basis of graft rejection; Immunodeficiency diseases: Primary and Acquired.

Text Books

1. Kuby Immunology, 5th edition, by R. A. Goldsby et al..
2. Immunology by Roitt
3. Immunology by Khan
4. Cellular and Molecular Immunology by Abdul, K., Abbas, Andrew K. L., Jordan, SP

Reference Books

1. Roitt, I.M. Essential Immunology.
2. Tizard I.R. Immunology.
3. Fundamentals of immunology By William Paul

Course Code:	BTPC204	No. of Credits:	4
Course Name:	ENZYME TECHNOLOGY	Sem End Exam & Cycle Test:	70+30

Course Educational Objectives
This course enables the students:

CEO1: Ability to carry out research /investigation independently in specialized area of Biotechnology.

CEO2: Recognise the need for continuous learning and will prepare oneself to create, select, learn and apply appropriate techniques, resources, and modern instrumentation to solve complex biotechnological activities with an understanding of the limitations.

CEO3: Demonstrate knowledge of biotechnology and management principles and apply to manage projects efficiently and economically with intellectual integrity and ethics for sustainable development of society.

CEO4: Ability to write and present a substantial technical report/document.

Course Outcomes
Towards the end of the course, a student should be able to:

CO1: Apply knowledge of enzyme technology in various cellular functions, inculcate a knowledge of various issues related to enzyme technology, the application and research involved in functioning of the different metabolic processes.

CO2: Design and analyse the experiments related with the different factors involved in enzyme technology to study the kinetics and rationale behind each phenomenon.

CO3: Identify, formulate, and solve problems arisen due to the inefficient functioning of the enzymes processes like inhibitors and activators.

CO4: Use the techniques, skills, and modern tools necessary for increase enzymes uses in different industries for better functions of enzymes and reduces the production and utilization cost of enzymes.

CO	PO1	PO2	PO3	PO4	PO5
CO1	1	2	2	3	-
CO2	3	2	3	1	-
CO3	2	1	3	2	-
CO4	1	2	2	3	-

COURSE CONTENT

Unit-1 :Enzymology-fundamentals [10 Hours]

Introduction to enzymes; nomenclature and classification of enzymes; activation energy; factors affecting enzyme activities; active site; allosteric site, coenzymes and co factors; Multi-enzyme complexes and Multi-functional enzymes, Applications of enzyme technology. Industrial level production of enzymes.

Unit-2 :Enzyme Kinetics [13 Hours]

Chemical kinetics; Rate and Order of reaction: zero order and first order; Derivation of Michaelis-Menton equation; Vmax and Km value and their significance; Lineweaver-burk plot; Negative and Positive Co-operativity; Mechanism of enzyme action: Lock & Key hypothesis and Induced fit hypothesis; Turnover number; Enzyme inhibition – Competitive, Non-competitive and Uncompetitive.

Unit-3 :Enzyme Catalysis [10 Hours]

Mechanism of enzyme catalysis - Acid-Base catalysis, Covalent catalysis, Metal ion catalysis and Entropy effect; Factors associated with enzyme catalysis; Allosteric enzymes and their significance.

Unit-4 :Functional Enzymes [12 Hours]

Structure and function of enzymes: Lysozyme, Chymotrypsin, RNase, Serine proteases; Enzyme regulation and control of their activity. Immobilization of enzymes; Whole cell immobilization and their application; Structure and mechanism of action of some important co-enzymes (NAD+, FAD, Pyridoxal phosphate and CoASH).

Text Books

1. Nelson, D.L., Cox, M.M. Lehninger. **Principles of Biochemistry**.
2. Kulkarni & Deshpande. **General Enzymology**.
3. Daniel, L, Purich, Melvin, I. Simon, John, N., Abelson. **Contemporary enzyme kineticsand mechanism**.

Reference Books

1.Palmer **Enzymology**
2.Paul F. Cook and W. W. Cleland. **Enzyme Kinetics and Mechanism**

Course Code:	BTPC205	No. of Credits:	4
Course Name:	PRACTICAL	End Exam:	100

1. Preparation of liquid and solid media for growth of microorganisms.
2. Isolation and maintenance of organisms by plating, streaking and serial dilution methods.
3. Isolation of pure cultures from soil, water and air.
4. Microscopic examination of bacteria by Gram stain, Acid fast stain, Endospore & Fungal staining.
5. Isolation of genomic DNA from Plant tissue.
6. Isolation of genomic DNA from human blood sample.
7. Purity determination and quantitation of DNA.
8. Electrophoresis of DNA.
9. Isolation and electrophoresis of Proteins.
9. Study of Antigen-Antibody interaction by Double and Radial Immuno-diffusion.
10. Blood film preparation and identification of various blood corpuscles.
11. Demonstration of Southern and Western blotting.
12. Isolation of Industrially important microbes.
13. Microbial production of antibiotics and its antimicrobial assay.
14. Determination of optimum pH, temperature, Km value of enzymes.

Course Code:	BTEC206	No. of Credits:	2
Course Name:	Seminar and technical writing	End Exam:	50

Every student will present a seminar on a topic related to theoretical or experimental, advanced topic, industrial project, training in a research institute, training of handling of sophisticated equipments etc. Each student will submit a technical report.

