

KADI SARVA
VISHWAVIDYALAYA,
GANDHINAGAR



M.Sc. BIOTECHNOLOGY

SYLLABUS

W.E.F. JULY 2014

BIOTECHNOLOGY

Course Description: This course is designed to enable students to acquire understanding of fundamentals of Biotechnology and applications of various Biotechnological resources and techniques. It also provides opportunities for utilizing Biotechnology products for the benefit of mankind. The course also provides practical training on Biotechnological resources, techniques and processes for creation of trained manpower for adsorption in upcoming Biotechnology Industry.

I SEMESTER

BT – 101	MOLECULAR BIOLOGY
BT – 102	BIOPHYSICAL AND BIOCHEMICAL TECHNIQUES
BT – 103	CELL BIOLOGY AND MICROBIAL PHYSIOLOGY
BT – 104	BIOCHEMISTRY AND ENZYMOLOGY
BT – 105	COMMUNICATION SKILLS AND RESEARCH METHODOLOGY
BT – 106	LABORATORY

II SEMESTER

BT – 201	GENETIC ENGINEERING
BT – 202	IMMUNOLOGY
BT – 203	BIOPROCESSING AND BIOCHEMICAL ENGINEERING
BT – 204	COMPUTER APPLICATIONS, BIOSTATISTICS AND BIOINFORMATICS
BT – 205	LABORATORY

III SEMESTER

BT – 301	MICROBIAL TECHNOLOGY
BT – 302	PLANT BIOTECHNOLOGY
BT – 303	ANIMAL CELL SCIENCE AND TECHNOLOGY
BT – 304	ENVIRONMENTAL BIOTECHNOLOGY
BT – 305	PHARMACEUTICAL BIOTECHNOLOGY
BT – 306	LABORATORY

IV SEMESTER

BT – 401	BIOTECHNOLOGY BUSINESS MANAGEMENT
BT – 402	DISSERTATION WORK

I SEMESTER

**Department of Biotechnology
KADI SARVA VISHWAVIDYALAYA**

BT: 101- MOLECULAR BIOLOGY

RATIONALE: This course is designed to acquire basic knowledge of Molecular Biology of prokaryotes and eukaryotes and to enable students to brush up the concepts of classical genetics.

LEARNING OUTCOMES:

- Enabling the students to know and understand the basics of replication, transcription, translation and regulation of gene expression in prokaryotes and eukaryotes.
- Refurbishing knowledge on classical genetics and genetic disorders.
- Acquiring knowledge on types of DNA damage and existing DNA repair mechanisms present in the cells to counter them.
- Understanding the concepts of recombination and transposons.

TEACHING AND EVALUATION SCHEME: The objective of evaluation is not only to measure the performance of students, but also to motivate them for better performance. Students are evaluated on the basis of Mid Term examinations for 30 marks and End Term Examination conducted by University examination for 70 marks.

Subject Code	Subject Title	Credits	Theory		Total Marks	
			Hrs.	Max Marks		
				Mid Term		End Term
BT 101	Molecular Biology	4	48	30	70	100

COURSE CONTENT

Section A

Unit 1	No. of Lectures: 4	Weightage: 8%
Mendel's laws – Law of segregation, Law of Independent Assortment. Exceptions to Mendel's Laws – Law of Incomplete dominance, Law of Co dominance, Linkage. Sex linked Inheritance in human beings – Color blindness, hemophilia.		

Unit 2	No. of Lectures: 4	Weightage: 10%
The genetic material –Properties, Experiments that prove DNA / RNA as genetic material. Chromatin structure and types, Organization of nucleosome and chromosomes.		

Unit 3	No. of Lectures: 6	Weightage: 12%
Prokaryotic and eukaryotic DNA replication, Telomerase.		

Unit 4	No. of Lectures: 5	Weightage: 10%
Promoters & Enhancers, Prokaryotic RNA Polymerase, Transcription in prokaryotes.		

Unit 5	No. of Lectures: 5	Weightage: 10%
Eukaryotic RNA Polymerases, Transcription in Eukaryotes.		

Section B

Unit 6	No. of Lectures: 2	Weightage: 8%
Properties of Genetic code, Wobbles Hypothesis, Ribosomes, Polysomes, Transfer RNA (tRNA)		

Unit 7	No. of Lectures: 8	Weightage: 12%
Protein synthesis in prokaryotes and eukaryotes, Inhibitors of protein synthesis		

Unit 8	No. of Lectures: 4	Weightage: 10%
Regulation of gene expression in Prokaryotes: lac operon, trp operon.		

Unit 9	No. of Lectures: 6	Weightage: 12%
DNA damage: DNA lesions. Thymine dimers. Deamination. Depurination: DNA repair mechanisms		

Unit 10**No. of Lectures: 4****Weightage: 12%**

Overview of Recombination; Transposable genetic elements: Insertion Sequences, Composite Transposons and Non composite transposons, Transposition – replicative and non replicative mechanisms.

REFERENCES

Molecular Biology of Cell:	B. Alberts <i>et. al.</i>
Molecular Biology of the Gene	J. D. Watson <i>et. Al.</i>
Genes X	B. Lewin
Instant notes on Molecular Biology	Turner
Principles of Genetics	Snustard
Fundamental Bacterial Genetics	Nancy Trun & Janie Trempy

INSTRUCTION STRATEGIES

1. Interactions with the students to understand the level of students
2. Explaining & Discussing the major terminologies related to environment
3. Teaching the topics included in the syllabus with the help of teaching aids like OHP, LCD (Power point presentation), Notes, Question Banks, References and Reprints / Copy of Articles, Models, Diagrams
4. Assistance in solving of questions from our question bank.
5. Assistance in solving of questions asked in national entrance exams like CSIR –NET / other Universities.
6. Updating the recent developments in the field of Molecular Biology

TEACHING AND EXAMINATION

UNIT	Examination Scheme % Weightage	Teaching Scheme No. of Lectures
Unit 1	8	4
Unit 2	10	4
Unit 3	12	6
Unit 4	10	5
Unit 5	10	5
Unit 6	8	2
Unit 7	12	8
Unit 8	10	4
Unit 9	12	6
Unit 10	8	4
Total	100	48

**Department of Biotechnology
KADI SARVA VISHWAVIDYALAYA**

BT: 102–BIOPHYSICAL & BIOCHEMICAL TECHNIQUES

RATIONALE: This course is designed to enable students to acquire basic knowledge of instruments and techniques related to analysis of processes & products and the separation procedures routinely used in biotechnology laboratories and industries.

LEARNING OUTCOMES:

- Development of skills related to handling of instruments.
- Enabling the students to design various analyses, processes and separation techniques used for research purposes and industrial use.

TEACHING AND EVALUATION SCHEME: The objective of evaluation is not only to measure the performance of students, but also to motivate them for better performance. Students are evaluated on the basis of Mid Term examinations for 30 marks and End Term Examination conducted by University examination for 70 marks.

Subject Code	Subject Title	Credits	Theory			Total Marks
			Hrs.	Max Marks		
				Mid Term	End Term	
BT 102	BIOPHYSICAL & BIOCHEMICAL TECHNIQUES	4	48	30	70	100

COURSE CONTENT

Section A

Unit 1	No. of Lectures: 3	Weightage: 10%
Use of analytical microscopy in elucidating the structure-function relationship in microbes: Electron microscopy, phase contrast and fluorescence microscopy & scanning tunneling microscopy.		

Unit 2	No. of Lectures:2	Weightage: 5%
Introduction: Osmosis, diffusion and Donnan Equilibrium.		

Unit 3	No. of Lectures:7	Weightage: 10%
Centrifugation techniques: Principles, types of centrifuges and, Separation and characterization of bio-molecules using Centrifugation techniques.		

Unit 4	No. of Lectures: 5	Weightage: 10%
Chromatographic techniques: Principles, types and applications of chromatographic techniques.		

Unit 5	No. of Lectures:7	Weightage: 15%
Electrophoresis: Principles, types of Electrophoresis, Separation and characterization of bio-molecules using electrophoretic techniques.		

Section B

Unit 6	No. of Lectures:- 2	Weightage: 5%
Basic concepts of Electromagnetic radiation – wave length, frequency, wave number, velocity. Properties of U.V and IR rays, fluorescence, Phosphorescence.		

Unit 7	No. of Lectures:- 7	Weightage: 15%
Principles and applications of Visible, UV, IR, AAS,		

Unit 8	No. of Lectures:- 6	Weightage: 10%
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Unit	No. of Lectures:- 4	Weightage: 10%
Fluorescence spectroscopy, Raman spectroscopy, CD, ORD, Characterization of macromolecules using X-ray diffraction analysis.		

Unit 10	No. of Lectures:- 5	Weightage: 10%
Principles and applications of Radio isotope techniques: Detection and measurement of radioactivity, Geiger Muller counters, Scintillation counting, Autoradiography and RIA; Applications of isotopes in biological studies.		

REFERENCES:

Principle and techniques of biochemistry & molecular biology	Keith Wilson & John Walker
Instrumental methods of analysis	B. Sivasankar
Biophysical chemistry: Principle and techniques	Upadhyay & Nath
Instrumental methods of analysis	Willard, Merritt, Dean & Settle
Instrumental analysis	D.A. Skoog, Holler & Crouch
Physical Biochemistry:	David Freifelder

INSTRUCTION STRATEGIES

1. Interactions with the students to understand the level of students
2. Explaining & discussing the major techniques related to separation, purification and analysis of macromolecules by using different analytical techniques.
3. Teaching the topics included in the syllabus with the help of teaching aids like OHP, LCD (Power point presentation), Notes, Question Banks, References and Reprints / Copy of Articles, Models, Diagrams
4. Assistance in solving of questions from our question bank.
5. Assistance in solving of questions asked in national entrance exams like CSIR –NET / other Universities.

TEACHING AND EXAMINATION

UNIT	Examination Scheme % Weightage	Teaching Scheme	No. of Lectures
Unit 1	10		3
Unit 2	5		2
Unit 3	10		5
Unit 4	10		7
Unit 5	15		7
Unit 6	5		2
Unit 7	15		7
Unit 8	10		6
Unit 9	10		4
Unit 10	10		5
Total	100		48

**Department of Biotechnology
KADI SARVA VISHWAVIDYALAYA**

BT: 103–Cell Biology & Microbial Physiology

RATIONALE: This course is designed to enable students to acquire knowledge on the structure, behaviour and functioning of cell constituents of Microbes and other living organisms.

