M.D. UNIVERSITY, ROHTAK

(NAAC Accredited 'A+' Grade)

SCHEME OF STUDIES AND EXAMINATION

B.TECH (Biotechnology Engineering)

SEMESTER 5th AND 6th

Scheme effective from 2020-21

COURSE CODE AND DEFINITIONS:

Course Code	Definitions
L	Lecture
T	Tutorial
P	Practical
BSC	Basic Science Courses
ESC	Engineering Science Courses
HSMC	Humanities and Social Sciences including Management courses
PCC	Professional Core Courses
LC	Laboratory Courses
MC	Mandatory Courses
PT	Practical Training
S	Seminar
TH	Theory
Pr	Practical

General Notes:

1. Mandatory courses are non credit courses in which students will be required passing marks in internal assessments.
2. Students will be allowed to use non programmable scientific calculator. However, sharing of calculator will not be permitted in the examination.
3. Students will be permitted to opt for any elective course run by the department. However, the department shall offer those electives for which they have expertise. The choice of the students for any elective shall not be binding for the department to offer, if the department does not have expertise. To run the elective course a minimum of 1/3rd students of the class should opt for it.

Scheme of Studies and Examination
B.TECH (Biotechnology Engineering) – 5th Semester
w.e.f. 2020-21

S N.	Category	Course Code	Course Title	(Hours per week)			Total Contact Hrs per Week	Credits	Examination Schedule				Duration of Examination (Hours)
				L	T	P			Internal Assessment	External Examination	Practical	Total	
1	Professional Core Courses	PCC-BT 301 G	Industrial Microbiology	3	0	0	3	3	25	75		100	3
2	Professional Core Courses	PCC-BT 303 G	Genetic Engineering	3	0	0	3	3	25	75		100	3
3	Professional Core Courses	PCC-BT 305 G	Bio Analytical Techniques	3	0	0	3	3	25	75		100	3
4	Professional Elective Courses	PEC-BT	Elective-I Annexure-1	3	0	0	3	3	25	75		100	3
5	Open Elective Courses	OEC-BT	Open Elective-I Annexure-2	3	0	0	3	3	25	75		100	3
6	Humanities and Social Science Including Management Courses	HSMC-01 G	Economics for Engineers	3	0	0	3	3	25	75		100	3
7	Mandatory course	MC-317G	Constitution of India	2	0	0	2	0					
8	Professional Core Courses	LC-BT 307 G	Industrial Microbiology Lab.	0	0	3	3	1.5	25		25	50	3
9	Professional Core Courses	LC-BT 309 G	Genetic Engineering Lab	0	0	3	3	1.5	25		25	50	3
10	Training	PT-BT-311 G	Practical Training-I									Refer *Note- 1	
Total Credits								**21**				800	

***Note**

1. The evaluation of the Practical Training- I will be based on seminar, viva-voce, report submitted by student. According to performance, the students are awarded grades A, B, C, F. The student who is awarded 'F' grade is required to repeat Practical Training.

2. Choose any one from open elective

A- Excellent, B- Good, C- Satisfactory, F- Not satisfactory

ANNEXURE-1
PROFESSIONAL ELECTIVE COURSES [PEC-BT]

Sr No.	Code	Subject	Semester	Credits
		ELECTIVE-I	5	3
1	PEC-BT 311 G	Bioreactor Analysis and Design		
2	PEC-BT 313 G	Developmental Biology		
3	PEC-BT 315 G	Medical Microbiology		

Choose any one from Elective-I

ANNEXURE-2
OPEN ELECTIVE COURSES [OEC-BT]

Sr No.	Code	Subject	Semester	Credits
		OPEN ELECTIVE-I	5	3
1	OEC-BT 301 G	Enzyme Technology		
2	OEC-BT 303 G	Diagnostic Techniques		
3	OEC-BT 305 G	Soft Skill & Interpersonal Communication		
4	OEC-BT 307 G	History of Science & Engineering		

Scheme of Studies and Examination
B.TECH (Biotechnology Engineering) – 6th Semester
w.e.f. 2020-21

S N.	Category	Course Code	Course Title	Teaching schedule (Hours per week)			Total Contact Hours /week	Credits	Examination Marks				Duration of Examination (Hours)
				L	T	P			Internal Assessment	External Examination	Practical	Total	
1	Professional Core Courses	PCC-BT 302 G	Plant Biotechnology	3	0	0	3	3	25	75		100	3
2	Professional Core Courses	PCC-BT 304 G	Animal Biotechnology & Stem Cells	3	0	0	3	3	25	75		100	3
3	Professional Core Courses	PCC-BT 306 G	Environmental Biotechnology	3	0	0	3	3	25	75		100	3
4	Professional Elective Courses	PEC-BT	Elective-II Annexure-3	3	0	0	3	3	25	75		100	3
5	Professional Elective Courses	PEC-BT	Elective-III Annexure-4	3	0	0	3	3	25	75		100	3
6	Mandatory course	MC-315G	Essence of Indian Traditional Knowledge	2	0	0	2	0					
7	Professional Core Courses	LC-BT 308 G	Plant Biotechnology Lab.	0	0	3	3	1.5	25		25	50	3
8	Professional Core Courses	LC-BT 310 G	Environmental Biotechnology Lab	0	0	3	3	1.5	25		25	50	3
9	Open Elective Courses	OEC-BT	Open Elective-II Annexure- 5	3	0	0	3	3	25		75	100	3
Total Credits								**21**				800	

PROFESSIONAL ELECTIVE COURSES [PEC-BT]

ANNEXURE-3

ELECTIVE-II

Sr No.	Code	Subject	Semester	Credits
			6	3
1	PEC-BT 312 G	Food Biotechnology		
2	PEC-BT 314 G	Protein Engineering		
3	PEC-BT 316 G	Cancer Biology		

ANNEXURE-4

ELECTIVE-III

			6	3
1	PEC-BT 318 G	Downstream Processing		
2	PEC-BT 320 G	RNAi Biology		
3	PEC-BT 322 G	Human Genetics		

1. **Choose any one from Elective-II**
2. **Choose any one from Elective-III**

ANNEXURE-5

OPEN ELECTIVE COURSES [OEC-BT]

Sr No.	Code	Subject	Semester	Credits
	ANNEXURE-5	**OPEN ELECTIVE-II**	6	3
1	OEC-BT 302 G	Biosensor		
2	OEC-BT 304 G	Fermentation Technology		
3	OEC-BT 306 G	Biofuels		
4	OEC-BT 308 G	Cyber Law & Ethics		

Course code	PCC-BT-301G				
Category	Professional Core Course				
Course title	**Industrial Microbiology**				
Scheme and Credits	**L**	**T**	**P**	**Credits**	**Semester-V**
	3			**3**	
Branches (B. Tech.)	**Biotechnology**				
Class work	25 Marks				
Exam	75 Marks				
Total	100 Marks				
Duration of Exam	03 Hours				

Note: Examiner will set nine questions in total. Question one will be compulsory. Question one will have 6 parts of 2.5 marks each from all units and remaining eight questions of 15 marks each to be set by taking two questions from each unit. The students have to attempt five questions in total, first being compulsory and selecting one from each unit.

UNIT-I

Basics of Industrial Microbiology: An overview, history, scope and applications of industrial microbiology.

Fermentation: Basic principle, component, range and types of fermentation.

Isolation and Screening of Industrially Important Microorganisms: Characteristic of an ideal producer strain, Isolation methods utilizing and not utilizing selection of desired characteristics, Screening for new product- primary and secondary screening.

UNIT-II

Strain Development: Need, Strain improvement**,** Improvement of industrial microorganisms using Mutant Selection- Isolation of auxotrophhs, revertant and resistant mutants, Recombination and Recombinant DNA technology approaches.

UNIT-III

Fermentation Medium: Characteristics of an ideal fermentation medium. Types of medium used in fermentation industry. Types of raw materials used as major carbon and nitrogen sources in fermentation medium. Antifoam agents, Special compounds- precursors, inducers and inhibitors.

Sterilization of medium, Sterilization of air, Sterilization of fermenters.

Inoculum Development: Development of inocula for yeast processes, for bacterial processes, for fungal processes, for vegetative fungi.

UNIT-IV

Production of Microbial Metabolites: Industrial production of amino acid-glutamic acid, Industrial production of Alcoholic beverages -beer, wine, Industrial production of enzymes - amylases, proteases

Industrial production of antibiotics- penicillin, tetracycline, Industrial production of vitamin B12, organic acids -citric acid, acetic acid and Biopesticides.

References:

1. Biotechnology: a handbook of Industrial Microbiology: W. Cruger & , Panima, latest edition
2. Industrial Microbiology: L.E Casida, Wiley Eastern Ltd., latest edition
3. Principles of Fermentation Technology,P F Stanbury and A Whitaker, Pergamon Press
4. Industrial Microbiology: Prescott & Dunn, CBS Publisher, latest edition
5. Introduction to Biochemical Engineering D G Rao latest edition

Course code	PCC-BT-303G			
Category	Professional Core Course			
Course title	**Genetic Engineering**			
Scheme and credits	L	T	P	Credits
	3	0		3
Class work	25 Marks			
Exam	75 Marks			
Total	100 Marks			
Duration of exam	03 Hours			

Course Objectives:

At the end of the course, student will be able to:

1. Familiarize with the basic concepts and principles of utilization of different expression vectors for cloning in prokaryotic and eukaryotic organisms.
2. Understand the different strategies of gene cloning and construction of genomic and cDNA libraries for applications of recombinant DNA technology.
3. Understand the principles and applications of advanced techniques like PCR, Sequencing and hybridization.
4. Appreciate gene expression in heterologous systems to solve problems ethically.

Note: Examiner will set nine questions in total. Question one will be compulsory. Question one will have 6 parts of 2.5 marks each from all units and remaining eight questions of 15 marks each to be set by taking two questions from each unit. The students have to attempt five questions in total, first being compulsory and selecting one from each unit.