CRITERIA	Max. Marks
Presentation	10
Communication	15
Seminar contents	25
Total Marks	**50**

SEMESTER-III

Course Code:	BTPC301	No. of Credits:	4
Course Name:	GENETIC ENGG. & r-DNA TECHNOLOGY	Sem End Exam & Cycle Test:	70+30

COURSE EDUCATIONAL OBJECTIVES:

CEO1: To know the concepts of gene cloning and its requirements.

CEO2: To study the various techniques associated with gene cloning and DNA analysis.

COURSE OUTCOMES:
Towards the end of the course the students will be able to:

CO1 To know the scope, milestones and basic requirements of Genetic engineering.
CO2 To know about the cloning vectors, mechanism of gene cloning and expression of cloned genes through construction of libraries.
CO3 To know the techniques associated with gene expression study and study of molecular markers.
CO4 To understand the techniques of DNA sequencing, PCR, gene silencing, gene therapy and biosafety guidelines.

Mapping of COs with POs and PSOs

COs/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	1	1	1	3							
CO2	2	2	1	1	2							
CO3	1	2	2	1	2							
CO4	1	2	3	2	3							

1–Slight, 2 –Moderate, 3 –Substantial

COURSE CONTENT

Unit-1 **[12 Hours]**

Scope of Genetic engineering, Milestones in genetic engineering, General requirements for performing a genetic engineering experiment, Isolation of DNA and RNA, Restriction Endonuclease and Methylase, DNA ligase, Klenow enzyme, T4 DNA polymerase, Reverse transcriptase, Polynucleotide kinase, Alkaline phosphatase, homopolymeric tailing; Cohesive and blunt end ligation; Linkers; Adaptors; chemical synthesis of oligonucleotides.

Unit-2 **[13 Hours]**

Plasmids; Bacteriophages; Phagemids; Biology of bacteriophage lambda; Cosmids; Artificial chromosome vectors (YACs; BACs); Animal virus derived vectors - SV40 and retroviral vectors, Expression vectors; Site directed mutagenesis; DNA micro array technology.

Molecular cloning: Recombinant DNA techniques, Techniques of gene transfer, Construction of genomic DNA and cDNA libraries, screening of recombinants, Expression strategies for heterologous genes.

Unit-3 **[13 Hours]**

DNA analysis: labelling of DNA: nick translation, random priming, radioactive and non-radioactive probes, Southern and fluorescence in situ hybridization, DNA fingerprinting, chromosome walking, Techniques for gene expression: Northern and Western blotting, gel retardation technique, DNA foot printing, Primer extension, Sl mapping, Reporter assays, Phage display; Yeast two hybrid and three hybrid systems. Genetic and physical maps; Molecular markers in genome analysis: RFLP, RAPD, AFLP, SCAR, SNP and SSR.

Unit-4 **[12 Hours]**

Sequencing methods; Enzymatic DNA sequencing; Chemical sequencing of DNA; Automated DNA sequencing; Polymerase chain reaction and its applications, Gene silencing techniques: Principle and application; Somatic and germ-line therapy- in vivo and ex-vivo; Suicide gene therapy; Applications of genetic engineering. Biosafety regulation: Physical and Biological containment

Text Books

1. Nicholl An Introduction to Genetic Engineering
2. Molecular Cloning: A laboratory manual by J. Sambrook and E.F. Fritsch
3. S.B. Primrose, R.M. Twyman and R.W.Old; Principles of Gene Manipulation.

Reference Books

1. Genetic engineering Vol I-VI Setlow and Halander.
2. Molecular Biotechnology: Principles and applications of recombinant DNA by Glick
3. Brown TA, Genomes, 3rd ed. Garland Science.

Course Code:	BTPE302	No. of Credits:	4
Course Name:	ANIMAL BIOTECHNOLOGY	Sem End Exam & Cycle Test:	70+30

COURSE EDUCATIONAL OBJECTIVES:

CEO 1: To know the basic equipments and materials required for animal cell culture and various methods used for cell cloning

CEO 2: To understand the in vitro fertilization, Embryo culture, Tissue engineering, transfection mechanism and application of animal cell culture.

COURSE OUTCOMES:
Towards the end of the course the students will be able to :

CO1 Know the laboratory equipments and materials required for animal cell culture and establishment of cell line.
CO2 Understand about Various methods of cell separation, Cell cloning, Characterization of cultured cell.
CO3 Know about the in vitro fertilization, Embryo culture, Tissue engineering and mechanism of apoptosis.
CO4 Learn about the transfection of animal cell lines and applications of animal cell culture.

Mapping of COs with POs and PSOs

COs/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	2	2	1	2							
CO2	3	2	1	1	1							
CO3	1	2	2	1	1							
CO4	2	3	1	2	1							

1–Slight, 2 –Moderate, 3 –Substantial

COURSE CONTENT

Unit-1: [12 Hours]

Laboratory Equipments and materials for animal cell culture; Sterilization and aseptic techniques, General considerations in media design, Balanced salt solutions; Various type of cell culture media; Primary culture and its maintenance,Contact inhibition,Anchorage dependence,Transformation of cells: Characteristics of transformed cells and the process of Immortalization(by suppression of senescence genes, induction by viralgenes, by induction of telomerase and by chemical carcinogens),Establishment of cell line.

Unit-2 : [10 Hours]

Various methods of cell separation, Cell cloning, Characterization of cultured cell: Morphology of cells, Species identification, identification of tissue of origin, identification of specific cell lines, Cell culture in continuous, perfusion and hollow-fiber reactor,Preparation of chick fibroblast,Organ and histotypic cultures, Measurement of cell death.