LEARNING OUTCOMES:

- Development of knowledge of the morphology and structure of organisms, their nutrition, culturing and growth.
- Understanding of the functions of various organelles to support the viability, growth and metabolism
- Understanding of the interactions of environmental conditions and nutrition with growth and metabolic pathways.
- Enabling the students to design various techniques used for growth of organisms, particularly of microbes, for large scale cultivation for research and industrial purpose.

TEACHING AND EVALUATION SCHEME: The objective of evaluation is not only to measure the performance of students, but also to motivate them for better performance. Students are evaluated on the basis of Mid Term examinations for 30 marks and End Term Examination conducted by University examination for 70 marks.

Subject Code	Subject Title	Credits	Theory			Total Marks
			Hrs.	Max Marks		
				Mid Term	End Term	
BT: 103	Cell Biology & Microbial physiology	4	48	30	70	100

COURSE CONTENT

Section A

Unit 1	No .of Lectures:7	Weightage: 12%
Cell origin and evolution, overview of structure and functions of cellular organelles in Prokaryotes and Eukaryotes.		

Unit 2	No. of Lectures:- 4	Weightage: 8%
Organization of Cytoskeleton and nuclei, Cell division and overview of cell cycle.		

Unit 3	No. of Lectures:- 2	Weightage: 5%
Bio-membranes: Structures and Transport process		

Unit 4	No. of Lectures:- 8	Weightage: 15%
Microbial growth: Definition, mathematical expression of growth, growth curve, Growth as affected by environmental factors like temperature, acidity, alkalinity, water availability & oxygen.		

Unit 5	No. of Lectures:- 3	Weightage: 10%
Sterilization: Applications in biotechnology, various sterilization methods, Microbial contamination control and sterility testing.		

Section B

Unit 6	No. of Lectures:- 8	Weightage: 16%
Microbial metabolic diversity: Photosynthesis, Methanogenesis, Acetogenesis, Nitrogen fixation and Hydrocarbon transformations in microorganisms		

Unit 7	No. of Lectures:- 6	Weightage: 8%
Mitochondrial respiratory chain, order and organization of carrier's proton gradient, iron sulphur proteins, cytochromes and characterization. Regulation of respiration.		

Unit 8	No. of Lectures:- 4	Weightage: 10%
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Unit 9	No. of Lectures:- 3	Weightage: 8%
Culture collection: Maintenance of cultures, Biochemical characterization		

Unit 10	No. of Lectures:- 12	Weightage: 25%
Antimicrobial agents: Antibacterial, Antiviral, Antifungal agents, Mode of action and resistance to antibiotics		

REFERENCES:

Cell & Molecular Biology	E.D.P. De Roberties and E.M.F. De Roberties
Microbial Physiology	A.G.Moat and J.W.Foster
General Microbiology	Roger Stanier <i>et al</i>
Microbiology	Pelczar Michael J <i>et al</i>
Microbiology and Immunology	Johnson Arthur G
The Cell: A Molecular Approach	G.M.Cooper & R.E.Hausman
Microbiology	L.M.Prescott
Cell Biology & Molecular Biology	Verma & Agarwal
Cell Biology	T. Devasena
Brock's Biology of Microorganisms	Michael T. Madigan, John M. Martinko, David Stahl, David P. Clark

INSTRUCTION STRATEGIES

1. Interactions with the students to understand the level of students
2. Explaining & discussing the major terminologies related to identifying the cell structure and functions.
3. Teaching the topics included in the syllabus with the help of teaching aids like OHP, LCD (Power point presentation), Notes, Question Banks, References and Reprints / Copy of Articles, Models, Diagrams
4. Assistance in solving of questions from our question bank.
5. Assistance in solving of questions asked in national entrance exams like CSIR –NET / other Universities.

TEACHING AND EXAMINATION

UNIT	Examination Scheme	% Weightage	Teaching Scheme	No. of Lectures
Unit 1		8		4
Unit 2		10		4
Unit 3		12		6
Unit 4		10		5
Unit 5		10		5
Unit 6		8		2
Unit 7		12		8
Unit 8		10		4
Unit 9		12		6
Unit 10		8		4
Total		100		48

**Department of Biotechnology
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BT: 104 - BIOCHEMISTRY & ENZYMOLOGY

RATIONALE: This course is designed to enable students to acquire knowledge on the behaviour and functioning of cell constituents of Microbes and other living organisms. It provides the information on the characteristics of various enzymes and their application in various industries

LEARNING OUTCOMES:

- Gain the knowledge regarding the biosynthesis and degradation of Biomolecules in different organisms.
- Understanding of structure, function, regulation, kinetics and inhibitors of various enzymes.
- Application of the knowledge of various enzymes in everyday life and in different industries.

TEACHING AND EVALUATION SCHEME: The objective of evaluation is not only to measure the performance of students, but also to motivate them for better performance. Students are evaluated on the basis of Mid Term examinations for 30 marks and End Term Examination conducted by University examination for 70 marks.

Subject Code	Subject Title	Credits	Theory			Total Marks
			Hrs.	Max Marks		
				Mid Term	End Term	
BT 104	BIOCHEMISTRY & ENZYMOLOGY	4	48	30	70	100

COURSE CONTENT

Section A

Unit 1	No. of Lectures: 4	Weightage: 8%
Carbohydrates: Glycolysis, citric acid cycles its function in energy generation and biosynthesis of energy rich bonds.		

Unit 2	No. of Lectures: 4	Weightage: 8%
Oxidative phosphorylation. Alternate pathways of carbohydrate metabolism. Gluconeogenesis, inter conversion of sugars, Biosynthesis of Oligosaccharides.		

Unit 3	No. of Lectures: 6	Weightage: 12%
Amino acids: Biosynthesis and degradation of amino acid. Regulation of amino acid metabolism in microbial system.		

Unit 4	No. of Lectures: 6	Weightage: 12%
Lipids: Fatty acid biosynthesis, Acetyl CoA carboxylase, Fatty acid synthase, desaturase and elongase. Fatty acid oxidation.		

Unit 5	No. of Lectures: 4	Weightage: 10%
Nucleic acid: Biosynthesis of purines and pyrimidines. Regulation of purines and pyrimidines biosynthesis. Structure and regulation of ribonucleotide reductase.		

Section B

Unit 6	No. of Lectures: 6	Weightage: 14%
Classification & nomenclature of Enzymes, Units of activity, Specific activity of enzyme and Methods of enzyme assay, isolation & purification. Enzyme specificity, Factors affecting the rate & efficiency of enzyme catalyzed reactions forms and derivation of M M equation; Significance of V_{max} and K_m .		

Unit 7	No. of Lectures: - 6	Weightage: 10%
Enzyme inhibition – type of inhibitions, Protein ligand binding; Protein sequencing.		

Unit 8	No. of Lectures: - 4	Weightage: 8%
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nature of multi-enzyme systems, Coenzymes and co-factors.

Unit 9 **No. of Lectures:-4** **Weightage: 8%**
Immobilized enzymes and their utility.

Unit 10 **No. of Lectures:- 4** **Weightage: 10%**
General mechanism of enzyme regulation; Feedback inhibition and feed forward stimulation;
Enzyme repression, induction and degradation; Enzyme engineering and its applications.
Manufacturing & applications of enzymes.

REFERENCES:

Lehninger's Principles of Biochemistry	D.L.Nelson and M.M.Cox
Biochemistry	L. Stryer
Biochemistry	D.Voet and J.G.Voet.
Biochemistry: Chemical Reactions of the Living Cells(Vol.I & II)	D.Metzerler
Fundamentals of Enzymology:	N.C. Price and L.Stevens
Enzyme Structure and Mechanism:	A. Fersht
Understanding Enzymes:	T. Palmer
Biochemistry	Jain & Jain
Enzymology	T. Devsena

INSTRUCTION STRATEGIES

1. Interactions with the students to understand the level of students
2. Explaining & Discussing the major terminologies and applications related to biochemistry and enzymology.
3. Teaching the topics included in the syllabus with the help of teaching aids like OHP, LCD (Power point presentation), Notes, Question Banks, References and Reprints / Copy of Articles, Models, Diagrams
4. Assistance in solving of questions from our question bank .
5. Assistance in solving of questions asked in national entrance exams like CSIR –NET / other Universities.
6. Updation on recent developments in the field of biochemistry and enzymology.

TEACHING AND EXAMINATION:

UNIT	Examination Scheme	% Weightage	Teaching Scheme	No. of Lectures
Unit 1		8		4
Unit 2		8		4
Unit 3		12		6
Unit 4		12		6
Unit 5		10		4
Unit 6		14		6
Unit 7		10		6
Unit 8		8		4
Unit 9		8		4
Unit 10		10		4
Total		100		48

**Department of Biotechnology
KADI SARVA VISHWAVIDYALAYA**

BT: 105- COMMUNICATION SKILLS AND RESEARCH METHODOLOGY

RATIONALE: This course is designed to enable students to acquire the knowledge and competence in communication skills and research methodology that will ensure better presentation and writing skills

LEARNING OUTCOMES:

- Enabling the students to understand the lectures, presentation, articles and Text books in English better
- Learn better ways of writing, presenting and communicate in internationally acceptable language.
- Acquiring knowledge on the recent trends of Research Methodology to be successful in Research / Professional career in Biotechnology Industry.
- Development of capabilities to plan and execute new experiments, develop improved methodologies and to present their ideas and work better in the present competitive environment

TEACHING AND EVALUATION SCHEME: The objective of evaluation is not only to measure the performance of students, but also to motivate them for better performance. Students are evaluated on the basis of Mid Term examinations for 30 marks and End Term Examination conducted by University examination for 70 marks.

Subject Code	Subject Title	Credits	Theory			Total Marks
			Hrs.	Max Marks		
				Mid Term	End Term	
MB105	Communication Skills and Research Methodology	4	48	30	70	100

COURSE CONTENT

Section A

Unit 1	No. of Lectures: 6	Weightage: 12%
Process of communication: Concept of effective communication- Setting clear goals for communication; Determining outcomes and results; Initiating communication; Avoiding breakdowns while communicating; Creating value in conversation; Barriers to effective communication; Non verbal communication- Interpreting non verbal cues; Importance of body language, Power of effective listening; recognizing cultural differences.		

Unit 2	No. of Lectures: 6	Weightage: 10%
Presentation skills: Formal presentation skills; Preparing and presenting using Over Head Projector, Power Point; Defending Interrogation; Scientific poster preparation & presentation; Participating in group discussions		

Unit 3	No. of Lectures: 6	Weightage: 15%
Technical Writing Skills: Types of reports; Layout of a formal report; Scientific writing skills: Scientific Publication Writing: Elements of a Scientific paper including Abstract, Introduction, Materials & Methods, Results, Discussion, References; Drafting titles and framing abstracts. Importance of communicating Science; Problems while writing a scientific document; Plagiarism.		