UNIT- I

Basics of DNA cloning: Genetic Engineering: Introduction, scope, milestones and guidelines.
Gene cloning methodologies, restriction enzymes and nucleic acid modifying enzymes, TA cloning, topoisomerase-based cloning, ligation independent cloning, GATEWAY technology; Vectors for gene cloning - plasmids, phages, phagemids, cosmids, shuttle vectors, artificial chromosomes, plant viruses and other advanced vectors; Methods for selection and screening of recombinant clones, selection and screening of clones (marker genes, reporter genes, positive and negative selection, insertion inactivation, alpha-complementation) Bacterial transformation methods.

UNIT II:

Gene Libraries and gene expression

Gene cloning: Construction of Gene libraries, gene probes, screening of libraries, analysis of gene expression, site directed Mutagenesis, microarrays and DNA chips.

Gene Expression: Vector and host engineering, expression in bacteria, yeasts, mammalian cells and plants.

UNIT III:

DNA sequencing, hybridization and amplification:

Principles of DNA sequencing: DNA sequencing methods (Maxam-Gilbert, Sanger, automated sequencing, Next Generation Sequencing or NGS platforms); Introduction to mapping and sequencing of genomes (whole genome shotgun and clone-by-clone approach of genome sequencing).

Labeling of nucleic acids: Random priming - Nick translation - End labeling - RNA labeling - Non-isotopic labeling methods, Blotting techniques

DNA amplification: Polymerase chain reaction: Concept and enzymes employed, optimization of PCR, types of PCR, alternative techniques and applications of PCR

UNIT IV

Gene expression and function, regulatory issues:

Gene Expression -- Gene expression analyses at transcriptional level Northern blotting and its variants, real-time PCR, S1 nuclease mapping, in situ hybridization, RNase protection, nuclear run-on assays, DNA microarrays), translational level (Western blotting, ELISA and immunofluorescence assays). Processing of recombinant proteins.

Applications and ethics of Recombinant DNA Technology -- Production of useful recombinant molecules, improving agronomic traits, diagnostic and therapeutic applications in human diseases.

References:

1. Brown, T. A. Gene Cloning and Analysis: An Introduction. Wiley-Blackwell Publishing, UK., latest edition
2. Glick B. R., Pasternak J. J. and Patten C. L. Molecular Biotechnology: Principles and Applications of Recombinant DNA. ASM Press, USA. latest edition
3. Primrose, S. B. and Twyman, R. M. Principles of Genetic Manipulation and Genomics. Blackwell Publishing, UK. latest edition
4. Dale J. W., Schantz M. V. and Plant N. From Genes to Genomes: Concepts and Applications of DNA Technology. John Wiley & Sons, UK. latest edition
5. Wilson, K. and Walker, J. Principles and Techniques of Biochemistry and Molecular Biology. Cambridge University Press, USA. latest edition
6. Green M. R. and Sambrook J. Molecular Cloning: A Laboratory Manual. CSHL Press, USA. latest edition

Course outcomes:

1.The course work will provide knowledge of principles and applications of the basic as well as advanced tools and techniques in recombinant DNA technology.

2. Students will be familiar with designing experiments and analysing experimental data.

3. The course will not only help in developing molecular/technical skills but also create interest in research.

4. It will also provide a foundation to enable students to understand the advanced courses in the succeeding semesters.

Course code	PCC-BT-305G				
Category	Professional Core Courses				
Course title	**Bio Analytical Techniques**				
Scheme and Credits	**L**	**T**	**P**	**Credits**	**Semester-V**
	3	**0**		**3**	
Branches (B. Tech.)	**Biotechnology Engineering**				
Class work	25 Marks				
Exam	75 Marks				
Total	100 Marks				
Duration of Exam	03 Hours				

Note: Examiner will set nine questions in total. Question one will be compulsory. Question one will have 6 parts of 2.5 marks each from all units and remaining eight questions of 15 marks each to be set by taking two questions from each unit. The students have to attempt five questions in total, first being compulsory and selecting one from each unit.

Course Objectives

- Understanding of analytical techniques to be used in examinations of biological samples.
- Understanding fundamental of microscopy, centrifugation, chromatography, spectroscopy and electrophoresis.
- Understanding of advanced analytical techniques such as radioisotope techniques

UNIT – I

Microscopy: History of microscopy, Principle of microscopy, Sample Preparation for light microscopy. Limit of resolution, magnification power. Technical arrangement, principle and working of instrument: Light Microscopy- Bright Field, Dark Field and Phase Contrast microscopy, Fluorescence microscopy, Electron microscopy- Scanning & Transmission.

UNIT – II

Centrifugation: Basic principles of sedimentation, Basic instrumentation of centrifuges, types of rotors, types of centrifuges and their applications. Care and safety aspects of centrifuges. Preparative centrifugation and analytical centrifugation. Density Gradient centrifugation, Ultracentrifugation, Sub-Cellular Fractionation.

UNIT – III

Chromatography: General principles. Partition chromatography, Ion-exchange chromatography, Affinity Chromatography, High Pressure Liquid Chromatography, Gas Chromatography, Paper Chromatography and thin layer chromatography.

Electrophoresis: Principles of Electrophoresis, support media, electrophoresis of proteins and nucleic acids, Isoelectric Focusing, Two-dimensional gel Electrophoresis.

UNIT – IV

Spectroscopy: Basic Concepts of spectroscopy, λmax. Principle, instrumentation and applications of various spectroscopic techniques; UV/ Visible Spectroscopy, spectrophotometer, fluorescence spectroscopy, X-ray Spectroscopy, Circular Dichorism Spectroscopy, Infra Red and Raman Spectroscopy, Nuclear Magnetic resonance.

Radioisotope Techniques: Nature of radioactivity, properties of radioactive radiations. Detection and measurement of radioactivity; Geiger Muller and Scintillation counting, Auto-radiography, Safety aspects and radio-waste management.

Course Outcomes

- Students will be able to understand basic principles of techniques used in analysis of biological samples
- Students will be able to understand working of various instruments used in biotechnology.
- Students will be able to operate the basic instruments used in biotechnology laboratories such as spectrophotometer, microscope, HPLC, gel electrophoresis etc.

References:

1. Principles and Techniques of Biochemistry and Molecular Biology, Keith Wilson, John Walker, latest edition, Cambridge University Press
2. Biological Spectroscopy, ID Campbell and RA Durek, Benjamin/Cummings Pub. Co.
3. Spectroscopy for the Biological Sciences, Gordon G. Hammes, Wiley

Course code	LC-BT-307G				
Category	Professional Core Course				
Course title	**Industrial Microbiology Lab.**				
Scheme and Credits	**L**	**T**	**P**	**Credits**	**Semester-V**
	0	**0**	**3**	**1.5**	
Branches (B. Tech.)	**Biotechnology**				
Class work	25 Marks				
Exam	25 Marks				
Total	50 Marks				
Duration of Exam	03 Hours				

LIST OF EXPERIMENTS/PRACTICALS

1. Collection of soil samples.
2. Isolation of industrially important microorganisms.
3. Maintenance of pure culture of isolates.
4. Morphological identification of isolates.
5. To compare the enzymatic activity of different isolates.
6. Revival /Isolation of yeast culture.
7. To plot a growth curve of yeast culture.
8. Fermentation of carbohydrates by yeast culture.
9. Production of alcohol from molasses.
10. Recovery of alcohol by distillation.
11. To isolate antibiotic producing microorganisms from soil.
12. To determine the antimicrobial spectrum of the isolated antibiotic producing microorganisms.
13. Industrial Visit.

Course Outcome

Students will be able to
Carry out sampling.
Isolate, maintain pure culture of isolates both bacterial and yeast culture .
Morphologically identify isolates.
Study growth of yeast culture and fermentation of different carbohydrates by yeast.
Carry out alcohol production in shake flask and its recovery by distillation.
Isolate antibiotic producing microbes and study antimicrobial spectrum .

References:

1. Microbiology A Laboratory Manual: Cappuccino James. & Sheeman Natalie,latest Edition ,Pearson Education Ltd, United Kingdom.
2. Experiment in Microbiology, Plant Pathology, Tissue Culture & Microbial Biotechnology: Aneja K.R, latest Edition, New Age International Publishers, New Delhi.
3. Practical Microbiology: Dubey R.C & Maheshwari D.K , 2011, S. Chand & Company Ltd., New Delhi.

Course code	LC-BT-309G				
Category	Professional Core Course				
Course title	Genetic Engineering Lab				
Scheme and credits	L	T	P	Credits	Semester
			3	1.5	V
Class work	25 Marks				
Exam	25 Marks				
Total	50 Marks				
Duration of exam	03 Hours				

List of experiments:

1. Isolation of plasmid DNA from bacteria
2. Isolation of genomic DNA from blood/ leaf.
3. Elution of DNA from agarose gel.
4. Construction of RE map of plasmid DNA.
5. Restriction endonuclease digestion of λ DNA.
6. To perform ligation of DNA fragments using T_4 DNA ligase
7. To prepare competent cells for genetic transformation
8. To perform transformation of E. coli cells with pDNA
9. Isolation of protein and analysis by SDS-PAGE.
10. To amplify the given DNA by PCR.
11. To perform southern hybridization of DNA

References:

1. Green M. R. and Sambrook J. Molecular Cloning: A Laboratory Manual. CSHL Press, USA.

<u>Learning Outcomes:</u> At the end of the course the students shall be able to:

CO1 - Students will be able to isolate and quantify genomic DNA from eukaryotic tissue and bacterial cells as well extract DNA from agarose gels.

CO2 - Students will be able to perform the restriction digestion of lambda DNA with restriction enzymes and analyse the restriction pattern by agarose gel electrophoresis.

CO3 - Students will be able to ligate DNA fragments and also transform it into host cells

CO4 - Students will learn advanced techniques like PCR, Southern hybridization and analysis of gene expression by SDS-PAGE

Course code	HSMC-01 G				
Category	Humanity and social Science including Management				
Course title	**Economics for Engineers**				
Scheme and Credits	**L**	**T**	**P**	**Credits**	**Semester-V**
	3	**0**		**3**	
Branches (B. Tech.)	**Biotechnology Engineering**				
Class work	25 Marks				
Exam	75 Marks				
Total	100 Marks				
Duration of Exam	03 Hours				

Course Objectives:

1. **Acquaint the students to basic concepts of economics and their operational significance.**
2. **To stimulate the students to think systematically and objectively about contemporary economic problems.**

Note: Examiner will set nine questions in total. Question one will be compulsory. Question one will have 6 parts of 2.5 marks each from all units and remaining eight questions of 15 marks each to be set by taking two questions from each unit. The students have to attempt five questions in total, first being compulsory and selecting one from each unit.