Unit-3 : [8 Hours]

In vitro fertilization, Embryo culture,Tissue engineering: Design stages for tissue engineering, cell substrates andsupport materials,cell sources,, Necrosis and apoptosis (mechanism and assay), Cryopreservation

Unit-4 : [10 Hours]

Transfection of animal cell lines, Construction of animal viral vectors for gene transfer into cell lines;Sperm mediated gene transfer;Embryo transfer technology; Micromanipulation,Application of animal cell culture; Somatic cell genetics; Molecular pharming; Cell culture based vaccines and other therapeutic proteins. Stem cell culture and its application,

Text Books

1. Culture of animal cells by R.I. Freshney.
2. Tissue Culture–Methods and Applications by Paul F. Kruse Jr. and M. K.Patterson, Jr.
3. Cell Culture Lab Fax by Butler and Dawson.
4. Cell and Tissue culture: Laboratory procedures by Doyle and Griffiths

Reference Books

1.B.Hafez, E.S.E Hafez, Reproduction in Farm Animals.
2.Louis-Marie Houdebine, Transgenic Animals: Generation and Use.
3.Ed. John R.W. Masters, Animal Cell Culture - Practical Approach.
4.Ed. Martin Clynes, Animal Cell Culture Techniques.

Course Code:	BTPE303	No. of Credits:	4
Course Name:	ANIMAL STEM CELL TECHNOLOGY	Sem End Exam & Cycle Test:	70+30

COURSE EDUCATIONAL OBJECTIVES:

CEO 1: To know about the basic of various animal stem cell and its isolation, characterization and maintenance.

CEO 2: To understand regulatory mechanisms in Embryonic and adult stem cells and Stem cell technologies.

COURSE OUTCOMES:

Towards the end of the course the students will be able to :

CO1 Know about the various animal stem cell and its development and differentiation.
CO2 Understand about isolation, characterization and maintenance of various stem cells.
CO3 Know about the regulatory mechanisms in embryonic and adult stem cells with its development and differentiation.
CO4 Learn about the Stem cell technologies, transplantations and ethical and regulatory issues.

Mapping of COs with POs and PSOs

COs/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	2	2	2									
CO2	3	2	2	1	1									
CO3	1	2	2	1	1									
CO4	2	2	1	2	1									

1–Slight, 2 –Moderate, 3 –Substantial

COURSE CONTENT

UNIT-1: **[10 Hours]**

Introduction to stem cells , Embryonic stem cells,embryonal carcinoma cells, embryonic germ cells, adult stem cells, hematopoietic stemcells,mesenchymal stem cells, cancer stem cells, induced pluripotent stem cells. Cellular potency,Stem cell differentiation, dedifferentiation & trans differentiation,Asymmetric cell division, telomerases in relevance to stem cell development and differentiation.

Unit-II: **[12 Hours]**

Isolation, characterization and maintenance of embryonic stem cell isolated from: Mouse and Human.Serum and feeder free culture of human embryonic stem cells, evolution of xeno-free culture systems. Somatic and Germ cell derived stem cells: epithelial stem cells, mesenchymal stem cells, neural stem cells, haematopoitic stem cells, cardiac stem cells,Cancer stem cells, molecular and evolutionary mechanisms addressing origin and maintenance of cancer stem cells.

Unit-III: **[13 Hours]**

Molecular basis of pluripotency, stem cell niche,.Regulatory mechanisms in Embryonic and adult stem cells: Core regulatory circuitry, DNA methylation, histone modifications, histone modifiers, chromatin remodelers, RNA PolII code, post transcriptional control of gene expressionin ESC: role of miRNAs, LincRNAs and RNA binding proteins. Spatial organization of genome during ESC development and differentiation.

Unit-IV: **[10 Hours]**

Stem cell technologies: Generation of chimeric animals and animal cloning Stem cell and progenitor cell assays: Purification of tissue specific stem cells and transplantations, Tissue engineering,stem cells and gene therapy,Ethical and regulatory issues in the use of stem cells. Methods & Bioinformatics resources related to Stem cells

Text Books

1.Handbook of Stem Cells, 2ndEdition, Atala A & Lanza R, Academic Press, 2012.
2.Essential of Stem Cell Biology,3rd Edition, Lanza R, et al, Elsevier Academic Press, 2013.
3.Translational Approaches in Tissue Engineering & Regenerative Medicine, Mao JJ, et al, Artech House, 2007.
4.Stem Cell Repair and Regeneration, Volume-2, Habib NA, Levièar NY, Gordon M, Jiao L & Fisk N, Imperial College Press, 2007.

Reference Books

1.Lanza R, Gaerhart J, Hogan B, Melton R, Thomas D, Thomas J, and Wilmut S. Essentials of Stem Cell Biology. Elsevier Inc.
2.Stillman B, Stewart D and Grodzicker T, Control and Regulation of Stem Cells.
3.Tursen Kursad, Stem Cell Biology and Regenerative Medicine, Humana Press.