Unit 4	No. of Lectures: 6	Weightage: 10%
Computing Skills for Scientific Research: Web browsing for information search; search engines and their mechanism of searching; Hidden Web and its importance in Scientific research; Internet as a medium of interaction between scientists; Effective email strategy using the right tone and conciseness.		

Section B

Unit 5	No. of Lectures: 2	Weightage: 5%
Research methodology: Introduction- Basic research, applied research, need based research.		

Identification of the problem, Defining the problem, Research project planning.

Unit 7 **No. of Lectures: 5** **Weightage: 10%**
Literature search – Information sources, library resources- books, journals, abstracts hand books, procedure manuals, encyclopedias, annual reports, data banks, CDROMS, online literature search – internet access, websites, directories of information resources.

Unit 8 **No. of Lectures: 7** **Weightage: 15%**
Design of the experimental programme – Variables in the experiments, materials and methods, evolution of methods, application of methods.

Unit 9 **No. of Lectures: 5** **Weightage: 10%**
Progress of research – Evaluation of results, statistical approach, comparison with existing methodologies, validation of findings, research communications, impact factor of journals.

REFERENCES:

Research Methodology	CR Kothari
Study and Communication Skills for the Biosciences	Stuart Johnson & Jon Scott

INSTRUCTION STRATAGIES

1. Interactions with the students to understand the level of students
2. Explaining & Discussing the major terminologies related to environment
3. Teaching the topics included in the syllabus with the help of teaching aids like OHP, LCD (Power point presentation), Notes, Question Banks, References and Reprints / Copy of Articles, Models, Diagrams
4. Assistance in solving of questions from our question bank.
5. Assistance in solving of questions asked in national entrance exams like CSIR –NET / other Universities.
6. Updating the recent developments in the field of Research Methodologies and Communications

TEACHING AND EXAMINATION

UNIT	Examination Scheme	% Weightage	Teaching Scheme	No. of Lectures
Unit 1		15		6
Unit 2		10		6
Unit 3		15		6
Unit 4		10		6
Unit 5		5		2
Unit 6		10		5
Unit 7		10		5
Unit 8		15		7
Unit 9		10		5
Total		100		48

**Department of Biotechnology
KADI SARVA VISHWAVIDYALAYA**

BT: 106 Practical

RATIONALE: This course is designed to enable students to acquire on hand practical knowledge of Good laboratory practices. Isolation, separation, purification and analysis of macromolecules by using different analytical techniques.

LEARNING OUTCOMES:

- Handling of Automated and latest versions of instruments and equipments used in Biotechnology laboratories and industries for upstream and downstream processing including Centrifugation, Electrophoresis & Chromatography
- Gain practical knowledge of techniques for isolation and purification of macromolecules
- Qualitative and Quantitative analysis of macromolecules by using spectroscopy and chromatography

TEACHING AND EVALUATION SCHEME: Each practical's listed in the syllabus will be explained and demonstrated in the laboratory. Students are evaluated based on the marks obtained in writing part as well as performance in the laboratory. General viva voce and subject viva voce will be conducted to analyze the knowledge of the student.

Subject Code	Subject Title	Credits	Practical				Total Marks	
			Hrs	Max Marks				
				Experiments & writing	Spots	Viva		Journal
BT 106	Practical	12	36	120	40	20	20	200

COURSE CONTENT

List of the Experiments
1. Good laboratory practices and management.
2. Introduction to Instruments that are routine used in the laboratory.
3. Basics of weights, measurements and preparation of standard solutions.
4. To isolate DNA from Animal source.
5. To isolate the DNA from a plant source.
6. To isolate the DNA from a Biological source.
7. Estimation of DNA by Diphenyl amine method.
8. To visualize the DNA samples by Agarose gel electrophoresis.
9. Isolation of proteins from plant source and its analysis.
10. Thin layer chromatography of fatty acids/lipids
11. Paper chromatography of carbohydrates by ascending technique.
12. Paper chromatography of carbohydrates by radial or circular paper chromatography.
13. Paper electrophoresis of amino acids.
14. To observe the effect of hypertonic, hypotonic and isotonic environment of human RBC.
15. Microscopic examination of bacteria and yeast by different staining methods.
- Monochrome staining
- Negative staining
- Gram's staining
- Acid fast staining
- Spore staining
- Capsule staining

List of the Experiments (Contd.)

16. Isolation, cultivation & identification of molds
17. Preparation of sterile liquid and solid media for growth of microorganisms.
18. Isolation and maintenance of organisms from soil by plating, streaking and serial dilution methods, slant and stab culture.
19. Purification of cultures, maintenance and preservation of pure cultures.
20. To study bacterial growth curve & factors affecting it.
21. Isolation and detection of Mitochondria from leaves.
22. Isolation and detection of Chloroplast from leaves.
23. To study different stages of Mitosis and Meiosis.
24. To determine the isoelectric point of amino acid – Glycine.
25. To estimate proteins in the given sample by Folin- Lowry's method.
26. To estimate proteins in the given sample by Biuret method.
27. To estimate the carbohydrate in the given sample by Anthrone method
28. Estimation of reducing sugar by DNSA method.
29. Isolation of casein from milk.
30. Isolation of lactose from milk.
31. Isolation of Urease enzyme from plant source.
32. Assay of Urease activity.
33. To study the enzyme kinetics (Amylase).
34. To perform standard substrate curve.
35. To study effect of substrate concentration on enzyme activity.
36. To study effect of pH on enzyme activity.
37. To study effect of Temperature on enzyme activity.
38. To study effect of Incubation time on enzyme activity.

REFERENCES:

An introduction to Practical Biochemistry	David T.Plummer
Biochemical Methods	S. Sadasivan & A. Manickam
Practical Biotechnology	R.S.Guad, G. D. Gupta, S.B.Gokhale
Methods In Enzymology	Shelby L Berger & Alan R. Kimmel
Molecular cloning :A Lab Manual	Sambrooks
Lab manual in analytical Biochemistry and separation techniques	P. Palanivelu
Experiments in Microbiology plant pathology , tissue culture and mushroom cultivation	K.R.Aneja
An introduction to Practical Biochemistry	David T.Plummer
Experimental Microbiology	R. J.Patel
Laboratory exercises in Microbiology	Harley Prescot
Laboratory manual in Biochemistry.	Jaynarayan

INSTRUCTION STRATEGIES

1. Explanation of Principles, protocols, expected result trends, handling of instruments and equipment, precautions and safety measures in the class and demonstration of important steps.
2. Monitoring of the students performing the experiments in the practical hall.
3. Evaluation of results of each experiment.

II SEMESTER

**Department of Biotechnology
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BT: 201- GENETIC ENGINEERING

RATIONALE: This course is designed to enable students in understanding the basics and applications of Genetic Engineering.

LEARNING OUTCOMES:

- Enabling the students to know and understand the basics, techniques and the applications of Molecular Cloning.
- Acquiring knowledge on PCR, DNA sequencing and Mutations and Mutagenesis.
- Understanding the Applications and Scope of Genetic Engineering.
- Understanding the concepts of Regulatory aspects.

TEACHING AND EVALUATION SCHEME: The objective of evaluation is not only to measure the performance of students, but also to motivate them for better performance. Students are evaluated on the basis of Mid Term examinations for 30 marks and End Term Examination conducted by University examination for 70 marks.

Subject Code	Subject Title	Credits	Theory			Total Marks
			Hrs.	Max Marks		
				Mid Term	End Term	
BT 201	Genetic Engineering	4	48	30	70	100

COURSE CONTENT

Section A

Unit 1	No. of Lectures: 2	Weightage:5%
Concept and emergence of r-DNA technology, Tools of r-DNA technology.		

Unit 2	No. of Lectures: 6	Weightage: 12%.
Restriction endonucleases, Modification methylases and other enzymes to modify the DNA.		

Unit 3	No. of Lectures: 8	Weightage:12%
Vectors – plasmids, bacteriophages, cosmids, phagemids, artificial chromosome vectors (YAC, BAC), Animal virus derived vectors - SV40 and retroviral vectors, Vectors in yeast and cloning in eukaryotes.		

Unit 4	No. of Lectures: 4	Weightage:12%
Molecular cloning, – isolation of DNA, Genomic DNA libraries, Shot gun gene cloning, cDNA libraries, full length cDNA cloning		

Unit 5	No. of Lectures: 2	Weightage:9%
Transformation of recombinant DNA, screening of recombinants, Southern, Northern and Western blotting,		

Section B

Unit 6	No. of Lectures: 5	Weightage: 15%.
Polymerase chain reaction and its applications, Sequencing of DNA – Maxam and Gilberts method, Sanger's method and other advances in sequencing, overview of chemical synthesis of oligonucleotides;		

Unit 7	No. of Lectures: 3	Weightage: 10%.
Mutation, Mutagens and Mutagenesis, techniques of in vitro mutagenesis, Site-directed mutagenesis.		

Unit 8	No. of Lectures: 12	Weightage: 15%
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Applications of genetic engineering: Transgenic microbes; Strain construction, production of recombinant pharmaceuticals; diagnosis of diseases, Chromosome walking, DNA finger printing, DNA foot printing, DNA microarrays.

Unit 9 **No. of Lectures: 2** **Weightage: 5%.**
Genetic engineering and Society – Social, ethical and legal aspects of genetic engineering; Regulatory mechanisms in releasing GMOs; Biosafety regulations.

Unit 10 **No. of Lectures: 2** **Weightage: 5%.**
 IPR; WTO; GATT & TRIPS; Genetic engineering in industries – international collaboration, national level policies on genetic engineering.