UNIT-I

Definition of Economics- Various definitions, types of economics- Micro and Macro Economics, nature of economic problem, Production Possibility Curve, Economic laws and their nature, Relationship between Science, Engineering, Technology and Economic Development.

Demand- Meaning of Demand, Law of Demand, **Elasticity of Demand**- meaning, factors effecting it, its practical application and importance.

UNIT-II

Production- Meaning of Production and factors of production, Law of variable proportions, Returns to scale, Internal and external economies and diseconomies of scale.

Various concepts of cost of production- Fixed cost, Variable cost, Money cost, Real cost, Accounting cost, Marginal cost, Opportunity cost. Shape of Average cost, Marginal cost, Total cost etc. in short run and long run.

UNIT-III

Market- Meaning of Market, Types of Market- Perfect Competition, Monopoly, Monopolistic Competition and Oligopoly (main features).

Supply- Supply and law of supply, Role of demand & supply in price determination and effect of changes in demand and supply on prices.

UNIT-IV

Indian Economy- Nature and characteristics of Indian economy as under developed, developing and mixed economy (brief and elementary introduction), Privatization - meaning, merits and demerits.

Globalization of Indian economy - merits and demerits.

Banking- Concept of a Bank, Commercial Bank- functions, Central Bank- functions, Difference between Commercial & Central Bank.

COURSE OUTCOMES:

1. The students will able to understand the basic concept of economics.
2. The student will able to understand the concept of production and cost.
3. The student will able to understand the concept of market.
4. The student will able to understand the concept of privatization, globalization and banks.

REFERENCES:

1. Jain T.R., Economics for Engineers, VK Publication.
2. Chopra P. N., Principle of Economics, Kalyani Publishers.
3. Dewett K. K., Modern economic theory, S. Chand.
4. H. L. Ahuja., Modern economic theory, S. Chand.
5. Dutt Rudar & Sundhram K. P. M., Indian Economy.
6. Mishra S. K., Modern Micro Economics, Pragati Publications.
7. Singh Jaswinder, Managerial Economics, dreamtech press.
8. A Text Book of Economic Theory Stonier and Hague (Longman's Landon).
9. Micro Economic Theory – M.L. Jhingan (S.Chand).
10. Micro Economic Theory - H.L. Ahuja (S.Chand).
11. Modern Micro Economics : S.K. Mishra (Pragati Publications).
12. Economic Theory - A.B.N. Kulkarni & A.B. Kalkundrikar (R.Chand & Co).

Course code	MC-317G			
Category	Mandatory Course			
Course title	**Constitution of India**			
Scheme and credits	L	T	P	Credits
	2	0	0	0

Course Objectives:

Students will be able to:

1. Understand the premises informing the twin themes of liberty and freedom from a civil rights perspective.
2. To address the growth of Indian opinion regarding modern Indian intellectuals' constitutional role and entitlement to civil and economic rights as well as the emergence of nationhood in the early years of Indian nationalism.
3. To address the role of socialism in India after the commencement of the Bolshevik Revolution in 1917 and its impact on the initial drafting of the Indian Constitution.

Unit – I

Philosophy of Indian Constitution: Salient features of Indian Constitution, Preamble, and Nature of Indian Constitution, Procedure for amendment of the Constitution.

Unit – II

Citizenship: Meaning, Citizenship at the commencement of the Constitution, Termination of citizenship, Common wealth citizenship, Modes of acquisition of Citizenship:

Unit – III

Organs of Governance: President – Qualification and Powers of the President, Governor- Qualification and Powers of Governor, Parliament: Composition, Qualifications and Disqualifications, Judiciary: Appointment, Tenure and Removal of Judges.

Unit – IV

Fundamental Rights: Origin and development of Fundamental rights, Need for fundamental rights. Introduction to Right to equality , Right to freedom, Right against exploitation, Right to freedom of religion, Cultural and Education rights and Fundamental duties.

References:

1. The Constitution of India, 1950 (Bare Act), Government Publication.
2. Dr. S.N. Busi, Dr. B.R. Ambedkar framing of Indian Constitution, latest Edition
3. M.P. Jain, Indian Constitution Law, Lexis Nexis, latest edition
4. D.D. Basu, Introduction to Constitution of India, Lexis Nexis, latest edition.

Course Outcomes:

Students will be able to:

1. Discuss the growth of the demand for civil rights in India for the bulk of Indians before the arrival of Gandhi in Indian politics.
2. Discuss the intellectual origins of the framework of argument that informed the conceptualization of social reforms leading to revolution in India.
3. Discuss the circumstances surrounding the foundation of the Congress Socialist Party [CSP] under the leadership of Jawaharlal Nehru and the eventual failure of the proposal of direct elections through adult suffrage in the Indian Constitution.
4. Discuss the passage of the Hindu Code Bill of 1956.

The examination of the regular students will be conducted by the concerned college/Institute internally. Each student will be required to score minimum 40% marks to qualify in the paper. The marks will not be included in determining the percentage of marks obtained for the award of degree. However, these marks will be shown in the detailed marks certificate of the students.

ANNEXURE – 1

Course code	PEC-BT 311 G				
Category	Professional Elective Course				
Course title	**Bioreactor Analysis and Design**				
Scheme and Credits	**L**	**T**	**P**	**Credits**	**Semester-V**
	3	**0**	0	**3**	
Branches (B. Tech.)	**Biotechnology Engineering**				
Class work	25 Marks				
Exam	75 Marks				
Total	100 Marks				
Duration of Exam	03 Hours				

Note: Examiner will set nine questions in total. Question one will be compulsory. Question one will have 6 parts of 2.5 marks each from all units and remaining eight questions of 15 marks each to be set by taking two questions from each unit. The students have to attempt five questions in total, first being compulsory and selecting one from each unit.

COURSE OBJECTIVES:

1. To learn the basics introduction to bioreactor.
2. To learn the concept of ideal and non-ideal reactors.
3. To learn the concept of maintaining aseptic conditions in fermenters.
4. To learn about the instrumentation and controlling the various parameters.

Unit I

Introduction to Bioreactor: Basic functions of a fermenter, Overall containment categorization, Body construction, Construction materials, Temperature control. Types of Bioreactors – STR, Air lift reactor, bubble column reactor, PBR, FBR, TBR, Hollow fiber reactor.

Unit II

Concept of ideal and non-ideal reactors: residence time distribution, models of non-ideal reactors- plug flow with axial dispersion, tanks-in-series model.

Aeration and agitation: The agitator (impeller), Stirrer glands and bearings, The stuffing box (packed-gland seal), The mechanical seal, Magnetic drives, Baffles, The aeration system (sparger), Porous sparger, Orifice sparger, Nozzle sparger, Combined sparger-agitator.

Unit III

The achievement and maintenance of aseptic conditions: Sterilization of the fermenter, Sterilization of the air supply, Sterilization of the exhaust gas from a fermenter, The addition of 17nalyzing, nutrients and other, supplements, Sampling, Feed ports, Sensor probes.

Monitoring and control of various parameters: Valves and steam traps: Gate valves, Globe valves, Piston valves, Needle valves, Plug valves, Ball valves, Butterfly valves, Pinch valves, Diaphragm valves, Check valves, Pressure-control valves, Pressure-reduction valves, Pressure-retaining valves, Safety valves, Steam traps.

Unit IV

Instrumentation and Control: Methods of measuring process variables like Temperature, Mercury-in-glass thermometers, Electrical resistance thermometers, Thermistors.
Flow measurement and control, Gases, Liquids, Pressure measurement, Pressure control, Safety valves, Agitator shaft power, Rate of stirring, Foam sensing and control.
Weight, Microbial biomass, Measurement and control of dissolved oxygen, Inlet and exit-gas analysis, Ph measurement and control, Redox, Carbon dioxide electrodes.
Control systems: Manual control, Automatic control, Two-position controllers (on/off), Proportional control, Components of a computer-linked system, Data logging, Data analysis, Process control.

COURSE OUTCOMES:

1. Students will be able to understand the basic concept of bioreactor and their types.
2. Students will be able to understand about aeration and agitation process in ideal and non- ideal reactor models.
3. Students will be able to understand maintaining aseptic conditions, controlling the reactor and 18nalyzing different parameters with data analysis.

REFERENCES

1. Biochemical Engineering fundamentals, Bailey and Ollis, Mcgraw Hill Pub.
2. Priciples of fermentation technology, PF stanbury and A Whitaker, Pergamon press
3. Unit Operation of Chemical Engineering, McCabe, Smith and Hariot, Mc Graw Hill Pub.
4. Bioprocess Engineering Principles, Pauline M. Doran, Academic Press, Harcourt Brace & Company.

Course code	PEC-BT-313G				
Category	Professional Elective Course				
Course title	**DEVELOPMENTAL BIOLOGY**				
Scheme and credits	L	T	P	Credits	Semester
	3	0		3	V
Class work	25 Marks				
Exam	75 Marks				
Total	100 Marks				
Duration of exam	03 Hours				

Note: Examiner will set nine questions in total. Question one will be compulsory. Question one will have 6 parts of 2.5 marks each from all units and remaining eight questions of 15 marks each to be set by taking two questions from each unit. The students have to attempt five questions in total, first being compulsory and selecting one from each unit.

