VIT®

Vellore Institute of Technology

(Deemed to be University under section 3 of UGC Act, 1956)

SCHOOL OF BIO SCIENCES AND TECHNOLOGY

M.Tech Biotechnology (MBT)

Curriculum and Syllabus

(2023-2024 admitted students)

VISION STATEMENT OF VELLORE INSTITUTE OF TECHNOLOGY

Transforming life through excellence in education and research.

MISSION STATEMENT OF VELLORE INSTITUTE OF TECHNOLOGY

- **World class Education**: Excellence in education, grounded in ethics and critical thinking,for improvement of life.
- **Cutting edge Research**: An innovation ecosystem to extend knowledge and solve criticalproblems.
- **Impactful People**: Happy, accountable, caring and effective workforce and students. **Rewarding Co-creations**: Active collaboration with national & international industries &universities for productivity and economic development.
- **Service to Society**: Service to the region and world through knowledge and compassion.

VISION STATEMENT OF THE SCHOOL OF BIO SCIENCES AND TECHNOLOGY

- To nurture high-quality bioengineers and science graduates with the potential to innovate, invent and disseminate knowledge for the benefit of society and environment

MISSION STATEMENTOF THE SCHOOL OF BIO SCIENCES AND TECHNOLOGY

- To offer academic programs to impart knowledge skills to cater to the dynamic needs of the bio sciences and the food industry
- To foster the spirit of innovation and creativity in the young minds in solving the real-time problems arising in society and industry
- To instill confidence, ethics, values, and employability skills in the future citizens to focus on the sustainable growth of the economy

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Mission of M.Tech., Biotechnology

- Acquire students with skills of biotechnology and provide solutions through industry-academia interface
- Empower the students to be effective entrepreneurs and excellent researchers to invent unique products for societal need with proper ethical statutes

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M.TECH BIOTECHNOLOGY

PROGRAMME EDUCATIONAL OBJECTIVES (PEOs).

1. Graduates will be engineering professionals, innovators or entrepreneurs engaged in technology development, technology deployment, or engineering system implementation in industry
2. Graduates will function in their profession with social awareness and responsibility
3. Graduates will interact with their peers in other disciplines in industry and society and contribute to the economic growth of the country
4. Graduates will be successful in pursuing higher studies in engineering or management
5. Graduates will pursue career paths in teaching or research

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M.TECH BIOTECHNOLOGY

Programme Outcomes

POs	Statements
PO_01	Having an ability to apply mathematics and science in engineering applications
PO_02	Having an ability to design a component or a product applying all the relevant standards and with realistic constraints, including public health, safety, culture, society and environment
PO_03	Having an ability to design and conduct experiments, as well as to analyse and interpret data, and synthesis of information
PO_04	Having an ability to use techniques, skills, resources and modern engineering and IT tools necessary for engineering practice
PO_05	Having problem solving ability- to assess social issues (societal, health, safety, legal and cultural) and engineering problems
PO_06	Having adaptive thinking and adaptability in relation to environmental context and sustainable development
PO_07	Having a clear understanding of professional and ethical responsibility
PO_08	Having a good cognitive load management skills related to project management and finance

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M.TECH BIOTECHNOLOGY

PROGRAMME SPECIFIC OUTCOMES (PSOs)

1	Acquire students with skills of biotechnology and provide solutions through industry-academia interface
2	Empower the students to be effective entrepreneurs and excellent researchers to invent unique products for societal need with proper ethical statutes
3	Ability to independently carry out research and development work to solve the practical problems

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CREDIT INFO		
S.no	**Catagory**	**Credit**
1	Discipline Core	24
2	Discipline Elective	12
3	Projects and Internship	26
4	Open Elective	3
5	Skill Enhancement	5
Total Credits		70

Discipline Core									
sl.no	**Course Code**	**Course Title**	**Course Type**	**Version**	**L**	**T**	**P**	**J**	**Credit**
1	MBIT501L	Advanced Biochemistry	Theory Only	1.0	3	0	0	0	3.0
2	MBIT501P	Advanced Biochemistry Lab	Lab Only	1.0	0	0	2	0	1.0
3	MBIT502L	Analytical Techniques in Biotechnology	Theory Only	1.0	3	0	0	0	3.0
4	MBIT503L	Bioprocess Technology	Theory Only	1.0	3	0	0	0	3.0
5	MBIT503P	Bioprocess Technology Lab	Lab Only	1.0	0	0	4	0	2.0
6	MBIT504L	Computational Biology	Theory Only	1.0	3	0	0	0	3.0
7	MBIT504P	Computational Biology Lab	Lab Only	1.0	0	0	2	0	1.0
8	MBIT505L	Genetic Engineering	Theory Only	1.0	3	0	0	0	3.0
9	MBIT505P	Genetic Engineering Lab	Lab Only	1.0	0	0	4	0	2.0
10	MBIT506L	Immunotechnology	Theory Only	1.0	3	0	0	0	3.0