REFERENCES:

Recombinant DNA:	J.D.Watson <i>et. al.</i>
Genetic Engineering:	Sandya Mitra
Principles of Gene Manipulation	R.W.Old , Twyman M. & S.B.Primrose
Gene Cloning:	T. A. Brown
Molecular Biology LabFax I & II:	T. A. Brown
Biotechnology an Introduction:	Barnum Susan R
Concepts In Biotechnology	Balasubramanian D <i>et al</i>
Genetic Engineering	Smita Rastogi
Gene Biotechnology	S.N. Jogdand

INSTRUCTION STRATEGIES

1. Interactions with the students to understand the level of students
2. Explaining & Discussing the major terminologies related to environment
3. Teaching the topics included in the syllabus with the help of teaching aids like OHP, LCD (Power point presentation), Notes, Question Banks, References and Reprints / Copy of Articles, Models, Diagrams
4. Assistance in solving of questions from our question bank.
5. Assistance in solving of questions asked in national entrance exams like CSIR –NET / other Universities.
6. Updating the recent developments in the field of Molecular Biology

TEACHING AND EXAMINATION

UNIT	Examination Scheme% Weightage	Teaching Scheme	No. of Lectures
Unit 1	5		2
Unit 2	12		6
Unit 3	12		8
Unit 4	12		4
Unit 5	9		2
Unit 6	15		5
Unit 7	10		3
Unit 8	15		12
Unit 9	5		2
Unit 10	5		2
Total	100		48

**Department of Biotechnology,
KADI SARVA VISHWAVIDYALAYA**

BT: 202 IMMUNOLOGY

RATIONALE: This course is designed to enable students to acquire understanding of the structure of immune system, its functions and also gives awareness of various immunodeficiency diseases. The awareness of the immune system will help them for further work in the field of vaccine production and also drug designing especially against immunodeficiency diseases like AIDs

LEARNING OUTCOMES:

- Development of awareness of structure and function of immune system
- Steps involved in monoclonal production and its use in vaccine production
- Gain knowledge on the immune system during healthy and diseased status, malfunctioning of the immune system in immunological disorders (auto immune diseases, Hypersensitivities, immune deficiencies and also about transplant rejections)
- Enables the student to pursue further studies on immunotherapy and drugs / vaccine production for dreaded diseases

TEACHING AND EVALUATION SCHEME: The objective of evaluation is not only to measure the performance of students, but also to motivate them for better performance. Students are evaluated on the basis of Mid Term examinations for 30 marks and End Term Examination conducted by University examination for 70 marks.

Subject Code	Subject Title	Credits	Theory			Total Marks
			Hrs.	Max Marks		
				Mid Term	End Term	
BT 202	Immunology	4	48	30	70	100

COURSE CONTENT

Section A

Unit 1	No. of Lectures: 5	Weightage: 10%
Overview of the immune system: Innate and Adaptive immunity, Cells and organs of immune Systems.		

Unit 2	No. of Lectures: 4	Weightage: 10%
Antigens and super antigens, epitopes.		

Unit 3	No. of Lectures: 5	Weightage: 10%
Antigen-antibody interactions: Agglutination, precipitation, Complement fixation, Immuno-fluorescence, ELISA, Hybridoma technology: Introduction to Monoclonal antibodies and use of monoclonal antibodies in diagnostic kits. Vaccines: Different types of vaccines,		

Unit 4	No. of Lectures: 5	Weightage: 10%
Immunoglobulin: Structure and functions, Complement system.		

Unit 5	No. of Lectures: 5	Weightage: 10%
Cell mediated responses, Activation of T and B lymphocytes, Cytokines and their role, Hypersensitivity		

SectionB

Unit 6	No. of Lectures: 6	Weightage:10%
Generation of antibody diversity.		

Unit 7	No. of Lectures: 4	Weightage: 10%
B cell and T cell receptors, AIDS and other immuno deficiency diseases like: a. SCID, b. WAS c. Di George Syndrome, d. Ataxia telangiectasia, e. Chediak Higashi Syndrome, f. Chronic granulamatous diseases.		

Unit 8	No. of Lectures: 5	Weightage: 10%
MHC, antigen processing and presentation, Transplantation Immunology.		

Unit 9	No. of Lectures: 5	Weightage: 10%
Autoimmunity its mechanism and treatment with special reference to : a. Organ specific diseases (Addison's disease, Autoimmune hemolytic anaemia, Good pastures syndrome , Graves' disease , Hashimotos thyroiditis, Insulin dependent diabetes mellitus, Myasthenia gravis, Glomerular nephritis and Pernicious anaemia), b. Systemic diseases (Multiple sclerosis, Rheumatoid arthritis,SLE) Tumor immunology		

Unit 10	No. of Lectures: 4	Weightage: 10%
Immunity against infectious agents with special reference to: Virus: Influenza, Bacteria: Tuberculosis, Protozoans: Sleeping Sickness.		

REFERENCES:

Essential Immunology:	Ivan Roitt
Kuby's Immunology:	R.A.Goldsby, T.J.Kindt and B.A.Osborne
Immunology:	I.Roitt, Brostoff, Mole
Introductory Immunology:	How Davies
Immunology Introductory Text Book	Shetty Nandini

INSTRUCTION STRATEGIES.

1. Interactions with the students to understand the level of students
2. Explaining & Discussing the major terminologies related to Immunology
3. Teaching the topics included in the syllabus with the help of teaching aids like OHP, LCD (Power point presentation), Notes, Question Banks, References and Reprints / Copy of Articles, Models, Diagrams
4. Assistance in solving of questions from our question bank.
5. Assistance in solving of questions asked in national entrance exams like CSIR –NET / other Universities.
6. Up gradation on recent developments in the field of Immunology.

TEACHING AND EXAMINATION

UNIT	Examination Scheme	% Weightage	Teaching Scheme	No. of Lectures
Unit 1	10		5	
Unit 2	10		4	
Unit 3	10		5	
Unit 4	10		5	
Unit 5	10		5	
Unit 6	10		6	
Unit 7	10		4	
Unit 8	10		5	
Unit 9	10		5	
Unit 10	10		4	
Total	100		48	

**Department of Biotechnology
KADI SARVA VISHWAVIDYALAYA**

BT: 203 - BIOPROCESSING AND BIOCHEMICAL ENGINEERING

RATIONALE: The course imparts knowledge of production processes, infrastructure & techniques for manufacture of Biotechnology products from microorganisms, plants and animals and waste management from the manufacturing plants.

LEARNING OUTCOMES:

- Development of awareness of various processing operational systems of Biotechnological Industries
- Enabling the students to monitor the various physical and chemical parameters during Fermentation processes.
- Generation of knowledge of Industrial products related to production aspects.

TEACHING AND EVALUATION SCHEME: The objective of evaluation is not only to measure the performance of students, but also to motivate them for better performance. Students are evaluated on the basis of Mid Term examinations for 30 marks and End Term Examination conducted by University examination for 70 marks.

Subject Code	Subject Title	Credits	Theory			Total Marks
			Hrs.	Max Marks		
				Mid Term	End Term	
BT 203	BIOPROCESSING & BIOCHEMICAL ENGINEERING	4	48	30	70	100

COURSE CONTENT

Section A

Unit 1	No. of Lectures: 5	Weightage: 10%
Introduction to Fermentation & Bioprocess Technology. Growth phases, secondary metabolite pathways. Influence of environmental factors on growth and product formation. Growth kinetics: Microbial growth cycle, measurement of growth.		

Unit 2:	No. of Lectures: 6	Weightage: 10%
Screening, preservation and improvement of industrially important microorganisms.		

Unit 3:	No. of Lectures: 5	Weightage: 10%
Fermentation substrates and media formulation for inoculum development and for fermentation processes.		

Unit 4:	No. of Lectures: 5	Weightage: 10%
Elements of biochemical engineering, Bioreactor design; Solid state / Submerged cultivation; Batch, fed batch and continuous cultivation.		

Unit 5:	No. of Lectures: 5	Weightage: 10%
Sterilization of media reactor and air; Agitation and aeration and mass transfer of oxygen in different types of Bioreactors; additions and sampling;		

Section B

Unit 6	No. of Lectures: 5	Weightage: 10%
Control of process parameters: measurement of process parameters like pH, temperature, DO, foam etc.		

Unit 7	No. of Lectures: 4	Weightage: 10%
Instruments in process control, two position and proportionate control, biosensors and enzyme probes, microprocessor based control systems.		

Unit 8	No. of Lectures: 6	Weightage: 10%
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Downstream processing: Cell separation, Cell disintegration, product purification.

Unit 9 **No. of Lectures: 4** **Weightage: 10%**
Enzyme technology: Immobilization of enzymes, Enzyme reactors & bioconversion.

Unit 10 **No. of Lectures: 5** **Weightage: 10%**
Effluents and Waste treatment: Scale up of bioprocesses, Bioprocess economics, Investment decision and Entrepreneurship development

REFERENCES:

Principles of Fermentation Technology:	A.Whitekar, P.F. Stanbury & S.J.Hall
Comprehensive Biotechnology:	M.Moo-Young (Ed)
Methods in Industrial Microbiology:	G.Sikyta
Industrial Microbiology:	L.E.Casida
Biochemical Engineering Fundamentals	J.E.Bailey & D.F.Ollis
Microbial Technology	H.J.Peppler & D. Perlman (Ed)
Prescott & Dunn's Industrial Microbiology	G. Reed
Fermentation Technolgoy	HA Modi
Industrial Microbiology	A.H.Patel
Textbook of Biltechnology	W. Crueger and A. Crueger
Industrial Microbiology: An Introduction	M Waites ,N Morgan , J Rockey and G Higton

INSTRUCTION STRATEGIES

1. Interactions with the students to understand the level of students
2. Explaining & Discussing the major terminologies related to environment
3. Teaching the topics included in the syllabus with the help of teaching aids like OHP, LCD (Power point presentation), Notes, Question Banks, References and Reprints / Copy of Articles, Models, Diagrams
4. Assistance in solving of questions from our question bank.
5. Assistance in solving of questions asked in national entrance exams like CSIR –NET / other Universities.
6. Updation on recent developments in the field of environment.

TEACHING AND EXAMINATION

UNIT	Examination Scheme	% Weightage	Teaching Scheme	No. of Lectures
Unit 1	10		5	
Unit 2	10		6	
Unit 3	10		5	
Unit 4	10		5	
Unit 5	10		5	
Unit 6	10		5	
Unit 7	10		4	
Unit 8	10		6	
Unit 9	10		4	
Unit 10	10		5	
Total	100		48	

**Department of Biotechnology
KADI SARVA VISHWAVIDYALAYA**

204: COMPUTER APPLICATIONS, BIOSTATISTICS AND BIOINFORMATICS

RATIONALE: This course is designed to enable students to acquire the knowledge of Biostatistics and Computer and their applications in analysis of results of research in Biosciences, and compilation and utilization of Biotechnology data through Bioinformatics.

LEARNING OUTCOMES:

- Development of awareness of use of computers in the field of biology.
- Enabling the students to use statistical and bioinformatics softwares.
- Development of knowledge of deriving reproducible and acceptable conclusions of the research problems with the help of Biostatistics.
- Development of knowledge of Biological Databases and techniques to develop new biotechnology products for mankind.

