M.Sc. Biotechnology Course Contents

Semester I							
Course Code	**Course**	**L**	**T**	**P**	**Hrs.**	**Cr.**	**Marks**
MS101	Biochemistry	3	1	2	6	6	150
MS102	Microbiology	3	1	2	6	6	150
MS103	Cell Biology	3	-	2	5	5	150
MS104	Introduction to Mathematics & Biostatistics	3	-	-	3	3	100
MS105	Bioanalytical Techniques	3	-	2	5	5	150
TOTAL		15	2	8	33	25	700

Course Code: MS 101 **Total Lecture Hr.= 48**

Course Title: Biochemistry **L T P Hr C**

Marks: 100 **3 1 0 4 4**

Objective

The objective of this course is:

- To create general understanding about bio-molecules their synthesis, metabolism and interactions in relation to living systems.
- To familiarize the student with basic concepts in bioenergetics and lipid metabolism.

Learning outcome

At the end of the course, the students will have sufficient scientific understanding of the basic concepts in biochemical processes. This would enable him to understand use of biochemical methods in understanding synthesis of various producs

Prerequisites

This is an introductory course at the masters level. Graduate level knowledge of chemistry and life sciences is sufficient.

Course Description:

Sr. No.	Topics	Detail syllabus	No. of lectures
1	**Bioenergetics** (Introduction)	• First and second law of thermodynamics, internal energy, enthalpy, entropy, concept of free energy, standard free energy change of a chemical reaction, redox potentials, ATP and • High-energy phosphate compounds	6
2		• Elecron transport chain oxidative phosphorylation, energetics of oxidative posphorylation, energy yield by complete oxidation of glucose.	4
3	Lipid Metabolism:	• Biosynthesis of lipids: Requirements of carbon dioxide and citrate for biosynthesis, Formation of Malonyl CoA • Fatty acid synthase complex. • Regulation of biosynthesis. • Fatty acid oxidation**:** Phases of fatty acid oxidation, • Digestion mobilization & transport of fatty acids mobilization of stored triglycerides by hormones activation of fatty acids and their transport in mitochondria. • β-oxidation of saturated and unsaturated fatty acids • Formation of ketone bodies, energetic of β-	6

		oxidation.	
4	Triglycerides and phospholipids biosynthesis:	• Biosynthesis of triacylglycerides, membrane phospholipids, prostaglandin • Phosphoinositol triphosphate, PDGF (Platelet derived growth factor) Bile salts, fat-soluble vitamins • Biosynthesis of cholesterol and steroid hormones	4
5	Glycogen metabolism	• Biosynthesis and degradation of glycogen and its regulation. • Starch and cellulose biosynthesis.	4
6	Biosynthesis and degradation of amino acids	• Conversion of nitrogen to NH4 by microorganisms, Conversion of ammonia into amino acids by way of glutamate & glutamine, Conversion of citric acid intermediates to amino acids, glutamate as precursor of glutamine, proline & arginine, Conversion of 3-phosho glucerate to serine, synthesis of cystein from serine & homocystein. , Biosynthesis of aromatic acids and one carbon atom transfer by folic acid	8
7	Biosynthesis and degradation of purine, pyrimidine nucleotides, regulation	• Purine biosynthesis: formation of PRPP, Biosynthesis of IMP, Purine nucleotide interconversions, Regulation of purine biosynthesis • Pyrimidine biosynthesis: assembly of the pyrimidine nucleus, synthesis of di & tri phosphates, formation of deoxy ribonucleotides, thymine biosynthesis, Salvage pathway • Degradation of purines & pyrimidines , uric acid & urea	6
	Integrationof etabolism & hormonal regulation of mammalian metabolism	• Integrationof etabolism & hormonal regulation of mammalian metabolism	4

Methodology

The course will be covered through lectures supported by tutorials. In tutorials, apart from the discussion on the topics covered in lectures, assignments in the form of questions will be given. Normally a students is expected to complete the assignment by himself, however if needed, difficulties will be discussed in the tutorial classes. There will be two class tests/ and surprise test conducted during the tutorial classes.

Evaluation Scheme (theory)

Examination	**Duration**	**Marks**
Minor test 1	1 hours	15
Minor test 2	1 hours	15
Tutorials & Home assignment		10
Major test at the end of semester	3 hours	60
Total		**100**

Books recommended:

- The principles of Biochemistry By Nelson Cox
- Metabolic Pathways By Greenbrg
- Biochemistry by Lubert Stryer 3 rd Edition By W.H. Freeman and Co.
- Biochemistry By G. Zubay, Addision Wesly Publication [1988]
- Biochemistry by J.L.Jain
- Biochemistry by Voet and Voet

Course # MS 102 **Total Lecture Hr.= 48**

General Microbiology and Virology **L T P Hr C**

Marks:100 **3 1 0 4 4**

Objective

The objective of this course is:

- To create general understanding about distribution, classification and life cycleof microorganisms.
- To familiarize the student with protozoa, viruses, cultivation of microorganism, sterilization techniques..

Learning outcome

At the end of the course, the students will be familiar with microbial technology. This would help him to launch himself in industrial biotechnology which is the fastest growing industry in the developing country.