Discipline Elective									
sl.no	**Course Code**	**Course Title**	**Course Type**	**Version**	**L**	**T**	**P**	**J**	**Credit**
1	MBIT601L	Industrial Biotechnology	Theory Only	1.0	3	0	0	0	3.0
2	MBIT602L	Nanobiotechnology	Theory Only	1.0	3	0	0	0	3.0
3	MBIT603L	Protein Engineering and Technology	Theory Only	1.0	3	0	0	0	3.0
4	MBIT604L	Programming for Biologists	Theory Only	1.0	3	0	0	0	3.0
5	MBIT605L	Food Process Technology	Theory Only	1.0	3	0	0	0	3.0

6	MBIT606L	Natural Product Technology	Theory Only	1.0	3	0	0	0	3.0
7	MBIT607L	Plant Biotechnology	Theory Only	1.0	3	0	0	0	3.0
8	MBIT608L	Animal Biotechnology	Theory Only	1.0	3	0	0	0	3.0
9	MBIT609L	Pharmaceutical Biotechnology	Theory Only	1.0	3	0	0	0	3.0
10	MBIT610L	Environmental Biotechnology	Theory Only	1.0	3	0	0	0	3.0
11	MBIT611L	Aquatic Biotechnology	Theory Only	1.0	3	0	0	0	3.0
12	MBIT612L	Proteomics	Theory Only	1.0	3	0	0	0	3.0
13	MBIT613L	Cancer Biology	Theory Only	1.0	3	0	0	0	3.0
14	MBIT614L	Medical Biotechnology	Theory Only	1.0	3	0	0	0	3.0
15	MBIT615L	Microbial Biotechnology	Theory Only	1.0	3	0	0	0	3.0

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Projects and Internship									
sl.no	**Course Code**	**Course Title**	**Course Type**	**Version**	**L**	**T**	**P**	**J**	**Credit**
1	MBIT696J	Study Oriented Project	Project	1.0	0	0	0	0	2.0
2	MBIT697J	Design Project	Project	1.0	0	0	0	0	2.0
3	MBIT698J	Internship I/ Dissertation I	Project	1.0	0	0	0	0	10.0
4	MBIT699J	Internship II/ Dissertation II	Project	1.0	0	0	0	0	12.0

Open Elective									
sl.no	**Course Code**	**Course Title**	**Course Type**	**Version**	**L**	**T**	**P**	**J**	**Credit**
1	MFRE501L	Francais Fonctionnel	Theory Only	1.0	3	0	0	0	3.0
2	MGER501L	Deutsch fuer Anfaenger	Theory Only	1.0	3	0	0	0	3.0

Skill Enhancement									
sl.no	**Course Code**	**Course Title**	**Course Type**	**Version**	**L**	**T**	**P**	**J**	**Credit**
1	MENG501P	Technical Report Writing	Lab Only	1.0	0	0	4	0	2.0
2	MSTS501P	Qualitative Skills Practice	Soft Skill	1.0	0	0	3	0	1.5
3	MSTS502P	Quantitative Skills Practice	Soft Skill	1.0	0	0	3	0	1.5

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Course Code	Course Title	L	T	P	C
MBIT501L	Advanced Biochemistry	3	0	0	3
Pre-requisite		Syllabus version			
		1.0			

Course Objectives

1. To ensure students having a strong knowledge in structure, composition and functions of various biomolecules.
2. To introduce them the nature and basic properties of biomolecules which are involved in various metabolic pathways
3. To understand the significance of these biomolecules and to apply these fundamentals in field of modern biotechnology.

Course Outcome

the end of the course the student will be able to

1. Develop knowledge on structure of macromolecules such as carbohydrates, proteins and lipids
2. Demonstrate the organization and biological functions of macromolecules
3. Make use of knowledge on carbohydrate metabolism
4. Understand the structure activity relationship of proteins and mechanism of enzyme action
5. Explain the thermodynamics of high energy compounds and energy metabolism
6. Explain the structural organization of membranes and ion channels.