Course Objectives:

- To understand of the concepts of early animal development.
- To study the process of embryonic development in animals with reference to model systems.
- To appreciate the role of developmental biology in evolution and the importance of stem cells

Unit I

History & Basic concepts of development: Introduction to animal development. Stages of development- zygote, blastula, gastrula, neurula. Cell fate & commitment – potency- concept of embryonic stem cells, differential gene expression, terminal differentiation ,lineages of three germ layers, fate map

Unit-II

Mechanisms of differentiation- cytoplasmic determinants, embryonic induction, concept of morphogenesis, mosaic and regulative development. Pattern formation- axis specification, positional identification (regional specification). Morphogenetic movements

Unit-III

Model organisms:
Early Development in invertebrate /vertebrate models**:** Xenopus, human
Cleavage, gastrulation, Axis specification (Dorsoventral, anterior posterior), & body plan patterning, left right asymmetry in vertebrates

Unit-IV

Late Development in invertebrate /vertebrate models: Organogenesis- development of central nervous system in vertebrates. Germ cell specification& migration.
Developmental mechanism of evolutionary change. Stem cells.

Text & Reference Books

- Developmental Biology, Eighth Edition" by Scott F Gilbert $9^{th}/10^{th}$ edition
- Essential Developmental Biology by Jonathan Slack
- Developmental Biology, Werner A Muller

Course Objectives: At the end of course students will be able to

- understand of the concepts of early animal development.
- understand the process of embryonic development in animals with reference to model systems.
- understand the role of developmental biology in evolution and the importance of stem cells

Course code	PEC-BT-315G				
Category	Professional Elective Course				
Course title	**MEDICAL MICROBIOLOGY**				
Scheme and credits	L	T	P	Credits	Semester
	3	0		3	V
Class work	25 Marks				
Exam	75 Marks				
Total	100 Marks				
Duration of exam	03 Hours				

Note: Examiner will set nine questions in total. Question one will be compulsory. Question one will have 6 parts of 2.5 marks each from all units and remaining eight questions of 15 marks each to be set by taking two questions from each unit. The students have to attempt five questions in total, first being compulsory and selecting one from each unit.

Course Objectives:

- To study various diseases caused by microbes
- To understand the epidemiology of the disease

Unit- I

Infections of the Gastrointestinal Tract Amoebiasis; Giardiasis and cryptosporidiosis; Intestinal infection by nematodes; Intestinal infection by cestodes (taeniasis and H.nana infection); Trematodes; Bacterial food poisoning(toxic and infective); E.coli Diarrhoea; Cholera; Bacillary dysentery; Hepatitis

Unit –II

Infections of the Respiratory system Streptococcal infections; Viral infections; Diphtheria; Whooping cough; Bacterial pneumonias (Haemophilus and GNB, Pneumococcus/Legionella/ etc); Tuberculosis

Unit –III

Pyrexial Illness Malaria; Kala-azar; Leishmaniasis; Filaria; Enteric fever; Brucellosis; Rickettsial diseases; Leptospirosis and relapsing fever; Viral Hemorragic fever Unit IV Infections of the Nervous System Viral encephalitis and Aseptic meningitis; Rabies; Cysticercosis and other CNS parasitic infections; Tetanus

Unit –IV

Sexually Transmitted Diseases and Congenital Infections Herpes Simplex virus infections; HIV infection and AIDS; Chlamydial infection; Syphilis; Mycoplasma and Ureaplasma infection; Gonorrhea and other bacterial STD; Congenital viral infections; Toxoplasmosis

Texts/References

1. Betty Forbes, Daniel Sahm, Alice Weinfield, Bailey-Scott's Diagnostic Microbiology, 12th Edition, Mosby. 2007.
2. Gerald Collee J, Andrew G Fraser, Barrie P Marmion, Mackie and McCartney's Practical Medical Microbiology, Elsevier. 2006.
3. Elmer W Koneman et al., Koneman's, Color Atlas and Text Book of Diagnostic Microbiology, 6th Edition, Lippincott Williams and Wilkins,2005.

ANNEXURE - 2

Course code	OEC-BT-301G				
Category	Open Elective Courses				
Course title	**Enzyme Technology**				
Scheme and Credits	**L**	**T**	**P**	**Credits**	**Semester-V**
	3	**0**		**3**	
Branches (B. Tech.)	**Biotechnology Engineering**				
Class work	25 Marks				
Exam	75 Marks				
Total	100 Marks				
Duration of Exam	03 Hours				

Note: Examiner will set nine questions in total. Question one will be compulsory. Question one will have 6 parts of 2.5 marks each from all units and remaining eight questions of 15 marks each to be set by taking two questions from each unit. The students have to attempt five questions in total, first being compulsory and selecting one from each unit.

Course Objectives

- Understanding basics concept of enzymes
- Understanding general characteristics of enzymes and enzyme kinetics
- Understanding of immobilization of enzymes
- Understanding of industrial applications of enzymes

UNIT – I

Introduction of enzymes: General properties of enzyme and significance, classification and nomenclature. Terms and definition in enzymology: enzyme activity, turnover number, active site, isoenzyme, multienzyme complex, extracellular enzymes, extremozymes, allosteric enzyme, abzymes, ribozymes. Free energy concept in enzyme catalyzed reactions, Cofactors for enzymes.

UNIT – II

Enzyme kinetics: Factor affecting enzyme activity: pH, Temperature, substrate concentration etc. Model for Enzyme substrate binding, Steady rate kinetics, Derivation of Michaelis-Menten equation using steady state/equilibrium kinetics, plots of Lineweaver-Burke. Significance of Km and Vmax, Kcat/Km, Mechanism of multi-substrate enzyme catalyzed reaction. Inhibition of enzyme activity; Competitive, noncompetitive and irreversible inhibition.

UNIT – III

Immobilized Enzymes: Free vs immobilized enzymes, Economic argument for immobilization, Methods of enzyme immobilization. Concept of heterogeneous mass transfer, Concentration gradient in solid catalyst . Kinetics and effect of solute partition and diffusion on it, enzymes deactivation. Bioreactors using immobilised enzymes

UNIT - IV

Application of enzymes: Isolation and purification of enzymes. Enzyme used as detergents, use of proteases in food, leather and wool industries, production of glucose syrup from starch. Lactose in dairy industry, glucose oxidase and catalase in food industry. Application of enzymes in industry, Enzyme engineering, Enzyme based nanostructure,

Course Outcomes

After studying the course, the student will be able to:

- Students will be able to understand the general characteristics of enzymes
- Students will be able to understand the factor effecting enzyme activity
- Students will be able to understand the kinetics of enzymes and its attributes
- Students will be able to understand the importance of immobilization of enzymes and application of enzymes in various factors.

References:

1) Outlines of Biochemistry, Conn, E.E; Stumpf, P.K; Bruening, G; Doi, R.H. John Wiley and Sons

2) Principles of Biochemistry (V Edition), By Nelson, D. L.; and Cox, M. M.W.H. Freeman and Company

3) Enzymes: Biochemistry, Biotechnology, Clinical Chemistry, P L Bonner and T Palmer, Elsevier

4) Biochemistry, Berg JM,Tymoczko JL, and Stryer L, published by W.H. Freeman and Company

Course code	OEC-BT-303G				
Category	Open Elective Courses				
Course title	**DIAGNOSTIC TECHNIQUES**				
Scheme and Credits	**L**	**T**	**P**	**Credits**	**Semester-V**
	3	**0**		**3**	
Branches (B. Tech.)	**Biotechnology Engineering**				
Class work	25 Marks				
Exam	75 Marks				
Total	100 Marks				
Duration of Exam	03 Hours				

Note: Examiner will set nine questions in total. Question one will be compulsory. Question one will have 6 parts of 2.5 marks each from all units and remaining eight questions of 15 marks each to be set by taking two questions from each unit. The students have to attempt five questions in total, first being compulsory and selecting one from each unit.

UNIT-I

Introduction: Comparison of the methods to diagnose bacterial & parasitic infections. Immunological Diagnostic Procedures:

Basic considerations: Antigen-antibody reactions. Signal amplification systems. Isolation and characterization of antibodies. Immuno assay systems. Assay development, evaluation and validation. Reagent formulation and their shelf life evaluation.

UNIT-II

Enzyme-Linked Immunosorbent Assay (ELISA) system: Applications in clinical diagnosis and prognosis of various diseases.

Membrane based Rapid Immuno assays.

Monoclonal Antibodies: Formation and selection of Hybrid cells. Screening for specific antibodies producing Hybrid cell lines.

UNIT-III

Applications of Monoclonal Antibodies: Detection of Polypeptide hormones, Tumor Markers and Cytokines. Diagnosis of infectious diseases and Drug monitoring. Detection of Miscellaneous targets e.g. Thyroxin, Vit B_{12}, Ferritin

Degradation products, Tau Protein etc.

UNIT-IV

DNA Diagnostic Systems: **Nucleic acid hybridization assay systems:** Basic considerations. Production of various types of hybridization probes. Diagnosis of *Plasmodium faliciparum, Mycobactrium tuberclosis, Trypanosoma cruzi* and Sickle cell by DNA hybridization.

Non-radioactive Hybridization procedures: Use of Chromogenic or chemiluminesent substrates and specific enzymes for detecting signal amplification.

DNA Finger Printing and Random Amplified Polymorphic DNA (RAPD) as Diagnostic tools.

Present methods for diagnosis of Specific diseases like Tuberculosis, Malaria and AIDS

References:

1. Essentials of Diagnostic Microbiology by Lissa Anne Shimeld.
2. Diagnostic Microbiology by Balley and Scott
3. Recombinant DNA. By James D Watson and Michael Gilman latest Edition
W. H Freeman and Company NY.

Course code	OEC-BT-305G			
Category	Open Elective Course			
Course title	**Soft Skills & Interpersonal Communication**			
Scheme and credits	L	T	P	Credits
	3	0		3
Class work	25 Marks			
Exam	75 Marks			
Total	100 Marks			
Duration of exam	03 Hours			

Note: Examiner will set nine questions in total. Question one will be compulsory. Question one will have 6 parts of 2.5 marks each from all units and remaining eight questions of 15 marks each to be set by taking two questions from each unit. The students have to attempt five questions in total, first being compulsory and selecting one from each unit.

Course Objectives:

- To understand the scope of personality and its development.
- To develop core skills for development of self.
- To cultivate interpersonal skills for successful life.