Prerequisites

This is an introductory course. Graduate level knowledge of life sciences is sufficient for undertaking this course.

Course Description:

Sr. No.	Topics	Detail syllabus	No. of lectures
1	Distribution ,classification and life cycles:	• Distribution ,classification and life	4
2	Classes of Microorganisms	• Bacteria, • Fungi • Anaerobes • Cyanobacteria	6
3	Protozoa and Viruses	• Protozoa and Viruses (animal, plant bacteriophages etc.,)	4
4	Ultra structure of microorganisms	• Ultra structure of microorganisms	4
5	Cultivation of Microorganism	• Cultivation, propagation and preservation of Microorganisms	4
6	Sterilization	• Sterilization	4
7	Industrially important microbes	• Industrially important microbes, secondary metabolites • Biotransformation • ethanol production	6
8	Antibiotics,	• Antibiotics, Biochemistry of drug resistance	4
9	Extremophiles	• Extremophiles	4
10	Viral replication:	• Viral replication: Nucleic acid and protein synthesis	4
11	Viral diagnostics and viral vaccines	• Viral diagnostics and viral vaccines	4

Methodology

The course will be covered through lectures using power point presentations and overhead projectors. There would self learning component as also presentations by the students. .In tutorials, there would be discussion on the topics. There will be two class tests/ and home assignments.

Evaluation Scheme (theory)

Examination	Duration	Marks
Minor test 1	1 hours	15
Minor test 2	1 hours	15
Tutorials & Home assignment		10
Major test at the end of semester	3 hours	60
Total		100

Books recommended:

- General Microbiology: Vol. I & 2 by Powar & Daginawala
- Microbiology by Pelczar
- Microbiology by Prescott
- General Microbiology by Stanier
- Instant notes in Microbiology by Nicklin.
- Principle of Fermentation technology by Stanbury & Witter

Course # MS 103 **Total Lecture Hr. = 48**

Course Titte: Cell Biology **L T P Hr C**

Marks: 100 **3 0 0 3 3**

Objective

The objective of this course is:

- To create general understanding about cell division, cell cycle, cell organelles, cell signaling and differences in plant and animal cells.

Learning outcome

At the end of the course, the students will be familiar with cell science and cell-cell interaction. This would help him to take further courses in biotechnology in the subsequent semesters.

Prerequisites

This is an introductory course. Graduate level knowledge of life sciences is sufficient for undertaking this course.

Course Description:

Sr. No.	Topics	Detail syllabus	No. of lectures
1	Cell	• Diversity • Structural and functional organization, • Ultra structure	**6**
2	Prokaryotic, plant and animal cell	• Prokaryotic, plant and animal cell	**4**
3	Cell Organelles	• Cytoskeleton, subcellular organelles and chromosomes	**4**
4	Cell division and Cell cycle	• Cell division and Cell cycle	**4**
5	Intracellular compartments and protein trafficking	• Intracellular compartments and protein trafficking	**6**
6	Biomembranes and electrophysiology	• Biomembranes and electrophysiology	**4**
7	Cell signaling	• Cell surface, hormone receptors • Signal transduction • Secondary messengers	**6**
8	Cell- cell interaction and cell matrix interaction	• Cell- cell interaction and cell matrix interaction	**4**
9	Cell differentiation and Apoptosis	• Cell differentiation • Apoptosis	**4**
10	Plant cell:	• Plastids, • Cytosenescence, • Cytoquiescence	**6**

Methodology

The course will be covered through lectures using power point presentations and overhead projectors. There would be special discussion componet in teaching. Students would be divided in groups and quiz competitions would be held. This would teach them group activity. .In tutorials, there would be discussion on the topics. There will be two class tests/ and home assignments.

Evaluation Scheme (theory)

Examination	Duration	Marks
Minor test 1	1 hours	15
Minor test 2	1 hours	15
Tutorials & Home assignment		10
Major test at the end of semester	3 hours	60
Total		100

Books recommended:

- Cell and Molecular Biology by De Robertis.
- Molecular Biology of Cell by Bruce Alberts 2002.
- The cell by Cooper 2000
- Cell Biology, Genetics, Molecular Biology, Evolution and Ecology by P. S Verma and VK Agarwaal. Publisher S. Chand and Comp. 2005
- Cell Biology by Powar

Course # MS 104 **Total Lecture Hr.= 48**

Course Ttle: Biomathematics **L T P Hr C**

Marks:100 **3 0 0 3 3**

Objective

The objective of the course is to familiarize the student with basic concepts in mathematics & statistics

Learning outcome

At the end of the course, the students will have sufficient understanding of different mathematics and statistical tools used in Biotechnology. This knowledge would be applicable in different industries

Prerequisites

Students should be familiar with school level mathematics to take up this course. In case they do not have mathematics at the twelfth level they would be helped by the teacher.