TEACHING AND EVALUATION SCHEME: The objective of evaluation is not only to measure the performance of students, but also to motivate them for better performance. Students are evaluated on the basis of Mid Term examinations for 30 marks and End Term Examination conducted by University examination for 70 marks.

Subject Code	Subject Title	Credits	Theory			Total Marks
			Hrs.	Max Marks		
				Mid Term	End Term	
BT 204	Computer applications, Biostatistics and Bioinformatics	4	48	30	70	100

COURSE CONTENT

Section A

Unit 1	No. of Lectures:6	Weightage: 13%
Definitions and scope of Biostatistics: Variable in biology, Sampling Techniques and data collection, classification and tabulation of data. Graphical and diagrammatic representation, histogram, frequency polygon, frequency curve.		

Unit 2	No. of Lectures:6	Weightage: 14%
Descriptive statistics: Measures of central tendency – Mean (arithmetic, harmonic and geometric), Median and Mode. Measures of dispersion – Standard deviation and standard errors		

Unit 3	No. of Lectures:3	Weightage: 5%
Elements of probability theory. Probability distributions – binominal and Poisson distribution, Measures of Asymmetry		

Unit 4	No. of Lectures:3	Weightage: 5 %
Correlation coefficient, Simple linear regression		

Unit 5	No. of Lectures:6	Weightage:13%
Basic idea of significance test. Statistical hypotheses, types of errors, level of significance, Student's t, chi-square, goodness of fit and F tests.		

Section B

Unit 6	No. of Lectures: 3	Weightage: 10%
History, development and types of computers: General awareness of computer systems – hardware and software (CPU and other peripheral devices, computer arithmetic, computer logic		

Unit 7	No. of Lectures: 5	Weightage: 8 %
Programming languages – machine language, assembly language, higher level languages).		

Unit 8	No. of Lectures: 4	Weightage: 7 %
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graphics, statistical packages – MINITAB, MATLAB etc

Unit 9 **No. of Lectures:6** **Weightage: 10 %**
Bioinformatics: Introduction to bioinformatics. Use of nucleic acid and protein data banks – NCBI, EMBL, DDBJ, SWISSPORT.

Unit 10 **No. of Lectures:6** **Weightage: 15%**
Pairwise sequence alignment, Multiple sequence alignment. Gene prediction. Genome analysis and phylogenetic prediction.

REFERENCES:

Computers Today:	D. H. Sanders
Developing Bioinformatics Computer Skills	C. Gibas and P. Jamback.
Bioinformatics A machine learning approach	P. Baldi & S. Brunak
Bioinformatics: A Practical guide to the analysis of genes and Proteins	A. D. Bzxevanis and B. F. F. Onellette
Bioinformatics Methods and protocols: Methods in molecular biology Vol. 132:	S. Misenes and S. A. Krawetz (Eds)
Fundamentals of Statistics	S. C. Gupta.
Biostatistics	S. Prasad

INSTRUCTION STRATEGIES

1. Interactions with the students to understand the level of students
2. Explaining & Discussing the major terminologies related to environment
3. Teaching the topics included in the syllabus with the help of teaching aids like OHP, LCD (Power point presentation), Notes, Question Banks, References and Reprints / Copy of Articles, Models, Diagrams
4. Assistance in solving of questions from our question bank
5. Assistance in solving of questions asked in national entrance exams like CSIR –NET / other Universities.
6. Updation on recent developments in the field of environment.

TEACHING AND EXAMINATION

UNIT	Examination Scheme	% Weightage	Teaching Scheme	No. of Lectures
Unit 1		13		6
Unit 2		14		6
Unit 3		5		3
Unit 4		5		3
Unit 5		13		6
Unit 6		10		3
Unit 7		08		5
Unit 8		07		4
Unit 9		10		6
Unit 10		10		6
Total		100		48

**Department of Biotechnology,
KADI SARVA VISHWAVIDYALAYA**

BT: 205 Practical

RATIONALE: This course is designed to enable students to acquire on hand practical knowledge of production and processing of metabolites, Isolation of microbes useful for industry, mainly those producing enzymes. These practicals make the students capable and competent to work in the Biotechnology related industries.

LEARNING OUTCOMES:

- Acquire knowledge of microbes useful for various industries like, pharmaceuticals, food, textiles etc.
- Practical knowledge on diagnosis of various diseases like AIDS, Syphilis ,typhoid etc
- Knowledge of Antibiotics and other Pharmaceuticals, their processing and steps to ensure Quality and Good Manufacturing Practices
- Students will acquire knowledge on various enzymes, immobilization of enzymes and their utility.

TEACHING AND EVALUATION SCHEME: Each practical's listed in the syllabus will be explained and demonstrated in the laboratory. Students are evaluated based on the marks obtained in writing part as well as performance in the laboratory. General viva voce and subject viva voce will be conducted to analyze the knowledge of the student.

Subject Code	Subject Title	Credits	Practical				Total Marks	
			Hrs	Max Marks				
				Experiments & writing	Spots	Viva		Journal
BT 206	Practical	12	36	120	40	20	20	200

COURSE CONTENT

List of the Experiments	
1	To determine the blood group of given sample.
2	To study Preparation of O antigen and H antigen from <i>Salmonella typhi</i> .
3	To detect the presence of antigen using WIDAL agglutination test.
4	To Perform Sandwich ELISA test
5	To Perform VDRL test for syphilis
6	To study Antigen-antibody interaction by using Oucaterlony Double Diffusion (ODD) technique.
7	To study Ag-Ab interaction by Immuno-electrophoresis.
8	To Isolate Amylase producing microorganisms from soil.
9	To Isolate Protease producing microorganisms from soil.
10	To Isolate Lipase producing microorganisms from soil.
11	To perform Screening of antibiotic producing microorganisms from soil.
12	To perform screening of organic acid producing microorganisms from soil.
13	To perform standard Citric acid estimation by titrimetric method.
14	To perform estimation of Reducing and Non-reducing sugar by Cole's method.
15	To perform fermentative production of Citric acid. -
16	To perform gel entrapment of yeast cells and determination of invertase activity of immobilized yeast cells.
17	To estimate RNA by orcinol method.
18	To isolate DNA from <i>E. coli</i> .
19	To isolate plasmid DNA from <i>E. coli</i> culture.
List of the Experiments (Contd.)	
20	To visualize the DNA samples by Agarose gel electrophoresis.
21	To separate proteins using SDS PAGE

22	To perform restriction digestion.
23	Ligation of digested DNA.
24	Transformation and selection of recombinants.
25	Isolation of RNA from biological source.
26	To study the Measures of Central Tendency
27	To study the Measures of Dispersion
28	To study the Measures of Relationship
29	To study the Test of Significance
30	Probability test
31	Creating a spreadsheet using the following information.
32	Type in the given spreadsheet, and formats
33	Using Excel's AND, OR, and NOT Functions
34	Using Excel's IF Function
35	To study the Statistical Functions In Excel
36	To calculate the averages for the given conditions for the data.
37	To perform paired t- test.
38	To study the Graphs in excel
39	To study operators in c program
40	Dot-matrix comparison – understanding sliding window – window size (word size) and stringency
41	Pairwise alignment
42	Multiple sequence alignment
43	Searching DNA databases with FASTA and BLAST
44	Searching protein sequence databases with FASTA and BLAST
45	Making Patterns (prosite syntax) and consensus sequence from multiple sequence alignments
46	Understanding ORF and gene prediction
47	Protein structure visualization
48	Secondary structure prediction online

REFERENCES:

Laboratory Manual in Environmental Engineering	P. D. Kulkarni
Experimental Microbiology	Rakesh Patel and Kiran Patel
Laboratory Manual and workbook on Microbiology	J. A. Morello, P. A. Granato, H.E.Mizer
Laboratory Exercises in Microbiology	J.P. Harley & L.M. Prescott
Laboratory Manual in Industrial Biotechnology	P. Chellapandi
Practical Biotechnology	R. S. Gaud, G. D. Gupta and S. B. Gokhale
Medical Microbiology	R. Cruickshank, J.P.Duguid, B.P.Marmion and RHA Swain
Microbiological Applications: A Laboratory Manual in General Microbiology	H.J. Benson
Biostatistics	S. Prasad
Molecular cloning: A laboratory manual, 2 nd ed.	Sambrook, J., Fritsch, E.F., Maniatis, T.

INSTRUCTION STRATEGIES

1. Explanation of Principles, protocols, expected result trends, handling of instruments and equipments, precautions and safety measures in the class and demonstration of important steps.
2. Monitoring of the students performing the experiments in the practical hall.
3. Evaluation of results of each experiment.

III SEMESTER

**Department of Biotechnology
KADI SARVA VISHWAVIDYALAYA**

BT: 301-MICROBIAL TECHNOLOGY

RATIONALE: The course imparts knowledge of production processes, techniques and utility of Biotechnology products from microorganisms in various areas including food, beverages, health & medicine, fuels, energy and environment.

LEARNING OUTCOMES:

- Development of awareness of commercial exploitation of microorganisms.
- Enabling the students to understand and explore the use of microbes for the benefit of mankind.
- Generation of knowledge of commercially important microbes and microbial products and fermented foods.
- Acquiring of knowledge of “green and ecosafe” microbial processes and technologies based on renewable sources

TEACHING AND EVALUATION SCHEME: The objective of evaluation is not only to measure the performance of students, but also to motivate them for better performance. Students are evaluated on the basis of Mid Term examinations for 30 marks and End Term Examination conducted by University examination for 70 marks.

Subject Code	Subject Title	Credits	Theory			Total Marks
			Hrs.	Max Marks		
				Mid Term	End Term	
BT 301	Microbial Technology	4	46	30	70	100

COURSE CONTENT

Section A

Unit 1	No. of Lectures: 3	Weightage: 5%
General concepts of Microbial Technology, Principles of exploitation of microbial biodiversity: Extremophiles, primary and secondary metabolism.		
Unit 2	No. of Lectures: 8	Weightage:15%
Microbial production of: Enzymes: Proteases, Amylases; Vitamins: Vit. B ₁₂ , Vit.B ₂ ; Amino acids: Glutamic acid, Lysine		
Unit 3	No. of Lectures:8	Weightage:15
Microbial production of: Antibiotics: Penicillin, Streptomycin; Organic acids: Citric acid, acetic acid;; Polysaccharides, Alkaloids; Microbial Transformations of Steroids.		
Unit 4	No. of Lectures: 3	Weightage: 5%
Microbial production of Alcoholic beverages: beer, wine, sake		
Unit 5	No. of Lectures: 2	Weightage: 10%
Microbial production of Food and Dairy products: Single cell proteins; Cheese, bread and yoghurt, Mushroom cultivation.		