UNIT I

Self-Development Skills: Introduction to Personality, Self-Esteem and Self-Confidence Know Thyself/ Understanding Self Introduction to Soft skills-Self discovery-Developing positive attitude-Improving perceptions-Forming values

UNIT II

Thinking and Problem Solving Skills. Stress Management. Time management SWOT Analysis and Goal-Setting

UNIT III

Interpersonal Skills: Hard Skills and Soft Skills. Effective Communication Understanding Others. Improved work relationship

UNIT IV

Developing interpersonal relationship-Team building-group dynamics-Net working. Skills for successful interview. Leadership. Social Empathy

TEXT BOOKS:

Meena.K and V.Ayothi (2013) A Book on Development of Soft Skills (Soft Skills : A Road Map to Success), P.R. Publishers & Distributors, No, B-20 & 21, V.M.M. Complex, Chatiram Bus Stand, Tiruchirappalli- 620 002. (Phone No: 0431-2702824: Mobile No: 94433 70597, 98430 74472)
Alex K. (2012) Soft Skills – Know Yourself & Know the World, S.Chand & Company LTD, Ram Nagar, New Delhi- 110 055. Mobile No : 94425 14814 (Dr.K.Alex)

REFERENCES:

(i) Developing the leader within you John c Maxwell (ii) Good to Great by Jim Collins (iii) The seven habits of highly effective people Stephen Covey (iv) Emotional Intelligence Daniel Goleman (v) You can win Shive Khera (vi) Principle centred leadership Stephen Covey

Course code	OEC-BT-307G			
Category	Open Elective Course			
Course title	**History of Science & Technology in India**			
Scheme and credits	L	T	P	Credits
	3	0		3
Class work	25 Marks			
Exam	75 Marks			
Total	100 Marks			
Duration of exam	03 Hours			

Note: Examiner will set nine questions in total. Question one will be compulsory. Question one will have 6 parts of 2.5 marks each from all units and remaining eight questions of 15 marks each to be set by taking two questions from each unit. The students have to attempt five questions in total, first being compulsory and selecting one from each unit.

Course Objectives:

- To understand the history of developments in field of science and technology.
- To have knowledge of ancient and modern technologies related to medicine and agriculture.
- To understand impact of technological developments in the current scenario.

Unit-I

Concepts and perspectives: Science and Technology-Meaning, Scope and Importance, Interaction of science, technology & society, Sources of history on science and technology in India.

Unit –II

Science and technology in ancient India : Technology in pre-historic period. Beginning of agriculture and its impact on technology. Science and Technology during Vedic and Later Vedic times.

Unit-III

Science and technology in medieval India: Legacy of technology in Medieval India, Interactions with Arabs. Development in medical knowledge, interaction between Unani and Ayurveda and alchemy. SCIENCE AND TECHNOLOGY IN COLONIAL INDIA Science and the Empire Indian response to Western Science Growth of techno-scientific institutions

Unit-IV

Science and technology in a post-independent India

Science, Technology and Development discourse. Shaping of the Science and Technology Policy Developments in the field of Science and Technology. Science and technology in globalizing India. Social implications of new technologies like the Information Technology and Biotechnology

B. TECH. BIOTECH. 6TH SEM

Course code	PCC-BT-302G				
Category	Professional Core Courses				
Course title	**Plant Biotechnology**				
Scheme and Credits	**L**	**T**	**P**	**Credits**	**Semester-VI**
	3	**0**	0	**3**	
Branches (B. Tech.)	**Biotechnology Engineering**				
Class work	25 Marks				
Exam	75 Marks				
Total	100 Marks				
Duration of Exam	03 Hours				

Course Objectives:

- The goal of this course is to introduce biotechnology methods in plants.
- The objective of the course is to give students knowledge of modern plant biotechnology processes including plant tissue culture.
- Understanding plant transformation methods and characterization of transgenic plants.
- Knowledge of production of transgenic plants for improved agronomic traits.
- Applications of plant biotechnology for commercial production of pharmaceutical and industrial compounds. Knowledge of IPRs in agriculture.

Note: Examiner will set nine questions in total. Question one will be compulsory. Question one will have 6 parts of 2.5 marks each from all units and remaining eight questions of 15 marks each to be set by taking two questions from each unit. The students have to attempt five questions in total, first being compulsory and selecting one from each unit.

UNIT-I

Plant tissue culture—its history, development and applications, Plant tissue culture media, Types of cultures. Micropropagation: Techniques and various steps involved in micropropagation, Production of disease free plants, Commercial aspects and limitations of micropropagation. Callus cultures, Cell and suspension cultures, Single cell clones, Protoplast culture and somatic hybridization. Embryo culture. Haploids. Germplasm conservation.

UNIT-II

Genetic Transformation--Various transformation methods; Agrobacterium-mediated gene delivery; Disarming the Ti plasmid; Principles of vector designing; Screenable and selectable markers, Generation of marker-free transgenic methods, chloroplast transformation.

UNIT-III

Transgenic Crops for Resistance to Biotic/abiotic Stresses and Quality Improvement -- Viral resistance, fungal resistance, insects and pathogens resistance, drought, salinity, heat stress, low temperature stress, flooding and submergence stress, post-harvest bioengineering, concept of biofactories, herbicide resistance, engineering other traits. Terminator technology. Commercial transgenic crops.

U**NIT-IV**

Molecular farming: of Alkaloids, Useful enzymes, Therapeutic proteins, custom- made Antibodies, Edible vaccines. Secondary metabolite extraction: Primary vs secondary metabolites, Production of secondary metabolites and other compounds using plant cell culture, Hairy root culture, Immobilized cell system, Elicitation and Biotransformation.

Introduction to Molecular markers and marker assisted selection. Biosafety and IPR-related issues -- Production and acceptance of transgenic crops; Public and private sectors in plant

biotechnology Intellectual property rights (IPR), Plant breeders rights (PBRs) and farmers rights.

References:

1. Razdan, M.K., Introduction to Plant Tissue Culture, Science Publishers (2003) 2nd ed.
2. Slater, A., Scott, N.W., and Fowler, M.R., Plant Biotechnology, Oxford University Press (2008) 2nd ed.
3. Plant Biotechnology and Genetics: Principles, Techniques & Applications Edited by C. Neal Stewart Jr. Publisher John Wiley & Sons New Jersey 2008
4. Biotechnology in Agriculture & Forestry Volume 64 Genetic Modification of Plants Eds. Frank Kempken & Christian Jung Publisher Springer- Verlag Heidelberg 2010
5. Hudson T Hartmann: Plant Propagation-Principle and Practices
6. Principles of Plant Biotechnology- An Introduction of Genetic Engineering in Plants by S.H. Mantell, J.W. Mathews and R.A. Mckee, Blackwell Scientific Publications.
7. Hamish A, Collin & Sue Edwards: Plant Cell Culture

Learning Outcomes: At the end of the course the students shall be able to:

- Apply knowledge of modern plant biotechnology techniques used for commercial purposes and preservation of plant germplasm.
- The students will have knowledge of methods of plant genetic engineering, selection systems and detection and characterization of transgenic plants.
- Understand the strategies of plant genetic engineering employed for crop improvement for introduction of agronomically important traits like biotic and abiotic stress tolerance, commercial transgenic crops.
- Understand industrial applications of plant biotechnology and IPRs in agriculture

Course code	PCC-BT-304G				
Category	Professional Core Courses				
Course title	**Animal Biotechnology and Stem Cells**				
Scheme and Credits	**L**	**T**	**P**	**Credits**	**Semester-VI**
	3	**0**	0	**3**	
Branches (B. Tech.)	**Biotechnology Engineering**				
Class work	25 Marks				
Exam	75 Marks				
Total	100 Marks				
Duration of Exam	03 Hours				

Note: Examiner will set nine questions in total. Question one will be compulsory. Question one will have 6 parts of 2.5 marks each from all units and remaining eight questions of 15 marks each to be set by taking two questions from each unit. The students have to attempt five questions in total, first being compulsory and selecting one from each unit.

Unit-I

Introduction: History and scope of animal biotechnology.

Basic technique of animal cell culture & their applications. Balanced salt solutions and simple growth media. Serum quality and cell culture.

Preservation and maintenance of animal cell lines. Cryo preservation and transport of animal germ plasm (i.e. semen, ovum and embryos)

Unit-II

Transgenic animals; Methodology – retroviral vector method, DNA microinjection method and engineered embryonic stem cell method. Cloning by nuclear transfer. Yeast artificial chromosome transgenesis.

In Vitro fertilization and embryo transfer.

Unit-III

Molecular biological techniques for rapid diagnosis of genetic diseases and gene therapy. Molecular maps of animal genomes. Chemical carcinogenesis. Transfection. Oncogenes and antioncogenes.

Unit-IV

Gene cloning techniques for mammalian cells, Establishment of immortal cell lines, cloning in mammalian cells, expression of mammalian genes in prokaryotic and eukaryotic systems. Extinction of gene function by antisense RNA and DNA.

References:

1. *Molecular Biotechnology* by Old and Primrose.
2. *Molecular Biotechnology: Principles and Applications of recombinant* DNA By Bernard R. Glick, Jack. J. Pasternak, latest Edition. ASM press Washington DC.
3. *Animal Cell biotechnology:* R.E. Spier and J.D Griffiths Academic press.

4. Living resources for Biotechnology, Animal cells: A. Doyle, R. Hay and B.E. Kirsop, Cambridge University Press, cambridge.

Course code	PCC-BT-306G				
Category	Professional Core Courses				
Course title	**Environmental Biotechnology**				
Scheme and Credits	**L**	**T**	**P**	**Credits**	**Semester-VI**
	3	**0**	0	**3**	
Branches (B. Tech.)	**Biotechnology Engineering**				
Class work	25 Marks				
Exam	75 Marks				
Total	100 Marks				
Duration of Exam	03 Hours				

Course Objectives:

1. Understand the applications of biotechnology for Environment Conservation/Protection and various types of pollutions.
2. Understand the various waste water treatment processes
3. Understand the global environmental problems and novel techniques
4. Legislative measures for environment protection

Note: Examiner will set nine questions in total. Question one will be compulsory. Question one will have 6 parts of 2.5 marks each from all units and remaining eight questions of 15 marks each to be set by taking two questions from each unit. The students have to attempt five questions in total, first being compulsory and selecting one from each unit.