Course Description:

Sr. No.	Topics	Detail syllabus	No. of lectures
1	Biomathematics:	**Fundamentals of set theory** • Limits of functions, derivatives of function • Logarithm • Permutation combination, Binomial theorem • Differentiation (first order), partial differential equations • Integration • Matrix algebra: Addition, subtraction, multiplication • Transpose inverse, and conjugate of matrix etc.	**8**
2	Bio-Statistics: Introduction	• Scope, application and use of statistics, • Collection and classification of data, • Census and sampling graphs and diagrams, • Arithmetic mean, median standard deviation	**6**
3	Correlation and regression**:**	• For ungrouped data, scatter diagram, • Calculation and interpretation of correlation coefficient	**6**

		• linear regression coefficient, nonlinear relationshiptransformable to linear.	
4	Population parameters and sample statistics	• Sample techniques, simple random sampling • stratified random sampling, systematic sampling, and • standard error of mean	**6**
5	Estimation, point and interval, confidence interval for population mean and proportion.	• Estimation, • Point and interval, • Confidence interval for population • mean and proportion	**6**
6	Hypothesis testing	• Type I and Type II errors levels of significance**,** • One-tiled and two-tailed tests, • Application to single mean and single proportion , • Equality of population means and two population proportions	**6**
7	Chi square test for independent attribute in R x C table, special case of 2 x 2 table	• Chi square test for independent attribute in R x C table, • special case of 2 x 2 table	**4**
8	Variance ratio, F-test, Fishers Z test, ANOVA	• Variance ratio, • F-test, • Fishers Z test, • ANOVA	**6**

Methodology

The course will be covered through lectures and assignments. They would be given problems to solve in the class room on the board where every body can participate. There will be two class tests/ and home assignments. They would be taught the use of statistical software.

Evaluation Scheme (theory)

Examination	Duration	Marks
Minor test 1	1 hours	15
Minor test 2	1 hours	15
Tutorials & Home assignment		10
Major test at the end of semester	3 hours	60
Total		100

Books recommended:

- Statistic by S. G. Gupta
- Statistical Method in Biology by Bailey.
- Mathematics for Biological Science by Jagdish Arya and Ladner.
- Numerical methods by E. Balguruswamy.
- Statistics from biologist by Campbell.

Course # MS 105 **Total Lecture Hr.= 48**

Course Title: Introduction to Analytical Techniques **L T P Hr C**

Marks:100 **3 0 0 3 3**

Objective

The objective of the course is to create general understanding of pH measurement, microscopy, spectroscopy, calorimetry, electrophoresis, CD & ORD spectroscopy, X-ray crystallography, sequencing methods, mass spectrography

Learning outcome

At the end of the course, the students will have sufficient scientific understanding of the basic concepts in instrumentation used in Biotechnology. This is essential because he would be using these techniques in forth coming semestyers.

Prerequisites

This is an introductory course. School level knowledge of physics is sufficient. There are no prerequisites**.**

Course Description:

Sr. No.	Topics	Detail syllabus	No. of lectures
1	Microscopy	• Light Microscopy, Compound Microscopy. • Phase Contrast, Interference Contrast and Confocal Microscopy. • Ultraviolet and Fluorescence Microscopy. Electron Microscopy	
2	Colorimetry and Spectroscopy	• Introduction: Properties of electromagnetic radiation, interaction with matter. • Difference between spectrophotometer and colorimeter. • Visible light spectroscopy: Principle, instrumentation and applications. Ultraviolet spectroscopy. Infrared spectroscopy	
3	Centrifugation	• Introduction: Basic principles of sedimentation • Types of centrifuges Design of centrifuges: Types of rotors • Ultracentrifuge Analytical and Preparatory • Applications.	
4	Separation Techniques Chromatography	Chromatography • Introduction: Chromatography theory and practice.	

		• Paper chromatography. • Thin layer chromatography. • Ion exchange chromatography. • Affinity chromatography. • Partition chromatography. • Adsorption chromatography. • Introduction to GC, HPLC and FPLC. • Permeation. Electrophoresis • Introduction: General principle, support media. • Agarose gels, polyacrylamide gels. • SDS PAGE, 2D PAGE • Pulsed field gel electrophoresis • Iso-electric focusing • Capillary electrophoresis	
5	Introduction to CD and ORD	• Introduction to CD and ORD	
6	X-ray Crystallography and Diffraction	• X-ray Crystallography and Diffraction	
7	Introduction to ESR, NMR and Mass Spectroscopy GCMS, MSMS, LSMS	• Introduction to ESR, • NMR and Mass Spectroscopy • GCMS, MSMS, LSMS	
8	Macromolecular Sequencer	• DNA and protein sequencers • Separation of proteins by 2D and 3D protein sequencers	

Methodology

The course will be covered through lectures and assignments. They would be given problems to solve in the class room on the board where every body can participate. There will be two class tests/ and home assignments. They would be taught the use of statistical software.