Section B

Unit 6	No. of Lectures: 8	Weightage: 15%
Algae: as a source of food, feed, industrial uses of algae. Mass cultivation of commercially valuable marine macroalgae for agar, alginates and other products of commerce and their uses; Mass cultivation of microalgae as a source of proteins, feed & oils.		
Unit 7	No. of Lectures: 5	Weightage: 10%
Biofertilizers: Nitrogen fixation and biofertilizers - Blue-green algae, Azolla - mass production for practical applications, Mycorrhizae - importance in agriculture and forestry.		

Biopesticides

Unit 9 Biopolymers and bioplastics	No. of Lectures: 2	Weightage: 5%
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Unit 10 Bio-fuels, Microbial Enhanced Mineral & Oil Recovery process.	No. of Lectures: 5	Weightage: 10%
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Reference Books:

Industrial Microbiology: Introduction Biotechnology	M. J. Waites, N. L. Morgan, J. S. Rockey, G. Higton HJ Rehm & G I Reed
Comprehensive Biotechnology	Ed M Moo Young
Economic Microbiology	A H Rose
Microbial Technology	H.J.Peppler & D. Perlman (Ed)
Concepts In Biotechnology	Balasubramanian D <i>et al</i>
Microbial Biotechnology:	Alexander N. Glazer & Hiroshi Nikaido (Ed.)
The Desk Encyclopedia of Microbiology:	M. Schaechter (ed.)
Industrial Microbiology:	L. E. Casida
Text Book of Industrial Microbiology:	W Creuger & A Creuger

INSTRUCTION STRATEGIES

1. Interactions with the students to understand the level of students
2. Explaining & Discussing the major terminologies related to environment
3. Teaching the topics included in the syllabus with the help of teaching aids like OHP, LCD(Power point presentation), Notes, Question Banks, References and Reprints / Copy of Articles, Models, Diagrams
4. Assistance in solving of questions from our question bank .
5. Assistance in solving of questions asked in national entrance exams like CSIR –NET / other Universities.
6. Updation on recent developments in the field of environment.

TEACHING AND EXAMINATION

UNIT	Examination Scheme	% Weightage	Teaching Scheme	No. of Lectures
Unit 1		5		3
Unit 2		15		8
Unit 3		15		8
Unit 4		5		3
Unit 5		10		2
Unit 6		15		8
Unit 7		10		5
Unit 8		10		4
Unit 9		5		2
Unit 10		10		5
Total		100		48

**Department of Biotechnology
KADI SARVA VISHWAVIDYALAYA**

BT: 302 - PLANT BIOTECHNOLOGY

RATIONALE: This course is designed to enable students to acquire the knowledge of plant tissue culture and techniques in plant transgenics. The study also includes the role of markers in genetic transformation and application of plant biotechnology to develop commercially important plants.

LEARNING OUTCOMES:

- Developing an understanding towards fundamentals of plant biotechnology
- Generation of capacity to design and perform experiments of Plant tissue culture and Plant transformation
- Enabling students to understand types, advantages and disadvantages molecular markers
- Development of capacity to formulate application of plant biotechnology for production of commercial transgenic plants

TEACHING AND EVALUATION SCHEME: The objective of evaluation is not only to measure the performance of students, but also to motivate them for better performance. Students are evaluated on the basis of Mid Term examinations for 30 marks and End Term Examination conducted by University examination for 70 marks.

Subject Code	Subject Title	Credits	Theory			Total Marks
			Hrs.	Max Marks		
				Mid Term	End Term	
BT 302	Plant Biotechnology	4	48	30	70	100

COURSE CONTENT

Section A

Unit 1 Conventional Plant Breeding: Introduction to cell and tissue culture; Tissue culture as technique to produce novel plants and hybrids. Tissue Culture Media (Composition & Preparation); Sterilization in tissue culture.	No. of Lectures: 3	Weightage: 6%
Unit 2 Initiation and maintenance of callus and suspension cultures; Single cell clones; Organo-genesis; Somatic embryogenesis; Shoot tip culture; Rapid clonal propagation and production of virus-free plants; Embryo culture and embryo rescue ; Transfer and establishment of whole plants in soil.	No. of Lectures: 6	Weightage: 16%
Unit 3 Anther, pollen and ovary culture for production of haploid plants and homozygous lines. Somaclonal variation.	No. of Lectures: 3	Weightage: 6%
Unit 4 Protoplast Isolation And Fusion: Protoplast isolation, culture and fusion; Selection of hybrid cells and regeneration of hybrid plants; Symmetric and asymmetric hybrids, cybrids. Cryopreservation.	No. of Lectures: 6	Weightage: 10%
Unit 5 Markers: Types their advantages and disadvantages Molecular markers – RFLP, RAPD, AFLP map based cloning, Molecular marker assisted selection.	No. of Lectures: 6	Weightage: 12%

Section B

Unit 6 Plant Transformation Technology Basis of tumor formation; Features of Ti and Ri plasmids; Mechanisms of DNA transfer; Role of virulence genes; Use of Ti and Ri as vectors; Binary vectors; Use of 35 S and other promoters; Genetic markers; Use of reporter genes; Methods of nuclear transformation; Viral vectors and their applications	No. of Lectures: 7	Weightage: 14%
Unit 7 Vector-less or direct DNA transfer; Particle bombardment, Electroporation, Microinjection	No. of Lectures: 4	Weightage: 8%
Unit 8	No. of Lectures: 2	Weightage: 5%

Transformations.

Unit 9 **No. of Lectures: 8** **Weightage: 18%**
Application of Plant Biotechnology & Commercial Transgenic plants : Herbicide resistance, insect resistance, Bt genes, disease resistance, virus resistance, antifungal proteins, nematode resistance, abiotic stresses.

Unit 10 **No. of Lectures: 3** **Weightage: 5%**
Successes: Metabolic engineering and industrial products – Plant secondary metabolites, Control mechanisms and manipulation of phenyl propanoid pathway, shikimate pathway

REFERENCE:

Biotechnology in Crop Improvement	H.S.Chawla.
An Introduction to Plant Tissue Culture	M.K.Razdan.
Handbook of Plant Cell Culture (Vols. 1 to 4)	Evans <i>et. al.</i>
Plant Tissue and Cell Culture	H.E.Street
Applied and Fundamental Aspects of Plant Cell Tissue and Organ Culture	J.Reinert&Y.P.S.Bajaj (Eds)
Principles of Plant Biotechnology: An Introduction to Genetic Engineering in Plants	S.H.Mantellet. <i>al.</i>
Plant Propagation by Tissue Culture	E.F.George, M.A.Hall& G-J de Klerk (Eds.)
Cell Culture and Somatic Cell Genetics of Plants	A.K.Vasil

INSTRUCTION STRATEGIES

1. Interactions with the students to understand the level of students
2. Explaining & Discussing the major terminologies related to environment
3. Teaching the topics included in the syllabus with the help of teaching aids like OHP, LCD (Power point presentation), Notes, Question Banks, References and Reprints / Copy of Articles, Models, Diagrams
4. Assistance in solving of questions from our question bank .
5. Assistance in solving of questions asked in national entrance exams like CSIR –NET / other Universities.
6. Updation on recent developments in the field of environment.

TEACHING AND EXAMINATION

UNIT	Examination Scheme	% Weightage	Teaching Scheme	No. of Lectures
Unit 1	06		3	
Unit 2	16		6	
Unit 3	06		3	
Unit 4	10		6	
Unit 5	12		6	
Unit 6	14		7	
Unit 7	08		4	
Unit 8	05		2	
Unit 9	18		8	
Unit 10	05		3	
Total	100		48	

KADI SARVA VISHWAVIDYALAYA
Department of Biotechnology

BT: 303 – ANIMAL CELL SCIENCE AND TECHNOLOGY

RATIONALE: This course is designed to enable students to acquire understanding of animal cell culture related to the biotechnology maintenance of high standards for good scientific practice, The aim of this Good Cell Culture Practice (GCCP) initiative is to reduce uncertainty in the development and application of *in vitro* procedures, by encouraging the establishment of principles for the greater standardization of laboratory practices, nomenclature, quality control systems, safety procedures and reporting, where appropriate, to the application of the principles of Good Laboratory Practice (GLP).

LEARNING OUTCOMES:

- Development of awareness of ethical issues related to the use of embryonic stem cells for cell culturing.
- The course aims to help students learn basic tissue culture methods and techniques enabling them to monitor the animal cell culture.
- Generation of knowledge of regeneration medicine and tissue engineering and ways to fix the damaged tissues with the desired functions quickly restored.
- Efforts for maintenance of cell and tissue culture in large scale so as to produce many valuable products for human health.

TEACHING AND EVALUATION SCHEME: The objective of evaluation is not only to measure the performance of students, but also to motivate them for better performance. Students are evaluated on the basis of Mid Term examinations for 30 marks and End Term Examination conducted by University examination for 70 marks.

Subject Code	Subject Title	Credits	Theory			Total Marks
			Hrs.	Max Marks		
				Mid Term	End Term	
BT 303	Animal Cell Science and Technology	4	48	30	70	100

COURSE CONTENT

Section A

Unit 1 Animal cell: structure and organization.	No. of Lectures: 2	Weightage: 4
Unit 2 Cell culture Laboratory design & Equipments: Planning, construction and services; Layout; Sterile handling area; Aseptic concepts; Maintenance of sterility; Cell culture vessels.	No. of Lectures: 4	Weightage: 12%
Unit 3 Different types of cell culture media: constituents, Role of CO ₂ ; Role of serum and supplements. Serum Free Media. Serum and protein free defined media and their applications.	No. of Lectures:5	Weightage: 12%
Unit 4 Animal cell line and viability testing. Primary and established cell line cultures. Measurement of viability and cytotoxicity. Measurement of cell death. Apoptosis.	No. of Lectures: 8	Weightage: 12%
Unit 5 Biology and characterization: Biology of Animal Cells: Cellular Interactions and characterization of the cultured cells, measuring parameters of growth.	No. of Lectures: 5	Weightage: 10%
Section B		
Unit 6 Culturing & Sub-Culturing of Animal Cells. primary culture; and maintenance; In Vitro Transformation: Cell Differentiation, Cell cloning Cell synchronization; Cell transformation.	No. of Lectures: 8	Weightage: 12%
Unit 7 Stem cell technology: Stem cell cultures, embryonic stem cells and their applications.	No. of Lectures: 3	Weightage: 8%
Unit 8	No. of Lectures: 4	Weightage: 8%

dimensional culture **Tissue engineering:** Design and engineering of tissues - tissue modeling. Embryonic stem cell engineering

Unit 9 **No. of Lectures: 3** **Weightage: 8%**
Embryo transfer technology: *In-vitro* fertilization. Transfer of genes: micro injection, electroporation and liposome mediated transformation.