Course Code:	BTPE304	No. of Credits:	4
Course Name:	PLANT BIOTECHNOLOGY	Sem End Exam & Cycle Test:	70+30

COURSE EDUCATIONAL OBJECTIVES:

CEO1: To provide basic concept of plant tissue culture
CEO2: To determine the factors influencing plant cell differentiation.
CEO3: To provide techniques of plant genome transformation
CEO4: To introduce the concept of production of secondary metabolites through tissue culture

COURSE OUTCOMES:

Towards the end of the course the students will be able to:

CO1 To know the composition and preparation of tissue culture media for culture of plant tissue
CO2 Be acquainted with culture the different plant tissue and protoplast
CO3 To have idea about vector and vector less gene transformation.
CO4 To design culture medium for production of secondary metabolites.

Mapping of COs with POs and PSOs

COs/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	1	2												
CO2	2	3												1
CO3	1	2												
CO4	2	1												

1–Slight, 2 –Moderate, 3 –Substantial

COURSE CONTENT

UNIT-I: PLANT TISSUE CULTURE [08 Hours]

Introduction to plant tissue culture; Tissue culture media; Sterilization techniques in plant tissue culture; Initiation and maintenance of callus; Suspension cultures; Organogenesis; Somatic embryogenesis; Artificial seed /Synthetic seeds technology; Rapid clonal propagation. Embryo culture and embryo rescue; Protoplast isolation, culture and fusion; Selection of hybrid cells; Symmetric and asymmetric hybrids; Cybrids; Anther, Pollen and Ovary culture for production of haploid plants; Somaclonal variation

UNIT-II : PLANT GENOME TRANSFORMATION [10 Hours]

Plant transformation technology – Basis of tumour formation; Hairy root; Features of Ti and Ri plasmids; Mechanisms of DNA transfer; Role of virulence genes; Use of Ti and Ri as vectors; Use of reporter genes as genetic markers; Reporter gene with introns; Methods of nuclear transformation; Viral vectors and their applications; Vector-less or Direct DNA transfer; Particle bombardment, electroporation, microinjection

UNIT-III : APPLICATION OF PLANT TRANSFORMATION [8 Hours]

Herbicide resistance; Insect resistance; Bt genes; Non Bt like protease inhibitors; alpha amylase inhibitor; RIP; Pathogenesis-related (PR) proteins; Role of Thionins in plant protection; Terminator seed technology.

Unit-IV : Application of Molecular Markers [12 Hours]

Application of Molecular markers in plant breeding; Chloroplast transformation-Advantages, Vectors and Success; Transgenic plants and their management; Plant secondary metabolites; Shikimate pathway; Phenylpropanoid pathway

Text Books:

1. **Plant biotechnology** – J Hammond, et al., Springer Verlag.
2. **Practical application of plant molecular biology** – R J Henry, Chapman & Hall.
3. **An introduction to plant tissue culture** – M K Razdan.

Reference Books:

1. **Principles of plant biotechnology: An introduction to genetic engineering in plants**-Mantell.
2. **Plant cell and tissue culture** – S Narayanswamy, Tata Mc Graw Hill Co.

Course Code:	BTPE305	No. of Credits:	4
Course Name:	AGRICULTURAL BIOTECHNOLOGY	Sem End Exam & Cycle Test:	70+30

COURSE EDUCATIONAL OBJECTIVES:

CEO1: To provide basic concept of plant tissue culture in agriculture
CEO2 : To impart knowledge on in vitro fertilization
CEO3: To provide techniques of animal cloning
CEO4: To introduce the concept of production of transgenic animals

COURSE OUTCOMES:
Towards the end of the course the students will be able to:

CO1 To know the application of biotechnology in tissue culture
CO2 Be acquainted with in vitro fertilization and embryo culture
CO3 To have idea about *in situ* and *ex situ* preservation of germplasm.
CO4 To know about transgenic animal production and application in expression of therapeutic proteins.

Mapping of COs with POs and PSOs

COs/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1												
CO2	2	3												1
CO3	1	2												
CO4	2	1												

1–Slight, 2 –Moderate, 3 –Substantial

COURSE CONTENT

UNIT-I: APPLICATION OF BIOTECHNOLOGY IN AGRICULTURE [12 Hours]

General application of biotechnology in Agriculture, Medicine, dairy and animal husbandry, Energy production and Forensics; Public perception of biotechnology. Early concepts of inheritance. Discussion on Mendel's paper; Sex determination, differentiation and sex-linkage, Sex-influenced and sex limited traits; Linkage, recombination and genetic mapping in eukaryotes, Somatic cell genetics. Structural and numerical changes in chromosomes; Mutations and mutagenic agents. Genetic code and protein biosynthesis; Extra chromosomal inheritance, Male sterility and incompatibility.

UNIT-II : GENETICS AND EVOLUTION [10 Hours]

Inheritance of quantitative traits; Concepts in population genetics; Genetics and evolution; Structure of sperms and ovum, cryopreservation of sperms and ova of livestock, artificial insemination, super ovulation, in vitro fertilization, culture of embryos, cryopreservation of embryos, embryo transfer, embryo-splitting, embryo sexing

UNIT-III : ANIMAL CLONING [8 Hours]

Basic concepts in Animal cloning, cloning from- embryonic cells and adult cells, cloning of different animals, cloning for conservation endangered species, ethical, social and moral issues related to cloning, *in situ* and *ex situ* preservation of germplasm, in utero testing of foetus for genetic defects, pregnancy diagnostic kits, anti-fertility animal vaccines

Unit-IV : TRANSGENIC ANIMAL PRODUCTION [12 Hours]

Introduction to breeds of cattle, buffalo, sheep, goats, pigs, camels, horses, canines and poultry, genetic characterization of livestock breeds, marker assisted breeding of livestock, introduction to animal genomics, transgenic animal production and application in expression of therapeutic proteins. Immunological and nucleic acid based methods for identification of animal species, detection of meat adulteration using DNA based methods, detection food/feed adulteration with animal protein, identification of wild animal species using DNA based methods using different parts including bones, hair, blood, skin and other parts confiscated by anti-poaching agencies

Teaching Methods: Chalk& Board/ PPT/Video Lectures

Text Books:

1. Plant cell and tissue culture for production of food ingredients – T J Fu, G Singh, et. al.
2. Biotechnology in crop improvement – H S Chawla.
3. Elements of biotechnology – P K Gupta.