Evaluation Scheme (theory)

Examination	Duration	Marks
Minor test 1	1 hours	15
Minor test 2	1 hours	15
Tutorials & Home assignment		10
Major test at the end of semester	3 hours	60
Total		100

Books recommended:

- Practical Biochemistry – Wilson and Walker.
- A Biologist's guide to principle and techniques of practical biochemistry –Wilson and Golding.
- Principles of Instrumentation-Skoog.
- Analytical Chemistry- Anand and Chatwal.
- Analytical Chemistry – David Friefelder

MS106A Practicals in (Biochemistry)

MS106B Practicals in Microbiology

MS106C Practicals in Cell Biology

MS 106D Practicals in Analytical Techniques

Semester III							
Course Code	**Course**	**L**	**T**	**P**	**Hrs.**	**Cr.**	**Marks**
MS301	Genetic Engineering	3	1	-	4	4	100
MS302	Enzymology and Enzyme Technology	3	1	2	6	6	150
MS303	Bioprocess Technology and Bioengineering	3	1	2	6	6	150
MS304	Biosafety, Bioethics and IPR	2	-	-	2	2	100
MS305	Elective Course*	3	-	2	5	5	100
TOTAL		14	3	12	23	23	

Elective courses:

- Biopharmaceuticals
- Food Biotechnology
- Environmental Biotechnology
- Clinical research
- Molecular modeling and Drug Designing

Title of the Course: Genetic Engineering

Course code: MS-301	**L**	**T**	**P**	**Hr**	**C**
Marks: 100	**3**	**1**	**0**	**4**	**4**

Objective

To familiarize the student with emerging field of biotechnology i.e. Recombinant DNA Technology As well as create understanding and expertise in wet lab techniques in genetic engineering.

Learning outcome

At the end of the course, the students will have sufficient scientific understanding of the subject and have good knowledge of application of Recombinant DNA techniques in Life Sciences Research.

Prerequisites

Knowledge of molecular biology is sufficient.

Course Description

Sr. No.	**Topics**	**Detail syllabus**	**Hrs**
1	Introduction	Landmarks in Molecular biology and biotechnology, Advantages of using microorganisms, What is genetic engineering and recombinant DNA technology, Control of gene expression and gene complexity in prokaryotes and eukaryotes., Genetic engineering in *Ecoli* and other prokaryotes, yeast, fungi and mammalian cells	10
2	Tools in genetic engineering	Enzymes- DNA polymerases, restriction endonucleases, ligases, reverse transcriptases, nucleases, terminal transferases, phosphatases etc. Cloning vectors-plasmids, bacteriophage vectors,cosmids,phagemids,vectors for plant and animal cells, shuttle vectors, YAC vectors, expression vectors etc.	6
3	Gene cloning	Isolation and purification of DNA (genomic, plasmid) and RNA,, Isolation of gene of interest- restriction digestion, electrophoresis, blotting,, Cutting and joining of DNA,, Methods of gene transfer in prokaryotic and eukaryotic cells, Recombinant selection and screening methods- genetic, immunochemical, South-western analysis, nucleic acid hybridization, HART, HRT, Expression of cloned DNA molecules and maximization of expression, Cloning strategies- genomic DNA libraries, cDNA libraries, chromosome walking and jumping.	10
4	Recombinant DNA techniques	Blotting Techniques, Autoradiography,	10

		Hybridization, Molecular Probes and Nucleic acid labeling , DNA sequencing, PCR, Mutagenesis, Analysis of gene expression , DNA fingerprinting, RAPD, RFLP, AFLP.	
5	Applications of Recombinant DNA technology		02
6	Protein interaction technology	Two-hybrid and other two component systems, Detection using GST fusion protein, co-immunoprecipitation, FRE etc.	04
7	Gene therapy	In vivo approach, ex-vivo approach Antisense therapy, Transgenics.	02
8	Genetic disorders-Diagnosis and screening	Prenatal diagnosis, Single nucleotide polymorphisms, DNA microarrays, Future strategies.	02
9	The Human Genome Project	The Human Genome Project details.	02
Total Lectures			48

Methodology

The course will be covered through lectures supported by tutorials, PowerPoint presentations, research articles and practical. In tutorials, apart from the discussion on the topics covered in lectures, assignments in the form of questions will be given. Normally a students is expected to complete the assignment by himself, however if needed, difficulties will be discussed in the tutorial classes. There will be two class tests/ and surprise test conducted during the tutorial classes.

Evaluation Scheme (theory)

Examination	**Duration**	**Marks**
Minor test 1	1 hours	15
Minor test 2	1 hours	15
Tutorials & Home assignment		10
Major test at the end of semester	3 hours	60
Total		100

Books Recommended:

- Biotechnology-Fundamentals and Applications- SS Purohit
- Principles of gene manipulation-Old and Primrose
- Gene Biotechnology-Jogdand
- Molecular Biology-Twyman
- Principles of genetics-Klug
- Molecular Biology of the gene-Watson
- Molecular Cloning (Vol 1,2,3)-Sambrook and Russell

Title of the Course: Enzymology & Enzyme Technology

Course code: MS-302	**L**	**T**	**P**	**Hr**	**C**
Marks: 100	**3**	**1**	**0**	**4**	**4**

Objective:

The objective of the course is to familiarize the student with enzymes, their kinetics, purification and applications in different fields

Learning outcome

At the end of the course, the students will have sufficient scientific understanding of the enzymalogy. This knowledge would be applicable in different industries

Prerequisites

This is an introductory course in enzymology. School level knowledge of organic chemistry and Biology is sufficient. There are no prerequisites.