UNIT-I

Environment: Introduction, Current status of biotechnology in environment protection.
Environment Pollution: Types of pollution (Air, Water and Soil), sources of pollution, effects and treatment.

UNIT-II

Sewage and Waste water Treatment: Primary, Secondary and Tertiary treatments.
Biological treatment: Aerobic biological treatment and Anaerobic biological treatment.
Treatment schemes for Waste Water of dairy, distillery, tannery and sugar industries.
Biotechnology for Hazardous Waste Management: Xenobiotic compounds and Biodegradation of xenobiotics

UNIT-III

Bioremediation: Introduction, types and applications.
Global Environmental Problems: Ozone depletion, Green house effect, Acid rain, their impact and management, Climate change.
Novel Methods of Pollution Control: Vermitechnology, Waste water treatment using aquatic plants, Root zone treatment.

UNIT-IV

Environmental Laws: Water (Prevention and Control of Pollution) Act, 1974, Air (Prevention and Control of Pollution) Act, 1981, Environment (Protection) Act, 1986, Wild Life Protection Act, 1972, Indian Forest Act, 1927.

References:

1. “Waste water Engineering Treatment and Disposal and Reuse” by Metcalf & Eddy.
2. “Water Pollution Management hand Book” by Lepathak.
3. “Waste Water Management” by Arceivala.
4. “Environment Biotechnology”by C.F. Forster and D.A. J. Wase.
5. “New Processes of Waste water treatment and recovery” by G. Mattock (ED) Ellis Horwood.

Course Outcomes:

CO1-Obtain knowledge of various pollutions and technologies of decontamination of persistent organic pollutants.
CO2- Obtain knowledge of physico-chemical technologies and waste water treatment processes.
CO3-Understand about global environmental problems and the technologies such as Vermitechnology
CO4- Understand about various legal measures for controlling environmental problems

Course code	LC-BT-308G				
Category	Professional Core Course				
Course title	**Plant Biotechnology Lab**				
Scheme and credits	L	T	P	Credits	Semester
			3	1.5	VI
Class work	25 Marks				
Exam	25 Marks				
Total	50 Marks				
Duration of exam	03 Hours				

List of experiments:

1. Study of laboratory equipments used in plant tissue culture lab and sterilization techniques in plant tissue culture.
2. Preparation of Stocks solutions and Plant Tissue Culture Media.
3. Explant selection, treatment and inoculation
4. Induction of callus in cultured explants
5. Meristem culture
6. Subculture of initiated cultures
7. Acclimatization of cultures
8. Agrobacterium- mediated genetic transformation
9. Extraction of DNA/RNA from plants and its estimation
10. Extraction of phytochemicals from plants
11. Analysis of phytochemicals present in plant extracts

Learning Outcomes: **The students shall be able to:**

- Understand the specific requirements and laboratory operations of Plant Biotechnology lab.
- To carry out initiation and maintenance of plant tissue cultures under *in vitro* conditions.
- Study the effect of different plant growth regulators and acclimatize the in vitro grown plants
- Learn basic plant transformation techniques, extraction and analysis of phytochemicals from plant sources.

Course code	PCC-BT-310G				
Category	Professional Core Course				
Course title	**Environment Biotechnology Lab**				
Scheme and credits	L	T	P	Credits	Semester
			3	1.5	VI
Class work	25 Marks				
Exam	25 Marks				
Total	50 Marks				
Duration of exam	03 Hours				

List of Experiments:

1. Determination of Chlorides in water sample
2. Determination of hardness of water sample
3. Determination of calcium in water sample
4. Determination of Magnesium in water sample
5. Determination of total alkalinity of water sample
6. Determination of chlorides in soil sample
7. Determination of total alkalinity in soil sample
8. To study/ demonstration cultivation of mushroom.
9. To study/ demonstration life-cycle of earthworms i.e Vermitechnology
10. To determine the Chemical Oxygen Demand (COD) of Water sample.

Course Outcomes

CO1-Students will be able to carry out determination of alkalinity, hardness, Chlorides

CO2- Students will earn the estimation of heavy metals and Calcium, Magnesium in water samples.

CO3-Students will learn the estimation of Chlorides and alkalinity in soil samples

CO4-Students will be able to carry out determination of chemical oxygen demand (COD) of sewage samples

CO5-Students will be able to carry out demonstration of Vermitechnology and Mushroom culture

ANNEXURE- 3

Course code	PEC-BT 312 G				
Category	Professional Elective Course				
Course title	**FOOD BIOTECHNOLOGY**				
Scheme and Credits	**L**	**T**	**P**	**Credits**	**Semester-VI**
	3	**0**	**0**	**3**	
Branches (B. Tech.)	**Biotechnology**				
Class work	25 Marks				
Exam	25 Marks				
Total	50 Marks				
Duration of Exam	03 Hours				

Note: Examiner will set nine questions in total. Question one will be compulsory. Question one will have 6 parts of 2.5 marks each from all units and remaining eight questions of 15 marks each to be set by taking two questions from each unit. The students have to attempt five questions in total, first being compulsory and selecting one from each unit.

Unit-I

Historical Background: history of Microorganisms in food, Historical Developments.

Sources, types, Incidence, and behaviour of Microorganisms in Foods: The Role and significance of Microorganisms, Primary sources of Microorganisms found in foods

Production of culture for food fermentations, Microbial, Intrinsic and Extrinsic parameters of foods. Industrial units involved in production of fermentated foods

Unit-II

Determine Microorganisms and their products in foods: Culture, Microscopic and Sampling Methods, Conventional, SPC, Membrane Filters, Microscopic Colony Counts, Agar droplets, Dry films, MPN, DMC, Dye reduction, Roll Tubes, Microbiological Examination of surfaces and sampling, Metabolically Injured Organism, Enumeration and Detection of food borne Organisms. Physical, Chemical and Immunological Methods and Bioassay.

Unit-III

Food additives: Need for food additives, types of food additives. Development of novel food and food ingredients; SCP, polysaccharides, low calorie sweeteners, naturally produced flavor modifier, food coloring agent, food supplements and Nutraceuticals.

Unit-IV

Food Spoilage: General principle of spoilage, factors affecting spoilage; Spoilage of fruits and Vegetables, Spoilage of Miscellaneous Foods, Food preservation, Characteristics of

Radiations of Interest in Food Preservation, Destruction of Microorganisms and Applications, Radappertization, Radicidation and Radurization of food legal status of food irradiation. **Storage and Stability of irradiated foods Preservation:** High and Low Temperature, Drying, Pathogens, Psychrotrophs, thermophiles and radiation resistance Microorganisms

References:

1. *Modern Food Micro-Biology* by J.M. Jay Van Nostrand Reinhold company New York.

Course code	PEC-BT-314 G				
Category	Professional Elective Course				
Course title	**Protein Engineering**				
Scheme and Credits	**L**	**T**	**P**	**Credits**	**Semester-VI**
	2	**1**		**3**	
Branches (B. Tech.)	**Biotechnology Engineering**				
Class work	25 Marks				
Exam	75 Marks				
Total	100 Marks				
Duration of Exam	03 Hours				

Note: Examiner will set nine questions in total. Question one will be compulsory. Question one will have 6 parts of 2.5 marks each from all units and remaining eight questions of 15 marks each to be set by taking two questions from each unit. The students have to attempt five questions in total, first being compulsory and selecting one from each unit.

COURSE OBJECTIVES:

1. To learn introduction of proteins, protein and engineering.
2. To analyze proteins by various methods.
3. To know about different stabilizing forces, present in the proteins and computational approaches.

UNIT-I

Introduction to Protein engineering: Definition, Protein Structures, Features and characteristics of proteins that can be engineered; structural changes in proteins due to change in parameters such as pH, temperature and amino acid sequence, aggregation propensities, etc.

.UNIT-II:

Measuring Protein Stability: Spectroscopic methods to study physicochemical properties of proteins: UV/Vis, Circular dichroism, Fluorescence, X-ray, Mass. Hydrodynamic properties– viscosity, hydrogen-deuterium exchange; introduction to NMR spectroscopy –emphasis on parameters that can be measured/obtained from NMR and their interpretation.

UNIT-III:

Forces for stabilizing proteins: Van der waals, electrostatic, hydrogen bonding and weakly polar interactions, hydrophobic effects. Experimental methods of protein engineering by mutagenesis: random and site directed mutagenesis.

UNIT-IV:

Computational approaches to protein engineering: sequence and 3D structure analysis of proteins, protein data bases, Data mining, Ramachandran map, Protein engineering by phage display, Colorimetric and Fluorescence-Based Screening.

COURSE OUTCOME:

1. Able to learn about proteins and their structures for modifications.
2. Learn about different methods used for characterization of proteins and their characteristics.
3. Learn about stabilizing forces for proteins and how they are necessary for engineering a protein.
4. Learn about computational approaches for proteins.

References:

1. Edited by T E Creighton, Protein structure: A practical approach, 2nd Edition, Oxford university press, latest edition

2. Edited by T E Creighton, Protein function. A practical approach, 2nd Edition, Oxford university press, latest edition

3. Edited by T E Creighton, Protein function. A practical approach. Oxford university press. latest edition

4. Cleland and Craik, Protein Engineering, Principles and Practice, Vol 7, Springer Netherlands. Press, latest edition
5. Ed. Robertson DE, Noel JP, Protein Engineering Methods in Enzymology, 388, Elsevier Academic Press, latest edition

Course code	PEC-BT-316 G			
Category	Professional Elective Course			
Course title	**CANCER BIOLOGY**			
Scheme and credits	L	T	P	Credits
	3	0		3
Class work	25 Marks			
Exam	75 Marks			
Total	100 Marks			
Duration of exam	03 Hours			

Course Objectives: To impart knowledge of

- basic concepts of cancer biology
- various stages in carcinogenesis, molecular cell biology of cancer, cancer metastasis,
- cancer therapy.