Reference Books:

1. Practical application of plant molecular biology – R J Henry, Chapman & Hall.
2. Plant biotechnology – J Hammond, et. al., Springer Verlag.

Course Code:	BTCBOE306	No. of Credits:	4
Course Name:	FOOD BIOTECHNOLOGY	Sem End Exam & Cycle Test:	70+30

Course Educational Objectives
This course enables the students:

CEO1: To provide thorough understanding on applications of biotechnology in food, pharmaceutical & agricultural sector and production bacteria based & yeast based products.
CEO2: To acquire in-depth knowledge about food products, food processing and food production technology.
CEO3: To provide students with a deep insight about various additives and agents used in food processing.
CEO4: To impart knowledge on food preservation techniques, food spoilage and its control.

Towards the end of the course, a student should be able to:

CO1: Acquire knowledge about role of biotechnology in agro, pharma and food sector and production of bacteria & yeast based food products.
CO2: Analyze the process of food processing and preservation using appropriate microorganism.
CO3: Employ the correct method of food preservation to improve the shelf life of food products and suggest steps to prevent food spoilage.
CO4: Apply the knowledge to develop novel approaches for food preservation in order to prevent food spoilage.

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	2	-	1	-							
CO2	-	2	1	1	2							
CO3	2	1	-	2	1							
CO4	1	-	3	3	-							

COURSE CONTENT

Unit-I: **[14 Hours]**

Prospectus, scope and applications of Biotechnology in food (Food industries), pharmaceuticals and agriculture; Application of biotechnology to food products: Bacteria-based products; dairy, meat, fish and vegetable products, vinegar and additives, Yeast-based products; food yeasts, alcoholic beverages and bread; Other microbial based products; enzymes, microbial biomass protein (MBP), additives and "smart foods."

Unit-II: **[12 Hours]**

Food quality and Production technology Analysis of food, major ingredients present in different product, Food additives colour, flavour, vitamins, Single cell protein, mushroom, Fermentative production of food, Pickling and alcoholic beverages, Genetically manipulated crop based food, oriental foods, probotics/ prebiotics in food products.

Unit-III: **[10Hours]**

Technology for improved process Enzyme in bakery, fermented cereal products, Enzymes in fat/oil industries, Protease in cheese making, enzymes in beverage production, Utilization of food waste for production of value added products, enzymes in sugar syrup, genetically modified food.

Unit-IV: **[14 Hours]**

Food spoilage and control Spoilage of food, Microbiology of water, meat, milk, vegetables, Microbial safety of food products, Chemical safety of food products, heavy metal, fungal toxins, pesticide and herbicide contamination, Food preservatives and additives, Post-harvest technology for food preservation. Technology – canning, dehydration, ultrafiltration, sterilization, irradiation etc.

Text Books:

1. Jay, Modern Food Microbilogy, CBS Publishers, 1987
2. Frazier, Food Microbiology
3. G.Reed, Prescott and Dunn's Microbiology, CBS publishers, 1987

Reference Books:

1. Desrosier, Teachnology of food preservation, CBS publishers
2. R.P. Singh and D.R. Headman, Introduction to food engineering, Aca. Press

Course Code:	BTCBOE307	No. of Credits:	4
Course Name:	PHARMACEUTICAL BIOTECHNOLOGY	Sem End Exam & Cycle Test:	70+30

Course Educational Objectives
This course enables the students:

CEO1: To get an idea about various aspects of plant secondary metabolites that are pharmaceutically important.

CEO2: To acquire knowledge w. r. t. the methods involved in the enhancement in the biosynthesis of secondary metabolites.

CEO3: To gain in-depth understand regarding biosensors used in pharmaceutical industries.

CEO4: To acquire knowledge regarding drug discovery, design and development.

Course Outcomes
Towards the end of the course, a student should be able to:

CO1: Gain idea regarding various mechanisms and manipulation strategies in relation to biosynthetic pathways of secondary metabolites; describe various methods of isolation, characterization and screening.

CO2: Describe the methods like Precursor feeding, elicitation through elicitors, hairy root induction etc. involved in the enhancement of biosynthesis of secondary metabolites along with the use of metabolic engineering for the enhancement.

CO3: Gain an idea relating to the working and applications of biosensors in Pharmaceutical industries.

CO4:Understand various strategies involve in the drug discovery, design and development in detail.

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	2	1				1					1
CO2	1	2	1									1
CO3	2	1	2									
CO4	3	2										1

COURSE CONTENT

Unit –I: **[10 Hours]**

Plant secondary metabolites, control mechanisms and manipulation of phenylpropanoid pathway, shikimate pathway and alkaloids. Various methods for Isolation, characterization and screening of pharmaceutically important plant secondary metabolites.