Course Description

Sr. No.	Topics	Detail syllabus	Hrs
1	Enzymes	Enzyme: Enzyme classification, enzyme properties. Coenzymes and Cofactors, and their roles. Enzyme substrate interactions. Active site identification - Chemical modification of active site amino acids.	6
2	Enzyme Kinetics & regulation of Enzyme action	Enzyme kinetics (Michaelis Menten equation). Inhibition-Enzyme, types and their kinetics. Mechanism of enzyme catalysis with reference to chymotrypsin, lysozyme, metalloenzyme and the role of metals in catalysis with reference to carboxypeptidases. Allosteric Enzymes. Ribozymes.	12
3	Enzyme purification	Source, methods of purification and criteria (amylases, lipases, proteases, renin, etc.) Role of immobilized enzymes.	06
4	Applications of enzymes in:	Food processing Medicine Diagnostics Production of new compounds As research tools (ELISA method) immobilized enzymes. Leather industry. Textile industry.	10
5	Enzyme technology	Enzymes as biosensors, enzyme engineering, artificial enzymes, future prospects for enzyme technology,	10

		recent advances in enzyme technology	
6	Spceific enzymes &Their applications	Thermozymes,Cold-adapted enzymes,Ribozymes,Hybrid enzymes,Diagnostic enzymes,Therapeutic enzymes	
Total Lectures			45

Methodology

The course will be covered through lectures supported by tutorials. In tutorials would discuss different applications of enezymes and methods of their extractions and purification. Students would be given assignments in the form of questions. Normally a students is expected to complete the assignment by himself, however if needed, difficulties will be discussed in the tutorial classes. There will be two class tests/ and surprise test conducted during the tutorial classes.

Evaluation Scheme

Examination	Duration	Marks
Minor test 1	1 hours	15
Minor test 2	1 hours	15
Tutorials & Home assignment		10
Major test at the end of semester	3 hours	60
Total		100

Books recommended:

- Fundamentals of Biochemistry by A. C. Deb.
- Introductory Practical Biochemistry by S. K. Sawhney, Randhir Singh.
- Biochemistry by Stryer.
- Biochemistry by Mathews.
- Biochemistry by Zubay.
- Biochemistry by Champ.
- Principles of Biochemistry by Nelson and Cox.
- Biochemistry by Rastogy.
- Text book of Enzymology by Nicolas Price and Lewis Stevens, 3rd edition, [Publishers Oxford University Press]

Title of the Course: Bioprocess Technology & Bioengineering
Course Code: MS-303 **L T P Hr C**
Marks: 100 **3 1 0 4 4**

Objective:

The objective of the course is to create general understanding amongst the students in the subject of Industrial Biotechnology through in-depth lectures & laboratory practicals. The objective of the course is to understand them a general overview, concepts and basic principles in the subject of Industrial Biotechnology with emphasis on how to apply the knowledge in bio processing engineering.

Learning outcome:

At the end of the semester, it is expected that students understood the basic principles of engineering knowledge to solve a critical problem. It is expected that they will be more confident to use the knowledge in pursuing Bioprocess knowledge in industrial biotechnological application.

Pre-requisites:

This is an introductory level course. Students are expected to have an understanding of introductory knowledge in Physics, Chemistry and Biology.

Course Description

Sr.No.	**Topics**	**Detail syllabus**	**No. of lectures**
1	Introduction	The component parts of a fermentation process Type of Bioreactors	4
2	Kinetics of microbial growth	Kinetics of growth in batch culture The ideal plug flow reactor The ideal continuous attired tank reactor Fed-batch culture	5
3	Measurement and control of Bioprocess parameters	Feed-back control Controller characteristics	4
4	Sterilization	Kinetics of cell death	2
5	Media design		3
6	Isolation, preservation and maintenance of industrial microorganisms	Isolation techniques Methods of preservation of culture	5
7	Downstream processing	Removal of microbial cells and solid matter Characterization of fermentation broths Sedimentation Centrifugation Filtration Precipitation	8

		Liquid-liquid extraction Chromatography Membrane process Drying and crystallization	
8	Whole cell immobilization and its industrial application	Advantages of whole cell immobilization Methods of immobilizing cells Biological films	4
9	Industrial production of chemicals	Production of ethanol production of organic solvents Production of organic acids Production of amino acids Production of antibiotics	6
10	Bioleaching	Types of leaching	4
		Total lecture	45

Methodology:

The course will be covered through lectures supported by tutorials and laboratory practicals. Students will be evaluated based on two class tests, lecture and laboratory attendance, class participation.

Evaluation Scheme:

Minor Test 1	1 Hour	15
Minor test 2	1 Hour	15
Class assignments		10
End Semester Examination	2 hr 30 min.	60
Total		100

Books Recommended

1 Principles of fermentation technology-Stanbury and Whitaker
2 Industrial microbiology-Casida
3 Industrial microbiology-Patel.