Unit 10 **No. of Lectures: 6** **Weightage: 14%**
Scale-up: Cell culture reactors; Perfusion cultures; Fluidized bed reactors, Scale-up in monolayers; Multisurface propagators; Multiarray disks, spirals and tubes; Roller culture; Microcarriers; Perfused monolayer cultures; Membrane perfusion; Hollow fiber perfusion; Matrix perfusion; Microencapsulation; Growth monitoring, Cell culture based vaccines.

REFERENCE:

Culture of Animal Cells:	R. I. Freshney
Animal Cell Culture – Practical Approach	J. R. W. Masters (Eds)
Animal Cell Culture Techniques:	M. Clynes (Ed)
Biotechnology:	U. Satyanarayana
Animal Cell Biotechnology Methods and Protocols,	Ralf Pörtner
Cell Culture:	M. Butler and M. Dawson (Eds)
Cell Growth and Division: A Practical Approach	R. Basega (Ed)
Methods in Cell Biology, Vol. 57: Animal Cell Culture Methods:	J.P. Mather and D. Barnes (Eds)

INSTRUCTION STRATEGIES.

1. Interactions with the students to understand the level of students
2. Explaining & Discussing the major terminologies related to environment
3. Teaching the topics included in the syllabus with the help of teaching aids like OHP, LCD (Power point presentation), Notes, Question Banks, References and Reprints / Copy of Articles, Models, Diagrams
4. Assistance in solving of questions from our question bank.
5. Assistance in solving of questions asked in national entrance exams like CSIR –NET / other Universities.
6. Updation on recent developments in the field of environment.

TEACHING AND EXAMINATION

UNIT	Examination Scheme	% Weightage	Teaching Scheme	No. of Lectures
Unit 1		4		2
Unit 2		12		4
Unit 3		12		5
Unit 4		12		8
Unit 5		10		5
Unit 6		12		8
Unit 7		8		3
Unit 8		8		4
Unit 9		8		3
Unit 10		14		6
Total		100		48

**Department of Biotechnology
KADI SARVA VISHWAVIDYALAYA**

BT: 304 - ENVIRONMENTAL BIOTECHNOLOGY

RATIONALE: This course is designed to enable students to acquire understanding of environmental pollution related to the biotechnology products and their management as well as the eco-safe management of environmental disturbances caused by any other issues. The study also includes the role of microbes, flora & fauna in maintaining the global ecological / environmental balance.

LEARNING OUTCOMES:

- Development of awareness of environment related issues.
- Enabling the students to monitor the environmental pollution.
- Generation of knowledge of Global warming and greenhouse gases and ways to reduce atmospheric concentrations of with the goal of "preventing dangerous anthropogenic interference with Earth's climate system".
- Efforts for maintenance of pollution free environment.

TEACHING AND EVALUATION SCHEME: The objective of evaluation is not only to measure the performance of students, but also to motivate them for better performance. Students are evaluated on the basis of Mid Term examinations for 30 marks and End Term Examination conducted by University examination for 70 marks.

Subject Code	Subject Title	Credits	Theory			Total Marks
			Hrs.	Max Marks		
				Mid Term	End Term	
BT 304	Environmental Biotechnology	4	48	30	70	100

COURSE CONTENT

Section A

Unit 1	No. of Lectures:2	Weightage: 10%
Environment: basic concepts and issues.		

Unit 2	No. of Lectures: 3	Weightage: 10%
Environmental pollution: Types of pollution and its measurement, Methodology of environmental management, Problem solving approach and its limitations. Air pollution and its control through Biotechnology.		

Unit 3	No. of Lectures: 3	Weightage: 10%
Water pollution and its control through Biotechnology. Water as a scarce natural Resource, need for water management, Measurement of water pollution, COD, BOD, sources of water pollution. Microbiology of water and Public health.		

Unit 4	No. of Lectures: 8	Weightage: 10%
Waste Water Treatment -Physical, chemical and biological treatment processes. Microbiology of waste water treatments Aerobic & Anaerobic processes, Bio-Gas .		

Unit 5	No. of Lectures: 8	Weightage: 10%
Treatment schemes for various industrial waste waters: Dairy, Distillery, Tannery, Sugar, Antibiotic industry.		

Section B

Unit 6	No. of Lectures: 10	Weightage: 10%
Microbiology of degradation of Xenobiotics in environment (Ecological consideration, Decay behavior and degradative plasmids): Degradation of Hydrocarbons, Substituted hydrocarbon, Oil pollution, Surfactants, Pesticides.		

Unit 7	No. of Lectures:4	Weightage: 10%
Global environmental problems, their impact and biotechnological approaches for management Ozone depletion, UV_B, Green house effect, Acid rains.		

Unit 8	No. of Lectures: 4	Weightage: 10%
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methods Phytoremediation .

Unit 9 **No. of Lectures: 4** **Weightage: 10%**
Biopesticides in Integrated Pest management.

Unit 10 **No. of Lectures: 4** **Weightage: 10%**
Solid waste : Sources and management, Composting, Vermiculture, Methane production.

REFERENCES:

Waste Water Treatment for Pollution Control:	Arceivala.
Environmental Microbiology:	R. M. Maier, I. L. Pepper & G. P. Gerba
Comprehensive Biotechnology, Vol. 4	M. Moo-Young (Ed)
Biotechnology:	H.J.Rehm and J.I.Reid (Eds)
Environmental Microbiology and Biotechnology	Singer Samuel
Biotechnology for Waste and Wastewater Treatment	Nicholas P. Cheremisinoff,
Environmental Biotechnology Theory and Application	Gareth M. Evans & Judith C. Furlong
The Desk Encyclopedia of Microbiology	M. Schaechter (ed.)

INSTRUCTION STRATEGIES

1. Interactions with the students to understand the level of students
2. Explaining & Discussing the major terminologies related to environment
3. Teaching the topics included in the syllabus with the help of teaching aids like OHP, LCD (Power point presentation), Notes, Question Banks, References and Reprints / Copy of Articles, Models, Diagrams
4. Assistance in solving of questions from our question bank .
5. Assistance in solving of questions asked in national entrance exams like CSIR –NET / other Universities.
6. Updation on recent developments in the field of environment.

TEACHING AND EXAMINATION

UNIT	Examination Scheme	% Weightage	Teaching Scheme	No. of Lectures
Unit 1		10		2
Unit 2		10		3
Unit 3		10		3
Unit 4		10		8
Unit 5		10		8
Unit 6		10		10
Unit 7		10		4
Unit 8		10		4
Unit 9		10		2
Unit 10		10		4
Total		100		48

**Department of Biotechnology
KADI SARVA VISHWAVIDYALAYA**

BT: 305 - PHARMACEUTICAL BIOTECHNOLOGY

RATIONALE: The course provides knowledge on the utility of Biotechnology products & techniques useful as medicines / diagnostics including the recombinant DNA products.

LEARNING OUTCOMES:

- Development of knowledge of Biopharmaceuticals, their development, designing, formulation and manufacturing.
- Enabling the students to monitor the change from chemical drugs to Biopharmaceuticals.
- Generation of knowledge of various commercialized Biopharmaceuticals and their Regulatory processes
- New upcoming technologies based on Biotechnology for disease prevention and control.

TEACHING AND EVALUATION SCHEME: The objective of evaluation is not only to measure the performance of students, but also to motivate them for better performance. Students are evaluated on the basis of Mid Term examinations for 30 marks and End Term Examination conducted by University examination for 70 marks.

Subject Code	Subject Title	Credits	Theory			Total Marks
			Hrs.	Max Marks		
				Mid Term	End Term	
BT 305	Pharmaceutical Biotechnology	4	48	30	70	100

COURSE CONTENT

Section A

Unit 1	No. of Lectures:4	Weightage: 10%
The Drug Development Process for Biopharmaceuticals, Microbial, Recombinant, Biochemical and Molecular level screening systems and their construction/ design strategies		

Unit 2:	No. of Lectures:- 4	Weightage: 5%
High throughput drug screening technology, Receptor versus enzyme mediated drug action.		

Unit 3	No. of Lectures:	Weightage: 5%
Dosage forms, Formulations and delivery routes for Biopharmaceuticals.		

Unit 4	No. of Lectures:8	Weightage: 20%
Microbial products as drugs: Therapeutic Proteins- Cytokines, Enzymes, Growth Hormones, Blood Factors, Monoclonal Antibodies, vaccines, immuno-modulators as drugs/diagnostic agents. Other microbial products in therapeutics.		

Unit 5	No. of Lectures:4	Weightage: 10%
Novel drugs through enzymatic conversion of chemical drugs, Microbes as models of Mammalian drug metabolism.		

Section B

Unit 6	No. of Lectures: 8	Weightage: 20%
Manufacturing of Biopharmaceuticals including dosage forms, Q.A. measures & SOPs.		

Unit 7	No. of Lectures:6	Weightage: 10%
Phytochemicals / Animal based Biopharmaceuticals: Stem Cells, Gene and Cell Therapy.		

Unit 8	No. of Lectures:2	Weightage: 5%
Molecular Pharming		

Unit 9	No. of Lectures:8	Weightage: 15%
Pharmaco-genetics and its impact on drug therapy, Regulatory aspects of Biopharmaceuticals		

REFERENCES:

Hugo and Russel's Pharmaceutical Microbiology:	
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Pharmaceutical Biotechnology: Drug Discovery & Clinical Applications:	O. Kayser & R.H. Muller
Biopharmaceuticals:	Jogdand, S.N
Molecular Biotechnology Therapeutic applications and Strategies	M. Sunil and P.D Salil
Pharmaceutical Biotechnology	S.P.Vyas and D.V. Kohli
Comprehensive Biotechnology	KG Ramawat & Shaily Goyal
Pharmaceutical Biotechnology Fundamentals & Applications	DJ Crommelin RD Sindler & Meibohm
Medical Biotechnology	P. Nallari & V V Rao

INSTRUCTION STRATEGIES

1. Interactions with the students to understand the level of students
2. Explaining & Discussing the major terminologies related to environment
3. Teaching the topics included in the syllabus with the help of teaching aids like OHP, LCD (Power point presentation), Notes, Question Banks, References and Reprints / Copy of Articles, Models, Diagrams
4. Assistance in solving of questions from our question bank.
5. Assistance in solving of questions asked in national entrance exams like CSIR –NET / other Universities.
6. Updation on recent developments in the field of environment.