UNIT I

Fundamentals of cancer biology: Regulation of Cell cycle, Mutations that cause changes in signal molecules, effects on receptor, signal switches, tumour suppressor genes, Modulation of cell cycle-in cancer. Different forms of cancers, Diet and cancer.

UNIT II

Principles of carcinogenesis: Chemical Carcinogenesis, Metabolism of Carcinogenesis, Natural History of Carcinogenesis, Targets of Chemical Carcinogenesis, Principles of Physical Carcinogenesis, X-Ray radiation – Mechanism of radiation Carcinogenesis.

UNIT III

Principles of molecular cell biology of cancer: Oncogenes, Identification of Oncogenes, Retroviruses and Oncogenes, detection of Oncogenes, Growth factor and Growth factor receptors that are Oncogenes. Oncogenes / Proto Oncogenes activity.

UNIT IV

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.

Cancer therapy: Different forms of therapy, Chemotherapy, Radiation Therapy, Detection of Cancers.

TEXT BOOKS :

1. King R.J.B., Cancer Biology, Addision Wesley Longmann Ltd, U.K., 1996.
2. Ruddon.R.W., Cancer Biology, Oxford University Press, Oxford, 1995.

Course Outcomes: The students will understand aspects of cancer related to

- Molecular basis and stages of cancer
- Cancer detection
- Cancer treatment

ANNEXURE-4

Course code	PEC-BT-318 G				
Category	Professional Elective Course				
Course title	**Downstream Processing**				
Scheme and Credits	**L**	**T**	**P**	**Credits**	**Semester-VI**
	2	**1**		**3**	
Branches (B. Tech.)	**Biotechnology Engineering**				
Class work	25 Marks				
Exam	75 Marks				
Total	100 Marks				
Duration of Exam	03 Hours				

Note: Examiner will set nine questions in total. Question one will be compulsory. Question one will have 6 parts of 2.5 marks each from all units and remaining eight questions of 15 marks each to be set by taking two questions from each unit. The students have to attempt five questions in total, first being compulsory and selecting one from each unit.

COURSE OBJECTIVES:

1. To learn the basics of fermentation technologies
2. To learn the concept of recovery and purification of fermented products
3. To learn the concept of effluent treatment.
4. To learn the concept of fermentation economics

Unit I

Introduction; Introduction to fermentation process, types of fermentation processes. Fermentation products; enzymes, metabolites, recombinants products. Parts of fermentation process, microbial growth kinetics, introduction to homogeneous and heterogeneous mass transfer, flow sheet. Stoichiometry of cell growth and product formation.

Unit II

Recovery and purification of fermentation products; Removal of microbial cells and solid material, foam separation, precipitation. Filtration; principle, types of filters, batch filters, continuous filters,

Unit III

Recovery and purification of fermentation products; Cell disruption by physical methods, chemical methods and enzymatic methods. Extraction methods; liquid-liquid extraction, liquid-solid extraction, aqueous two-phase extraction, supercritical fluid extraction. Chromatography (affinity, gel filtration, ion exchange, HPLC, GCMS), drying, crystallization.

Unit IV

Effluent Treatment; site survey, treatment of effluents, treatment processes, trickling filters, biologically aerated membranes, activated sludge processes, anaerobic treatment, disposal of effluents, By-products. Fermentation economics.

COURSE OUTCOMES:

1. Students will be able to understand the basic concept of fermentation technology
2. Students will be able to understand the process of recovery product
3. Students will be able to understand the process of isolation of products and analysis methods
4. Students will be able to understand the concept of effluent treatment and economic aspect of fermentation processes

REFERENCES:

1. Belter, P.A. and Cussler, E.L. Hu, W.S, Bioseparation: Downstream processing for Biotechnology, Wiley.

2. Ladisch, M.R., Bioseparation Engineering: Principles, Practice and Economics, Wiley, Interscience.

3. Stanbury, PF, Whitaker A, Hall SJ, Principles of fermentation technologies. Butterworth Heinemann.

Course code	PEC-BT-320G			
Category	Professional Elective Course			
Course title	**RNAi BIOLOGY**			
Scheme and credits	L	T	P	Credits
	3	0		3
Class work	25 Marks			
Exam	75 Marks			
Total	100 Marks			
Duration of exam	03 Hours			

Note: Examiner will set nine questions in total. Question one will be compulsory. Question one will have 6 parts of 2.5 marks each from all units and remaining eight questions of 15 marks each to be set by taking two questions from each unit. The students have to attempt five questions in total, first being compulsory and selecting one from each unit.

Course objectives:

- To understand the basic aspects of RNA interference.
- To learn use of siRNA and microRNAs for gene silencing,
- RNAi vectors and gene expression
- Knowledge of applications of RNAi in healthcare and agriculture.

UNIT-I

Discovery of RNA interference (RNAi): PTGS, RNAi and related phenomena. Categories of small non-coding RNAs: dsRNAs, siRNAs, shRNAs, piRNAs and miRNAs, Detection of small RNAs.

UNIT-II

Mechanism of RNAi: Different components of RNAi pathway and their evolutionary conservation and role in gene silencing, RNAi-like pathway in bacteria, Molecular basis of RNAi /siRNA /miRNA mediated gene silencing. RNAi in defense and the regulation of chromatin structure and gene expression; RNAi suppressors.

UNIT-III

miRNAs and siRNAs: Pathways, expression and functions of microRNAs, High-throughput analysis of miRNA gene expression; siRNA vectors, RNAi microarrays.
RNA informatics - Computational tools for miRNA discovery, siRNA and miRNA design.

UNIT- IV

Expression of dsRNA in animals and plants, and its applications: RNAi vectors and generation of transgenic animals and plants. Applications of RNAi in the prevention of diseases in animal models and crop improvement; Future prospects of RNAi. in biology, medicine and agriculture.

Text & Reference:

1. The RNA World TEds. T Gesteland et al. CSHL Press
2. RNA Interference Technology: From Basic Science to Drug Development. Eds. Fire et. al. Cambridge University Press,
3. RNAi: A Guide to Gene Silencing. Ed. Gregory J. Hannon CSHL Press
4 RNA Silencing: Methods and Protocols Ed. Gordon G. Carmichael CSHL Press
5. RNA Interference in Practice Ed. Ute Schepers, Wiley-VCH GmbH & Co. KGaA.
6. Genes IX. Lewin B Jones and Barlett Publishers

Course code	PEC-BT-322 G			
Category	Professional Elective Course			
Course title	**HUMAN GENETICS**			
Scheme and credits	L	T	P	Credits
	3	0		3
Class work	25 Marks			
Exam	75 Marks			
Total	100 Marks			
Duration of exam	03 Hours			

Note: Examiner will set nine questions in total. Question one will be compulsory. Question one will have 6 parts of 2.5 marks each from all units and remaining eight questions of 15 marks each to be set by taking two questions from each unit. The students have to attempt five questions in total, first being compulsory and selecting one from each unit.

Course objectives:

- To understand the basic aspects of human genetics.
- To study mapping of human genomes
- To understand basis of genetic disorders and inborn errors of metabolism
- Knowledge of ethical aspects.

Unit-I

Introduction to Human Genetics: History; Early perception, development and documentation; Genome organization; Chromosome structure, function and implications for disease.
Study tools in Human Genetics: Pedigree analysis- Mendelian inheritance and exceptions; Chromosomal analysis (in vitro, in vivo), Biochemical analysis; Somatic cell genetics (somatic cell hybrids, monochromosome hybrid panels, gene mapping); Molecular genetic analysis.

Unit-II

Human genome mapping methods: Physical mapping: Introduction to physical map markers- Chromosomal, G/Q- banding, radiation hybrid, Fluorescence in situ hybridization, comparative genome hybridization, long range restriction mapping, high resolution mapping- STS/EST/MS/SNP/sequencing;
Genetic mapping: Linkage analysis (RFLP/MS/SNP); Applications of mapping in normal and disease genome analysis; Gene identification using positional and functional cloning approach.

Unit-III

Human genome analysis: Conception, mapping, cloning and sequencing
Genetic variation in health and disease: Human genetic diversity- Methods of study – Biochemical/molecular genetic markers; some examples.

Diseases and disorders: Chromosomal disorders: Structural and numerical; Autosomal/sex chromosomal/sex reversal; Mechanisms – mitotic/meiotic non-disjunction/ chromosomal rearrangements; Some examples (Syndromes/Cancer/Infertility);

Unit-IV

Single gene and disease: Inborn errors of metabolism, Haemoglobinopathies; Multifactorial disorders: Introduction; Methods of study (Epidemiological, Twin/ adoption and Family studies); Etiology - genetic and non-genetic determinants; Common examples. Epigenetics and disease

Ethical, legal and social issues in Human genetics: Prenatal/adult (individual/family/population) screening of mutation/risk factor for genetic diseases; Confidentiality/privacy, Discrimination, Ethical dilemma, Human rights, Surrogate mothers; Human cloning and eugenics; Organ banking and transplantation; Research ethics; Medical ethics in India.

Suggested readings:

1. Human Genetics: Problems and Approaches TVogel F. and. Motulsky A. GT Springer Verlag
2. Human Molecular Genetics Strachan T & Read A Garland Science
3. An Introduction to Human Molecular Genetics: Mechanism of Inherited Diseases Pasternak J Fitzgerald Science Press
4 Chromosome Structural analysis: A Practical Approach (Ed.) W.A. Bickmore Oxford University Press

ANNEXURE-5

Course code	OEC-BT-302G				
Category	Open Elective Courses				
Course title	**Biosensors**				
Scheme and Credits	**L**	**T**	**P**	**Credits**	**Semester-VI**
	2	**1**		**3**	
Branches (B. Tech.)	**Biotechnology Engineering**				
Class work	25 Marks				
Exam	75 Marks				
Total	100 Marks				
Duration of Exam	03 Hours				

Note: Examiner will set nine questions in total. Question one will be compulsory. Question one will have 6 parts of 2.5 marks each from all units and remaining eight questions of 15 marks each to be set by taking two questions from each unit. The students have to attempt five questions in total, first being compulsory and selecting one from each unit.