Title of the Course: Biosafety, Bioethics and Intellectual Property Rights

Course code: MS-304	**L**	**T**	**P**	**Hr**	**C**
Marks: 100	**2**	**0**	**0**	**2**	**2**

Objective of the course:

The objective of the course is to make students learn about the legal, safety and public policy issues raised due to the rapid progress in Biotechnology and development of new products. The biotechnology students suppose to understand and follow the regulatory framework important for the product safety and benefit for the society. The students are given case history to discuss and express their views.

Learning Outcome

At the end of the course, it is expected that students have understood the basic issues of Biosafety, Bioethics and IPR.IT is expected that they will be more confidant to practice and implement all these policies in their future endeavor.

Prerequisites

This is an advance level course. Students must have an understanding of introductory undergraduate level course such as chemistry, biology, microbiology, plant and animal biology and molecular biology.

Course Description

Seq. No	Topic	Description	Hrs
1	Biosafety	Introduction and Development of Biosafety Practices Principles General lab requirements Definitions and Biosafety levels: 1,2,3,4 Summery Biological safety cabinets: centrifuges, Shipment of biological specimens, Biological waste management, Decontamination, Biosafety manuals, Medical surveillance, Emergency response	18
2	Bioethics	History and Introduction Ethics and genetic engineering Genetic Privacy Patent of genes Human races Trading Human Life Human Cloning Stem Cells Eugenics Biotechnology and Christian faith Human genome and religious considerations Case Studies	16

		Final Considerations	
3	Intellectual Property Rights	Introduction Types of Intellectual Property Rights Plant and Animal growers rights Patents Trade secretes, Copyrights, Trademarks IPR and plant genetic recourses GATT and TRIPS and Dunkels Draft Patenting of biological materials International conventions and cooperation Current Issues Patents for higher animal and higher plants Patenting of transgenic organisms and isolated genes Patenting of genes and DNA sequences Indian scenario.	14
Total number of Lectures			**48**

Methodology

The course will be covered through lectures. The students will be given problems and case histories to discuss and clear their problems. The students will be evaluated based on two class tests, lecture and lab attendance, class participation, write up and quizzes.

Evaluation Scheme:

Minor Test 1	1 Hour	15
Minor test 2	1 Hour	15
Quizzes		10
End Semester Examination	2 hrs 30 min	60
Total		100

Books recommended:

1 Understanding Biotechnology by Borem
2 Biotechnology an Introduction: Barnum S.R.
3 Biosafety and Bioethics : Joshi
4 Introduction to Bioethics : Bryant
5 Legal Aspects of Business : Pathak
6 Intellectual Property Rights : Raju
7 Patent Law : Narayan
8 Intellectual Property Management : Jungham

Elective course:Title of the Course: Food Biotechnology **Total Hrs:48**

Course code: MS-305A **L T P Hr C**

Marks: 100 **3 0 0 3 3**

Objective of the course:

The objective of the course is to familiarize the students with advanced research area and basic concept in Food Biotechnology

Learning Outcome

At the end of the course, the students will have sufficient scientific understanding of different types of biotechnological methods to improve the value of different food and new techniques used in Food Biotechnology.

Prerequisites

Since the course is very advance in science, student must know about the new biotechnological and molecular genetics method which to apply in food. Student must have background with Biotechnological aspects and molecular genetics.

Course Description

Seq. No	**Topic**	**Description**	**Hrs**
1	Introduction to Food Biotechnology	Biotechnology application to food stuffs Career in Food Biotechnology Activities of Food Biotechnologist	02
2	Biotechnology in Food Processing	Unit Operation in Food Processing Quality Factors in Preprocessed Food Food deterioration and its control Rheology of Food products	14
3	Molecular methods and Production	Methods And application of molecular cloning in foods Developmental technique for new plant verities	06
4	Application of Biotechnology to Food products	Microbial role in food products Yeast, Bacterial and other microorganisms based process and products	16
5	Modification and Bioconversion of food raw materials	Bioconversion of whey, molasses and starch and other food waste for value addition	06
6	Regulatory and Social aspects of Food Biotechnology	Modern Biotechnological regulatory aspects in food industries Biotechnology and Food : A Social Appraisal	04
Total number of Lectures			48

Methodology

The course would be taught through lectures, demonstrations and practical**.**

Evaluation Scheme :

Minor Test 1	1 Hour	15
Minor test 2	1 Hour	15
Seminars		10
End Semester Examination	3 hours	60
Total		100

Books recommended:

1 Food Biotechnology: Dietrich Knorr,Inc.New York and Basel
2 Food Science: Potter N.N. CBS publication
3 Handbook of Food Biotechnology : NIIR Board of Consultants and Engg., NIIR
4 Food Science and Technology: B.S.Khattar,Daya Publishing House,Delhi
5 Biotechnology: B.D.Singh,Kalyani Publishers
6 Food Microbiology: Frazier

Title of the Course: Environmental Biotechnology

Course code: MS-305B	**L**	**T**	**P**	**Hr**	**C**
Marks: 100	**3**	**0**	**0**	**3**	**3**

Objective of the course:

The objective of the course is to familiarize the students with advanced research area and basic concept in Environmental Biotechnology

Learning Outcome

At the end of the course, the students will have sufficient scientific understanding of different types of biotechnological methods to improve environment value and new techniques used in Environmental Biotechnology.