TEACHING AND EXAMINATION

UNIT	Examination Scheme	% Weightage	Teaching Scheme	No. of Lectures
Unit 1		10		4
Unit 2		5		4
Unit 3		5		4
Unit 4		20		8
Unit 5		10		4
Unit 6		20		8
Unit 7		10		6
Unit 8		5		2
Unit 9		15		8
Total		100		48

**Department of Biotechnology,
KADI SARVA VISHWAVIDYALAYA**

BT: 306 Practical

RATIONALE: This course is designed to enable students to acquire on hand practical knowledge of organisms utilized for biotechnology products, particularly microbial fermentation processes, environmental pollution, analysis of quality of water and pharmaceutical products.

LEARNING OUTCOMES:

- Gain knowledge of fermented foods like cheese, alcohol and yoghurt and their processing and Quality Assessment.
- Practical knowledge on Spawn production and mushroom cultivation.
- Knowledge of Antibiotics and other Pharmaceuticals, their processing and steps to ensure Quality and Good Manufacturing Practices
- Students will acquire knowledge on how to analyze water samples of drinking water and industrial effluents

TEACHING AND EVALUATION SCHEME:. Each practical's listed in the syllabus will be explained and demonstrated in the laboratory. Students are evaluated based on the marks obtained in writing part as well as performance in the laboratory. General viva voce and subject viva voce will be conducted to analyze the knowledge of the student.

Subject Code	Subject Title	Credits	Practical				Total Marks	
			Hrs	Max Marks				
				Experiments & writing	Spots	Viva		Journal
BT 306	Practical	12	36	120	40	20	20	200

COURSE CONTENT

List of the Experiments
1. Bacteriological examination of water
2. Isolation of Coliphages from raw sewage
3. Detection of Coliform by membrane filter method
4. Determination of Chemical Oxygen demand of water
5. Determination of Dissolved Oxygen of Water
6. Determination of Biochemical Oxygen Demand of Water
7. Measurement of Total Solids, Suspended Solids and Dissolved Solids in a given sample of Water and Waste Water
8. Measurement of Acidity in given Water Sample
9. Measurement of Alkalinity of the given Water Sample
10. Determination of the Hardness of Water
11. Measurement of Sulfate in Water Sample
12. Determination of Chlorides concentration (Mohr's method)
13. Determination of Orthophosphate
14. Isolation of symbiotic nitrogen fixing bacteria <i>Rhizobium</i>
15. Estimation of alcohol
16. Production of alcohol by yeast
List of the Experiments (Contd.)
17. Production of Yogurt in laboratory
18. Production of Cheese in laboratory
19. Determination of antagonistic (antifungal) activity of microorganisms

20. Mushroom Spawn Production Technology
21. Aseptic culture techniques for establishment and maintenance of cultures
22. Preparation of stock solutions of MS basal medium and plant growth regulator stocks
23. Standardization of method of Surface Sterilization of Potato Tubers
24. Standardization of sterilants for surface sterilization of various explant materials
25. Generation of tissue cultured plants through Micro-propagation from potato tubers
26. Callus culture development from carrot plants
27. Plant regeneration from callus
28. Single cell culture <i>Bergmann's plating technique</i>
29. Single cell culture using microchamber technique
30. Isolation of Protoplasts from plant leaves- Enzymatic method
31. Isolation of single cells from plant leaves- mechanical method.
32. Isolation of single cells from plant leaves- Enzymatic method
33. Immobilization of isolated plant cells by entrapment
34. Study of antifungal secondary metabolites produced by plants
35. Sterilization & instruments in an animal tissue culture laboratory
36. Media Preparation for Animal Tissue Culture

REFERENCES:

Laboratory manual in environmental engineering	P.D.Kulkarni
Experiments in Microbiology plant pathology , tissue culture and mushroom cultivation	K.R.Aneja
Laboratory manual and workbook on Microbiology	J.A.Morello,P.A.Granato,H.E.Mizer
Laboratory exercises in Microbiology	Harley Prescott
Microbiological Applications: A Laboratory Manual in General Microbiology	H.J. Benson
Practicals in Plant Biotechnology	H.S.Chawla
Animal Cell Biotechnology Methods & Protoocols	Rolf Portner

INSTRUCTION STRATERGIES

1. Explanation of Principles, protocols, expected result trends, handling of instruments and equipments, precautions and safety measures in the class and demonstration of important steps.
2. Monitoring of the students performing the experiments the practical hall.
3. Evaluation of results of each experiment.

IV SEMESTER

**Department of Biotechnology,
KADI SARVA VISHWAVIDYALAYA
BT: 401-BIOTECHNOLOGY BUSINESS MANAGEMENT**

RATIONALE: The course provides in depth knowledge & skills for the successful management of Business of Biotechnology products.

LEARNING OUTCOMES:

- Development of knowledge of Biotechnology Business, establishment, working, regulation and good management.
- Enabling the students to understand the administration, human resource, purchase, materials, accounts & financing and marketing concepts for Biotechnology industries.
- Generation of knowledge of various Regulatory processes, Laws, IPR Issues and Ethics
- Understanding of Acceptance of Biotechnology products, Biosafety and Bioterrorism.

TEACHING AND EVALUATION SCHEME: The objective of evaluation is not only to measure the performance of students, but also to motivate them for better performance. Students are evaluated on the basis of Mid Term examinations for 30 marks and End Term Examination conducted by University examination for 70 marks.

Subject Code	Subject Title	Credits	Theory			Total Marks
			Hrs.	Max Marks		
				Mid Term	End Term	
BT 305	Biotechnology Business Management	4	48	30	70	100

COURSE CONTENT

Section A

Unit 1	No. of Lectures: 12	Weightage: 20%
<p>Biotechnology: Multidisciplinary science, public perception, Biotechnology Companies, Business areas and priorities.</p> <p>Accounting and Finance: Decision on starting a venture; Assessment of feasibility of a given venture/new venture; Sources of financial assistance; Making a business proposal /Plan for seeking loans from financial institution and Banks; Funds for capital expenditure and for working. Statutory and legal requirements for starting a company/venture; Budget planning and cash flow management; concepts of balance sheet, Estimation of income, expenditure, profit, tax etc.</p> <p>Marketing: Assessment of market demand for potential product(s) of interest; Prediction of market changes; Developing distribution channels; Pricing /Competition; Promotion/ Advertising</p>		

Unit 2:	No. of Lectures:- 12	Weightage: 30%
<p>Negotiations/Strategy: With financiers, bankers etc.; With Government/law enforcement authorities; With companies/ Institutions for technology transfer; Broader vision– Global thinking</p> <p>Information Technology: Use of IT for business administration, better financial and inventory management; E-business setup,</p> <p>Human Resource Development (HRD): Leadership skills; Team building, teamwork; Appraisal.</p> <p>Role of knowledge centre and R&D: Role of technology and up gradation; Managing Technology Transfer; Regulations for transfer of foreign technologies; Technology transfer agencies/ Academia and research institutions</p>		

Section B

Unit 3:	No. of Lectures:- 12	Weightage: 25%
Intellectual property rights: Intellectual property rights: Meaning – Classification and forms, Importance of IPRs in the fields of science and technology, Patents – Concepts and principles of patenting – Patentable subject matter Types of patents; Indian Patent Act 1970; Recent WIPO Treaties; Patent application forms and guidelines, International patenting-requirement, Publication of patents-gazette of India, status in Europe and US, credit sharing, Rights of patents – Infringement of patent rights, remedies for infringement of patent rights.		

Unit 4:	No. of Lectures:- 12	Weightage: 25%
Biosafety & Regulation: Introduction; Primary Containment for Biohazards; Biosafety Levels; Biosafety Levels of Specific Microorganisms; Recommended Biosafety Levels for Infectious Agents and Infected Animals; Biosafety guidelines - Government of India; Roles of Institutional Biosafety Committee, RCGM, GEAC etc. for GMO applications in food and agriculture; Environmental release of GMOs; Cartagena Protocol		
Bioethics: Introduction – causes of unethical acts, ignorance of laws, codes, policies and procedures, ethical values to scientists, good laboratory practices, good manufacturing practices, laboratory accreditation		

REFERENCES:

Comprehensive Biotechnology	KG Ramawat & Shaily Goyal
Economic Analysis of Fermentation Processes	Reissman
Management of Pharmaceutical Industry	

INSTRUCTION STRATEGIES

1. Interactions with the students to understand the level of students
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5. Assistance in solving of questions asked in national entrance exams like CSIR –NET / other Universities.
6. Updation on recent developments in the field of environment.

TEACHING AND EXAMINATION

UNIT	Examination Scheme	%weightage	Teaching Scheme	No. of Lectures
Unit 1		20		12
Unit 2		30		12
Unit 3		25		12
Unit 4		25		12
Total		100		48

BT: 402- DISSERTATION

- Project work and Dissertation must be based on Applied aspects of Biotechnology, including Pharmaceuticals, Agriculture, Dairy & Food Processing, Environmental Issues and Bioinformatics.

- Semester IV students will be on Industrial Training at Industry / Research Institution / Department during entire term for Project Work and Dissertation. The Students have to devote 6 days, 8 hours per day at the work place that may be an Institute, Industry, Department and Hospital Laboratory.

- The Students will have to undergo continuous interaction and one evaluation of progress by a team of Departmental experts. A student who has undergone such evaluations only will be entitled to present his complete project work to the University for Exam.

- The University End Term Practical Examination will be carrying 300 marks divided as underneath and shall be conducted by One external expert along with an Internal expert:
 - Thesis Write up : 100 marks
 - Thesis Content : 100 marks
 - Thesis Presentation : 50 marks
 - Viva Voce : 50 marks

- Area of Final Project can be any of the following :
 - Biopharmaceuticals,
 - Biofertilizers,
 - Biopesticides
 - Enzymes
 - Biofuels,
 - Diagnostic Procedures
 - Dairy & Food Processing,
 - Tissue Culture
 - Bioremediation,
 - Bioleaching,
 - Pollution Abatement,
 - Extremophiles
 - Biological Effluent Treatment
 - Environmental Issues and
 - Bioinformatics.