Unit –II: **[8 Hour]**

Enhancement of secondary metabolites using precursor feeding, elicitors (biotic and abiotic) and hairy root induction. Metabolic engineering for enhancement of secondary metabolites

Unit –III: **[8Hours]**

Biosensors, Working and applications of biosensors in Pharmaceutical industries – (G-Protein Coupled Receptors) to market a novel process for testing drugs.

Unit –IV: **[12 Hours]**

Drug discovery, design and development: drug discovery without a lead (Penicillin). Lead discovery (Random screening, targeted screening). Lead modifications – identification of active part (Pharmacophore) and functional group modifications. Structural modifications to increase potency (Homologation, chain branching, ring-chain transformation, bioisosterism.

Text Books:

1. **Textbook of Pharmacology** by Rang and Dale; Churchill Livingstone
2. **Quientessence of Medical Pharmacology** by C.Chowdary; NCBA

Reference Books:

1. **Lippincott's illustrated reviews - Pharmacology** by Sangeeta Sharma & Thirumurthy Velpandian; Wolters Kluwer India Pvt. Ltd
2. **Essentials of medical pharmacology** by K. D. Tripathi; Jaypee Brothers Medical Publishers

Course Code:	BTPC308	No. of Credits:	4
Course Name:	PRACTICAL	End Exam:	100

1. Plasmid isolation by alkaline lysis and boiling method.
2. Restriction Digestion & Mapping.
3. Amplification of gene by PCR and analysis by agarose gel electrophoresis.
4. Cell Viability & Cytotoxicity.
5. Measurement of doubling time.
6. Tools and glass wares used for plant tissue culture and their sterilization.
7. Preparation of Plant tissue culture media.
8. Initiation of callus.
9. Cell fusion with Poly Ethylene Glycol.
10. Organogenesis.

SEMESTER-IV

Course Code:	BTPC401	No. of Credits:	4
Course Name:	ENVIRONMENTAL BIOTECHNOLOGY	Sem End Exam & Cycle Test:	70+30

Course Educational Objectives
This course enables the students:

CEO1: To get an idea regarding the functioning of ecosystem, threats to it and solutions through Environmental Biotechnology.

CEO2: To acquire basic knowledge regarding waste water treatment.

CEO3: To obtain knowledge about sources of heavy metal pollution and different remedies to control it.

CEO4: To gain broad idea regarding different Bioremediation processes.

Course Outcomes
Towards the end of the course, a student should be able to:

CO1: Explain various environmental issues, functional aspects of environment, solutions through Environmental Biotechnology, types of pollution, measurement and sources of waste water pollution.

CO2: Differentiate between Aerobic and Anaerobic waste water treatment processes and describe waste water treatment schemes w. r. t. different industries.

CO3: Gain some knowledge regarding heavy metal pollution and various remedies to overcome it. And explore scope of using genetically engineered organisms for pollution control.

CO4:Get complete idea regarding the types and applications of different bioremediation methods to control pollution.

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	2										1
CO2	2	1	1				1					
CO3	2	2	1	2			2					1
CO4	3	3	2	2			2					1

COURSE CONTENT

Unit-I: Environment and Environmental Pollution [10 Hours]

Environment: Environmental issues; Concept and dynamics of ecosystem; Biogeochemical cycles; Environmental Biotechnology and its current status.
Types of pollution & Types of wastes; Methods for the measurement of pollutants & waste; Air pollution and its control; Water Pollution; Measurement of water pollution; Sources of water pollution; Waste water collection and its treatment by physical and chemical processes.

Unit-II: Treatment of Waste [12 Hours]

Microbiology of Waste Water Treatment; Aerobic Process: Activated sludge, Oxidation ditches, oxidation ponds, trickling filter, rotating discs & drums; Anaerobic Processes: Anaerobic digestion, anaerobic filters, anaerobic sludge blanket reactors; Treatment schemes for waste waters of dairy, distillery and sugar industries.

Unit-III: Sources of Pollution

Sources of industrial and mining heavy Metal Pollution; Microbial Systems for Heavy Metal Accumulation, Biosorption, Bioleaching; Bioaugmentation; Plasmid borne metabolic activities; Use of genetically engineered organisms for pollution control.

Unit-IV: Bioremediation

Types of Bioremediation; Application of Bioremediation; Degradation of Xenobiotics; Oil spills; Solid waste management; Vermitechnology; Waste water treatment using aquatic plants; Biopesticides and their role in pest management.
Teaching Methods: Chalk& Board/ PPT

Text Books:

1. **Wastewater Engineering** - Treatment, Disposal and Reuse. Tata McGraw Hill.
2. **Environmental Chemistry**. A.K. De, Wiley Eastern Ltd.
3. **Environmental Biotechnology** by C. F. Forster and D. A. J. Wase.

Reference Books:

1**. Environmental Biotechnology** by Jogdand.
2**.Fundamentals of Ecology**by O.P. Odum

Course Code:	BTPE402	No. of Credits:	4
Course Name:	BOPROCESS ENGINEERING AND TECHNOLOGY	Sem End Exam & Cycle Test:	70+30

COURSE EDUCATIONAL OBJECTIVES:

CEO 1: To understand the isolation, screening and maintenance of industrially important microbes with Bioreactor designs and basic modes of fermentation process.

CEO 2: To know about the Strain improvement, enzyme stability and process of bioseparation techniques.