Prerequisites

Since the course is very basic in science, student must know about the new biotechnological methods which to apply in environment. Student must have background with Biotechnological aspects and molecular genetics.

Course Description

Seq. No	**Topic**	**Description**	**Hrs**
1	Environment	Physical Environment Man induced impact on environment Global warming Depletion of ozone layer	03
2	Environmental Pollution	Types of Pollution Water pollution Soil Pollution Methods of Pollution Measurement Environment Management	06
3	Air pollution and its control	Active trace gases in air Aerosols in air Control of air pollution through biotechnology	06
4	Global water distribution and management	Measurement of water pollution Sources of water pollution Waste water collection	06
5	Microbiology of waste water treatment	Aerobic treatment Anaerobic treatment Antibiotics in waste water	06
6	Microbiology of	Xenobiotics in environment	06

	degradation of xenobiotics	Decay behavior of xenobiotics	
7	Bioremediation	Bioremediation of contaminated soil and waste water Role of genetic engineering	03
8	Solid waste management	Sources Composting ,vermiculture,methane production	06
9	Global Environmental Problems	Ozone depletion Global warming Acid rain	06
Total number of Lectures			48

Methodology
The course would be taught through lectures, demonstrations and practical.

Evaluation Methodology theory

Minor Test 1	1 Hour	15	
Minor test 2	1 Hour		15
Seminars			10
End Semester Examination	3 hours		60
Total			100

Books recommended:

- Textbook of Biotechnology-H.K.Das
- Textbook of Biotechnology-Purohit
- Biotechnology-Ignacimuthu

Title of the Course: Molecular modeling and drug designing

Course code: MS-305C **L T P Hr C**

Marks: 100 **3 0 0 3 3**

Objective

- To create general understanding regarding basic principles involved in modern medicinal/structural chemistry systems.
- To familiarize the student with basic concepts in molecular modeling as: how to build the molecule, how to find out the coordinates of the molecule, how to use the programs that are available in graphics designing.
- To familiarize students with concepts in molecular mechanics and dynamics and to study the energy minimization algorithms
- To introduce them to concepts in quantum chemistry and methods for calculating the energies, that are required in energy minimization and docking studies
- To understand the methodology involved in structure based drug designing, and enzyme inhibition strategies

Learning outcome

At the end of the course, the students will have sufficient scientific understanding of the basic concepts in classical and modern molecular modeling and drug designing, concepts and laws applicable to quantum-mechanics particles. This would enable him to understand the entire concepts in computerized drug designing and interaction concepts

Prerequisites:-

This is an introductory course for the students who want to understand the concepts in molecular modeling and drug designing and should make a compulsory subject

Course Description

Sr. No.	Topics	Detail syllabus	No. of Lectures
1	Introduction to molecular graphics:	Cartesian, and crystal coordinate system, Reducing molecular coordinates to fit Computer monitor Basic principle of molecular graphics and structure visualization Small molecular structural data bases (Chembridge data base) Protein structural data base (PDB) Different molecular graphics packages, Graphics Programs: HAMOG, RASMOL,MOLMOL	08
2	Building of small molecules	Building of small molecules Internal and cylindrical polar co-ordinate system Methods used in building small molecules using crystal, Cartesian, polar and chemical internal coordinates. Building of Biopolymers DNA & oligopeptides in different secondary structure	10
3	Optimization of geometries of	Energy minimization by systematic search method Plotting conformation energy contours	10

	small molecules:	(Ramachandran plot), and finding out minimum energy conformation Gradient based Energy minimization methods Molecular mechanics approach Molecular Dynamics method Monte Carlo method Genetic algorithm	
4	Use of Quantum chemical methods for geometry optimization:	Schrödinger equation Basic Formalism in quantum mechanics Schrödinger equation for a multi- electron atom Schrödinger equation for a molecule Hartree- Fock Method Different MO methods Molecular electrostatic potential Optimization of geometries of small molecules Quantum chemical indices	10
5	Drug designing	Pharmacophore identification and novel drug designing, structure based drug design enzyme inhibition strategies	06
Total Lectures			36

Methodology

The course will be covered through lectures supported by tutorials and practicals. In tutorials, apart from the discussion on the topics covered in lectures, assignments in the form of questions will be given. Normally a students is expected to complete the assignment by himself, however if needed, difficulties will be discussed in the tutorial classes. There will be two class tests/ and surprise test conducted during the tutorial classes.