COURSE OBJECTIVES:

1. This course helps to understand the use of biomolecules as recognition elements.
2. To familiarize students with biosensor technology, their application in various fields.
3. To know about different materials used foe electrode fabrication.

UNIT-I:

Introduction to Biosensors: Biosensors- History of Biosensors, Advantages and limitations, various components of biosensors, Biocatalysis based biosensors, Bio affinity-based biosensors, Biologically active material and analyte. Types of membranes used for biosensor.

UNIT-II:

Transducers in Biosensors: Types of transducers; principles and applications - Calorimetric, Optical, Potentiometric / Amperometric, Conductometric, Piezoelectric, Impedimetric, Chemiluminiscene - based Biosensors. Nanomaterial based electrodes.

UNIT-III:

Application and Uses of Biosensors: Biosensors in clinical chemistry, medicine and health care, biosensors for veterinary, agriculture and food Low cost - biosensor for industrial processes for online monitoring; biosensors for environmental monitoring. Application of enzymes in analysis; healthcare, food and environment.

UNIT-IV:

Materials used & Characterization Techniques for Biosensor: Materials used for electrode fabrication. UV-Visible spectroscopy, Particle size analyzer, X-Ray diffraction, Scanning Electron Microscopy, Transmission Electron Microscopy, Atomic Force Microscopy, Fourier Transform Infrared Spectroscopy.

COURSE OUTCOME:

1. Able to learn about principle of biosensor.
2. Learn about different materials used for biosensor fabrication.
3. Learn about different types of transducers used.
4. Learn about application of biosensors in various fields.

References:

1. Donald G. Buerk - Biosensors Theory and Applications, First Edition Technomic Publishing. Co, Inc, latest edition
2. Brian R Eggins - Biosensors an Introduction, First edition, John Wiley & Sons Publishers, latest edition
3. Loic J Blum, Pierre R Coulet - Biosensors Principles and Applications, First edition, Marcel Dekker, Inc, latest edition
4. Tran Minh Canh - Sensor Physics & Technology - Biosensors, First Edition, Champan & Hall, latest edition

Course code	OEC-BT-304G				
Category	Open Elective Courses				
Course title	**Fermentation Technology**				
Scheme and Credits	**L**	**T**	**P**	**Credits**	**Semester-VI**
	3	**0**	0	**3**	
Branches (B. Tech.)	**Biotechnology Engineering**				
Class work	25 Marks				
Exam	75 Marks				
Total	100 Marks				
Duration of Exam	03 Hours				

Note: Examiner will set nine questions in total. Question one will be compulsory. Question one will have 6 parts of 2.5 marks each from all units and remaining eight questions of 15 marks each to be set by taking two questions from each unit. The students have to attempt five questions in total, first being compulsory and selecting one from each unit.

Course Objectives

- Understanding basics concept of fermenters
- Understanding general characteristics of culture medium and its components
- Understanding of Sterilization process
- Understanding of industrial applications of fermentation and product recovery

UNIT – I

Introduction to fermentation technology: History of fermentation, General attributes of fermentation processes; biomass, microbial metabolites, batch fermentation, continuous fermentation, fed batch fermentation, solid state fermentation. Microbial growth kinetics. Selection of microorganism used in fermentation process.

UNIT – II

Development of fermentation process: Different sterilization method, Medium sterilization for batch and continuous cultures, sterilization of fermenter, filter sterilization. Culture medium for fermentation processes; carbon sources, nitrogen sources, minerals, antifoam. Medium formulation, inoculum development and process optimization.

UNIT – III

Fermentation processes for different products: Fermentative production of different products; Single cell protein, enzymes, amino acids, citric acid, penicillin. Bioprocess economics, and Bioproduct regulation. Preservation and improvement in industrially important microorganisms.

UNIT – IV

Recovery and Purification of Fermentation products: Removal of microbial cells and solid matter, precipitation, filtration, centrifugation, cell disruption, product isolation, distillation, whole broth processing, aqueous two-phase separation, liquid-liquid extraction, chromatography. Introduction to effluent treatment.

Course Outcomes

After studying the course, the student will be able to:

- Students will be able to understand the general attributes of fermentation system
- Students will be able to understand the medium formulation and sterilization for fermentation processes,
- Students will be able to understand the development of fermentation process for different product,
- Students will be able to understand the downstream process of fermented products

References:

1. Principles of Fermentation Technology, PF Stanbury, A Whitaker, SJ Hall, Butterworth Heinmann publication

2. Industrial Microbiology: An Introduction, Michael J. Waites, Neil L. Morgan John S. Rockey, Gary Higton, Blackwell science Ltd

3. Biotechnology: A Textbook of Industrial Microbiology, Crueger and Crueger, Sinduer Associates, Inc.,

Course code	OEC-BT-306 G			
Category	Professional Elective Course			
Course title	**BIOFUELS**			
Scheme and credits	L	T	P	Credits
	3	0		3
Class work	25 Marks			
Exam	75 Marks			
Total	100 Marks			
Duration of exam	03 Hours			

OBJECTIVES:

- To give an introduction to biogas technology
- To understand the basics behind the bioethanol and biodiesel production
- To give basic idea for the production of green energy from biomass

UNIT-I

Biogas Technology:

Microbiology of biogas production, Methods to enhance the biogas production, Design parameters affecting the success and failure of biogas plants. Various techniques for increasing gas production in cold region. Effect of heating , insulation and stirring on gas production, Design optimization for biogas production, Multi criteria optimization, Immobilization biogas plant system – principle, Application of immobilization, Modular biogas systems for tropical areas – principle, Prospects of modular biogas systems, Alternate feedstock for biogas production.

UNIT -II

Bio-Ethanol and Bio-Diesel Technology:

Production of Fuel Ethanol by Fermentation of Sugars. Gasohol as a Substitute for Leaded Petrol. - Trans-Esterification of Oils to Produce Bio-Diesel.

UNIT -III

Green Technology – Microbial Fuel Cell:

Types of Biological fuel cells – Working Principle - Applications of biological Fuel cells. A brief study of the principle, construction of different types of fuel cells. Hydrogen production by photosynthetic bacteria, biophotolysis of water and by fermentation; Microbial recovery of petroleum by biopolymers (Xanthum gum), biosurfactants.

UNIT -IV

Energy from Biomass – Introduction – Biomass conversion Technologies – Photosynthesis – Biogas generation – Factors affecting Biodigestion – Classification – Types – Construction Details – Methods of obtaining energy from Biomass – Pyrolysis – Alcohol fuels - Design and operation of Fixed and Fluidized Bed Gasifiers. Combustion of Biomass and Cogeneration Systems:Combustion of Woody Biomass: Theory, Calculations and Design of Equipments. Cogeneration in Biomass Processing Industries. Case Studies: Combustion of Rice Husk, Use of Bagasse for Cogeneration.

TEXT BOOKS :

1. G.D.Rai (2011), *Non-Conventional Energy Sources* , Khanna Publishers.
2. B.H.Khan,(2006*) Non-conventional Energy Sources* , The McGraw Hill Companies.

REFERENCES:

1. Halwagi,(1984) *Biogas Technology - Transfer and Diffusion.* MNES Publication.
2. Chawla, O.P, (1986)*Advances in Biogas technology.* Publications and Information Division, Indian Council of Agricultural Research.

Course code	OEC-BT-308 G			
Category	Open Elective Course			
Course title	**Cyber Law & Ethics**			
Scheme and credits	L	T	P	Credits
	3	0		3
Class work	25 Marks			
Exam	75 Marks			
Total	100 Marks			
Duration of exam	03 Hours			

Note: Examiner will set nine questions in total. Question one will be compulsory. Question one will have 6 parts of 2.5 marks each from all units and remaining eight questions of 15 marks each to be set by taking two questions from each unit. The students have to attempt five questions in total, first being compulsory and selecting one from each unit.

Course Objectives :

1. To understand cyber space and cyber crimes
2. To know the Information Technology Act, 2000 and electronic Governance
3. To understand Jurisdiction issues and cyber law
4. To become aware of cyber ethics

Unit – I

Concept of cyber space: Definition and Meaning of Cyber space

Cyber crimes: Types of cyber crimes, Tempering with Computer Source documents, Hacking with computer system, Publishing of Obscene information in electronic form, Breach of confidentiality and privacy, Publishing of false digital signature certificate, Cyber Terrorism, Cyber defamation

Unit – II

Information technology Act, 2000 : Object and scope of the Information Technology Act, 2000

Electronic Governance: Legal recognition of electronic records, Legal recognition of digital signature and electronic signature, Use of electronic records and digital signatures in Government and its agencies

Unit – III

Jurisdiction Issues in cyber space: Concept of jurisdiction, Personal jurisdiction in cyber space, Indian perspective of Jurisdiction in cyber space

Cyber Law and related issues : Freedom of Speech and Expression in cyber space, India and cyber crimes conventions

Unit – IV

Cyber ethics: copyright infringement, plagiarism, and netiquette.

References :

- SudhirNaib, The Information Technology Act, 2005: A Handbook, OUP, New York, (2011)
- Verma S, K, Mittal Raman,Legal Dimensions of Cyber Space, Indian Law Institute, New Delhi, (2004)
- Chris Reed & John Angel, Computer Law, OUP, New York, (2007). Justice Yatindra Singh,Cyber Laws, Universal Law Publishing Co, New Delhi, (2012).
- JonthanRosenoer, Cyber Law, Springer, New York, (1997).

- Karnika Seth, Computers, Internet and New Technology Laws, Lexis
- S. R. Bhansali, Information Technology Act, 2000, University Book House Pvt. Ltd., Jaipur (2003).
- Vasu Deva, Cyber Crimes and Law Enforcement, Commonwealth Publishers, New Delhi,(2003).

Course Outcomes :

1. Student would be able to understand cyber space and cyber crimes
2. Students will be able to understand Information Technology Act, 2000 and electronic Governance
3. Students would be able to understand Jurisdiction issues and cyber law
4. Students would be able to understand cyber ethics