COURSE OUTCOMES:
Towards the end of the course the students will be able to :

CO1 Knowledge on isolation, screening and maintenance of industrially important microbes and sterilization process.

CO2 To understand about Bioreactor designs, fermentation process and production of various compounds.

CO3 Understand the methods of strain improvement, stabilization and applications of enzymes.

CO4 Learn about the process of bioseparation techniques and application of bioprocess technology.

Mapping of COs with POs and PSOs

COs/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	1	2	1									
CO2	2	3	1	2	1									
CO3	1	2	2	1	2									
CO4	2	3	1	1	2									

1–Slight, 2 –Moderate, 3 –Substantial

COURSE CONTENT

Unit-I : **[10 Hours]**

Isolation, screening and maintenance of industrially important microbes; Microbial growth and death kinetics; Primary and secondary metabolites; Influence of environmental factors on growth and product formation. Sterilization principles and practices, Media sterilization, Design of continuous sterilization.

Unit-II : **[15 Hours]**

Bioreactor designs; Types of fermentation and fermenters, Raw material and media formulation for fermentation process, Concepts of basic modes of fermentation - Batch, fed batch and continuous, Solid substrate, surface and submerged fermentation; Microbial Metabolites: Process technology for the production of primary metabolites e.g. ethanol, amino acids, citric acid, lactic acid; Production of secondary metabolites: Penicillin, Cephalosporin, Vitamins.

Unit-III : **[10 Hours]**

Strain improvement: induced mutation, over producing decontrolled mutants, genetically engineered strain, Pulse, Fluidised and Photo bioreactors, Stability of enzyme: Enzyme stabilization by selection and genetic engineering, protein engineering. Application of enzymes in industry, analytical purpose and medical therapy.

Unit-IV : **[10 Hours]**

Bioseparation - filtration, centrifugation, sedimentation, flocculation; Cell disruption; Liquid-liquid extraction; Purification by chromatographic techniques; Reverse osmosis and ultra-filtration; Drying; Crystallization; Treatment of effluent and its disposal. Industrially Important. Bioprocess automation and application of computers in bioprocessing, Recombinant products with representative examples.

Text Books

1. Jackson AT., Bioprocess Engineering in Biotechnology, Prentice Hall.
2. Shuler ML and Kargi F., Bioprocess Engineering: Basic concepts, 2nd Edition.
3. Principle of Fermentation Technology , P.F. Stanbury, A. Whitaker and S.J. Hall, Elsevier
4. Industrial Microbilogy, Prescot and Dunn,
5. Biochemical Engineering and Biotechnology Handbook, Atkinson, B and Marituna, F., The Nature Press, Macmillan Publ. Ltd.
6. Biochemical Engineering Fundamentals, Bailey & Olis. MGH.

Reference Books

1.Baily JE and Ollis DF., Biochemical Engineering fundamentals, 2nd Edition.
2.Comprehensive Biotechnology: The Principles, Applications and Regulations of Biotechnology in Industry.

Course Code:	BTPE403	No. of Credits:	4
Course Name:	MEDICAL BIOTECHNOLOGY	Sem End Exam & Cycle Test:	70+30

Course Educational Objectives
This course enables the students:

CEO1: To gain understanding regarding immunological concepts and immune pathogenesis.

CEO2: To acquire knowledge about genetic disorders, metabolic disorders and cancer.

CEO3: To obtain understanding regarding disease diagnosis and protein therapeutics.

CEO4: To acquire knowledge about stem cell therapy and gene therapy.

Course Outcomes
Towards the end of the course, a student should be able to:

CO1: Describe various cells & molecules of immune system and their significance along with the disorders associated with Immune system.

CO2: Get required knowledge about endocrine disorders, vitamin deficiency diseases, congenital disorders and cancer.

CO3: Get an idea about various kinds of disease diagnostic methods involving DNA probes, enzyme probes, PCR and therapeutics involving various proteins.

CO4: Classify Stem cells and describe the therapeutic applications of stem cells, strategies and methods involved in gene therapy along with applications.

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	2										1
CO2	1	2										1
CO3	2	1	1	2								
CO4	2	1	1	2				1				

COURSE CONTENT

Unit –I: Immunological Concepts and Immune pathogenesis [10 Hours]

Cells of the Immune system; Structure and functions of Immunoglobulins; Antigen – Antibody based diagnostic assays; Monoclonal antibodies and their applications; Autoimmune diseases; AIDS and other immunodeficiency diseases; Infections, Immunity and Vaccines.

Unit –II: Genetic disorders, Metabolic disorders and Cancer [8Hours]

Endocrine disorders; Vitamins and vitamin deficiency diseases; Congenital disorders and Chromosomal abnormalities; Cell death pathways, Cancer Biology

Unit –III: Disease diagnosis and Protein therapeutics [8 Hours]

Disease diagnosis by DNA probes and Enzyme probes; Use of PCR in infectious disease diagnosis; insulin, growth hormone, factor VIII, tissue plasminogen activator, interferons, lymphokines and Hepatitis-B vaccines

Unit –IV:Stem cell therapy and gene therapy [10 Hours]

Classification and sources of Stem cells, Overview of embryonic and adult stem cells, Therapeutic applications of stem cells; Human gene therapy (ex vivo, in vivo methods), Strategies and methods of Gene Therapy& applications**.**

Text Books:

1. **Medical Biotechnology**by P. Nallari & V.V. Rao**; Oxford University Press**
2. **Medical Biotechnology** by Bernard Glick et al; ASM Press

Reference Books:

1. **Medical Biotechnology** by Judith Pongracz &Mary Keen; Churchill Livingstone-Elsevier

Course Code:	BTPE404	No. of Credits:	4
Course Name:	ETHICS & INTELLECTUAL PROPERTY RIGHTS	Sem End Exam & Cycle Test:	70+30

Course Educational Objectives
This course enables the students:

CEO1: To provide thorough understanding on ethics, moral values, moral development theories, personal and professional ethics.