Evaluation Scheme

Examination	**Duration**	**Marks**
Minor test 1	1 hours	15
Minor test 2	1 hours	15
Tutorials & Home assignment		10
Major test at the end of semester	3 hours	60
Total	100	

Books recommended:

- Molecular Modeling, Holtje and Folkers G Weinheim New York
- Essentials of Drug designing, V. Kothekar Dhruv Publications 2005
- Molecular modeling: principles and applications, Leach.A.R
- Molecular modelling and drug design, Andrew Vinter A.and Gardner, M Boca Raton: CRC Press, 1994

Title of the Course: Practicals in Enzymology, Bioprocess Technology & Elective

Course code: MS-307A	**L**	**T**	**P**	**Hr**	**C**
Marks: 200	**0**	**0**	**16**	**16**	**8**

Practicals in Enzymology

Laboratory Description

Sr. No.	**Topics**	**No. of Lectures**
1	Estimation of specific activity of salivary α-amylase .	04
2	Estimation of specific activity of fungal amylase from Neozyme tablets. Comparison of activities of salivary & fungal amylase.	04
3	Estimation of specific activity of salivary β-amylase from sweet potato.	04
4	Determination of acrolic point of amylases.	04
5	Estimation of specific activity of acid phosphatase from germinated pea seeds.	04
6	Estimation of specific activity of alkaline phosphatase from germinated Bengal gram seeds	04
7	Estimation of specific activity of protease (Neozyme tablets)	04
8	Determination of proteolytic activity from serratia peptidase	04
9	Deternmination of optimum PH & temperature of amylases.	04

Methodology

The course will be covered through practical work supported by Labotatory work. Students would be made to achieve skills in practical aspects regarding enzymes. They would be taught how to correlate the thetotical & practical aspects of enzymology & metabolic engineering.

Evaluation Scheme

Examination-Lab

Minor test-I	1 hr	5
Lab report and attendance		5
Final	3 hr	40
Total		50

Course Title: **Practicals in Bioprocess Technology and Bioengineering**

Course code 307B	**L**	**T**	**P**	**Hr**	**C**
Marks: 200	**0**	**0**	**16**	**16**	**8**

Course Description

Sr. No.	**Laboratory exercise**	**Hrs**
1	Screening and improvement of cultures.	4
2	Preservation of Industrial cultures.	4
3	Inoculum development techniques.	4
4	Media preparation and selection techniques.	4
5	Small scale submerged fermentation.	4
6	Small scale solid state fermentation	4
7	Instrumentation control for small scale Bioreactor	4
8	Scale up/down studies	4
9	Fermentation design and finding out different factors affecting fermentation process.	4
10	Downstream processing techniques	4
11	Production and Immobilization of industrial enzymes	4

Methodology

The course will be covered through lectures supported by tutorials and laboratory practicals. Students will be evaluated based on two class tests, lecture and laboratory attendance, class participation.

Evaluation Methodology theory

Minor test-I	1 hr	5
Lab report and attendance		5
Final	3 hr	40
Total		50

Books Recommended

Principles of fermentation technology by Whitekar
Biochemical engg. By Bailey &Ollis
Bioprocess engg. By Dorau.
Bioprocess engg. By shular&kargi.

Course code 307C

Practicals in Molecular Modeling and Drug Designing	**L**	**T**	**P**	**Hr**	**C**
Marks: 200	**0**	**0**	**16**	**16**	**8**

Sr.No.	Labortory Exercise	Hrs.
1	BUILDING MOLECULES	4
2	glycine	4
3	glycine-glycine	4
4	alanine	4
5	glycine-alanine	4
6	phenylalanine	4
7	benzene	4
8	SPDBV	4
9	calculate the electrostatic potential using spdbv software	4
10	analysis of Ramachandran plot using spdbv software	4
11	HYPERCHEM	4
12	Use of molecular modeling software HYPERCHEM for building small molecules.	4
13	Computation of quantum chemical parameters using HYPERCHEM	4
14	Creating database for small molecular indices using HYPERCHEM	4
15	MOE	4
16	Use of molecular modeling software MOE for building small molecules	4
17	Use of molecular modeling software MOE for building oligopeptides and oligonucleotides	44
18	Computation of force field parameters using MOE	4
19	Computation of conformation map of a small molecule using MOE	4
20	Optimization of geometries of small molecules using MOE	4
21	Creating database for small molecular indices using MOE	4

Evaluation scheme Practical training

Minor test 1	1 hour	15
Continuous Assessment		10
Major test at the end of semester	3 hours	25
Total		50

Practicals in Food Biotechnology **Total Hrs:48**
Course Code: 307C **L T P Hr C**
Marks: 200 **0 0 16 16 8**

Laboratory Description

Sr. No.	Topics	Hrs
1	Determination of quality of milk by MBRT test	04
2	Detection of number of bacteria by SPC method	04
3	Microscopic determination of microbial flora from yoghurt and lactic acid determination	04
4	Microbial examination of food	04
5	Detection of pathogenic bacteria from food samples	04
6	Determination of milk clotting enzyme activity.	04
7	Preparation of Cheese	04
8	To determine mineral salt concentrations in fruit juices by using flame photometer	04
9	To check the food efficacy testing of chemical preservatives	04
10	Preparation of Bread	04

Methodology

The course will be covered through practical work supported by field study. Students would be made to gain scientific data information using various food products resources. They would be taught how to improve quality and useful microbial flora to food products.

Evaluation Scheme

Minor test-I	1 hr	5
Lab report and attendance		5
Final	3 hr	40
Total		50

Books Recommended:
Practical in Food Microbiology
Practical in Microbiology : Kannan