CEO2: To provide students with a deep insight about Profession and Professionalism, Professional accountability and ethical theories.

CEO3: To impart knowledge on intellectual properties, intellectual property rights and their need in research.

CEO4: To learn about patentable requirements, various IPRs and patent filling procedure.

Course Outcomes
At the end of the course, a student should be able to:

CO1: Recognize the philosophical assumptions that are embedded in moral ideas and in philosophical works in order to define one's moral responsibility in contemporary society.

CO2: Reflect on and evaluate ethical arguments from diverse sources in order to communicate effectively with others who might have a different opinion from one's own.

CO3: Gain awareness about Intellectual Property Rights (IPRs) to take measure for the protecting their ideas and devise business strategies by taking account of IPRs.

CO4: Acquire more insights into the regulatory affair and assists in technology up-gradation for enhancing competitiveness.

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	1	2	1	-							
CO2	-	2	1	1	-							
CO3	2	3	-	2	1							
CO4	1	-	2	1	-							

COURSE CONTENT

Unit-I **[8 Hours]**

Introduction to Ethics: 1.1 Basic terms- Moral, Ethics, Ethical dilemma, Emotional intelligence 1.2 Moral development theories of Kohlberg and Piaget 1.3 View on ethics by Aristotle 1.4 Governing factors of an individual's value system 1.5 Personal and professional ethics

Unit-II **[12 Hours]**

Profession and Professionalism: 2.1 Clarification of the concepts: Profession, Professional, Professionalism, Professional accountability, Professional risks, Profession and Craftsmanship, Conflict of interest 2.2 Distinguishing features of a professional 2.3 Role and responsibilities of professionals 2.4 Professionals' duties towards the organization and vice-a-versa 3 Ethical Theories: 3.1 Various ethical theories and their application- Consequentialism, Deontology, Virtue theory, Rights Theory, Casuist theory 3.2 Ethical terms: Moral absolutism, Moral Relativism, Moral Pluralism etc. 3.3 Resolving Ethical Dilemma

Unit-III **[10 Hours]**

Concept of property, rights, duties and their correlation; Intellectual property rights and its types-Patents, Trademarks, Copyright & Related Rights, Industrial Design, Traditional Knowledge, Geographical Indications, Protection of new GMOs; Process patent vs product patent; International framework for the protection of IP; IP as a factor in R&D; IPs of relevance to Biotechnology and few Case Studies.

Unit-IV **[12 Hours]**

Basic requirement of a patentable invention- novelty, inventive step, Prior art and Stae of art;Patent databases; Searching International Databases; Analysis and report formation; Filing of a patent application; Role of a Country Patent Office; Precautions before patenting-disclosure/non-disclosure; International patenting-requirement; Introduction to History of GATT, WTO, WIPO, TRIPS, PCT and Implications; Patent infringement-meaning, scope, litigation, remedies; Case studies and examples-Rice, Neemetc.

Text Books:

1. R. Subramanian, "Professional Ethics" , Oxford University Press, New Delhi, 2013
2. Edmund G. Seebauer and Robert L. Barry, "Fundamentals of Ethics", Oxford University Press, New Delhi, 2012.

Reference Books:

1. Stanley SA, Bioethics, Wisdom educational services
2. Sateesh MK, Bioethics and Biosafety, IK International Pvt. Ltd.

Course Code:	BTPE405	No. of Credits:	4
Course Name:	PRACTICAL	End Exam:	100

1. Determination of dissolved oxygen concentration of water sample.
2. Detection of coliforms for determination of the purity of potable water.
3. Determination of total dissolved solids of water.
4. Determination of biological oxygen demand (BOD) of a sewage sample.
5. Determination of chemical oxygen demand (COD) of sewage sample.
6. Determination of Acidity of drinking water.
7. Determination of Alkalinity of drinking water.
8. Estimation of nitrate in drinking water.
9. Determination of thermal death point (TDP) and thermal death time (TDT) of microorganisms.
10. Production of Ethanol using different substrates.
11. Production of Citric acid using *Aspergillus niger*.

Course	BTEC406	No. of Credits:	10

Code:			
Course Name:	**Major Research Project /Dissertation**	**End Exam**	**200**

Objectives:

Every student will have to complete one individual project under the guidance of the professors of the department. The project can be a theoretical or experimental related to advanced topic, industrial project, training in a research institute, training of handling of sophisticated equipments etc. Each student will submit a project report with details as per the Performa and sample provided.

The project report should be hard bound and the students will have to submit ***four copies*** of the project repor*t* for final evaluation of ***200 marks*** based on the following criteria.

CRITERIA	Max. Marks
Literature Survey/Reference	20
Objectives/Plan of the project	20
Experimental/Theoretical Methodology	40
Significance and originality of the study	20
Depth of knowledge in the subject	20
Results and Discussions	20
Presentation/seminar/Viva	60
Total Marks	**200**