Module:1	Solubility of Macromolecules	5 hours

Effect of solvent and additive, Mechanism of solvation, Buffers for biochemical reagents, buffering capacity, and numerical problems on buffer preparation, pH and the Henderson- Hasselbalch equation.

Module:2	Carbohydrates	5 hours

Classification, cyclic structure of monosaccharides, stereoisomerism, sugar derivatives, disaccharides, homo and heteropolysaccharides, glycosaminoglycan (GAGs), proteoglycans, bacterial cell wall polysaccharides, glycoproteins, lectins and medical applications of oligosaccharides

Module:3	Carbohydrate metabolism	4 hours

Carbohydrate metabolism and regulation in microbes, plants and animals

Module:4	Proteins	7 hours

Structural organisation of Proteins. Structure activity relationship of proteins- haemoglobin, myoglobin, collagen, keratin, Insulin, Enzyme coenzymes and cofactors. Mechanism of enzyme action, with particular reference to serine proteases

Module:5	Bioenergetics	7 hours

Recap of redox reactions, redox potential and Nernst equation. Thermodynamics. High energy compounds. Role of ATP in energy metabolism. Substrate level phosphorylation, Oxidativephosphorylation and photophosphorylation

Module:6	Lipids and membranes	7 hours

Membrane lipids & proteins; structure & properties of membrane lipids; fluid mosaic model;function (carriers, receptors, enzymes, anchors, cell-cell recognition); osmosis & diffusion, tonicity; TAG catabolism, anabolism (animal metabolism)

Module:7	Signalling and Transport	8 hours

Signaling types, receptor types (intra vs surface); transport: bulk (endocytosis, exocytosis), selective (facilitated, active); ion channels, transporters; signal transduction cascades: GPCRs,cytokine, TK; apoptosis.

Module:8	**Contemporary Issues**	**2 hours**
	Total Lecture hours:	**45 hours**

Text Book(s)	
1.	David L Nelson, Michael M Cox, Albert L Lehninger (2013) Lehninger Principles of Biochemistry - 6th edition, New York : W.H. Freeman.
Reference Books	
1	Jeremy M Berg, John L Tymoczko, Gregory J Gatto, Lubert Stryer (2015) Biochemistry - 8th Edition, Palgrave MacMillan.
2.	Donald Voet, Judith G Voet (2010) Biochemistry - 4th Edition, Wiley India Pvt Ltd.

Mode of Evaluation: Continuous assessment test, written assignment, Quiz and Final assessment test			
Recommended by Board of Studies	27-05-2022		
Approved by Academic Council	No. 67	Date	08-08-2022

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Course code	Course Title	L	T	P	C
MBIT501P	Advanced Biochemistry Lab	0	0	2	1
Pre-requisite	Nil	Syllabus version			
		1.0			

Course Objectives

1. To infer properties of biomolecules based on quantitative analysis.
2. To impart knowledge of methods and techniques for biomolecules separation and purification

Course Outcome

1. Analyse biomolecules quantitatively.
2. Demonstrate the separation and estimation of biomolecules

Indicative Experiments

1	Determination of the organic acids and their buffering range in variousjuices
2	Identification of sugars by DNSA method and TLC
3	Detection of isoelectric point of casein
4	Specificity of amylase for starch in different flours, monitoring with DNSA
5	Quantitative determination of vitamin C in different vegetables, fruits
6	Proteins in biological fluid – determination by Bradford and separation bygel electrophoresis
7	Extraction of lipid/oil from the plant material and determination of itssaponification and iodine number.

Total Laboratory Hours	**30 hours**

Mode of assessment: Continuous assessment / FAT / Oral examination and others

Recommended by Board of Studies	27-07-2022		
Approved by Academic Council	No. 67	Date	08-08-2022

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Course Code	Course Title	L	T	P	C
MBIT502L	Analytical Techniques in Biotechnology	3	0	0	3
Pre-requisite	NIL	Syllabus version			
		1.0			

Course Objectives

1. Developing the skills to understand the theory and practice of analytical techniques
2. Enhancing the understanding in analytical techniques in detail to interpret results
3. Improving the learning ability on how to analyze and separate biomolecules based on their properties.

Course Outcome

e student will be able to

1. Demonstrate instruments related to bio techniques
2. Build knowledge on choice of appropriate techniques for their samples
3. Make samples for instrumental analysis
4. Design and execute the experiments
5. Analyze the samples and interpret results
6. Explain the limits of instrumental techniques.

Module:1	**Absorption spectroscopy**	**5 hours**

Working principle, instrumentation, sample preparation, and its applications –UV-Vis, AAS, NMR, ESR / EPR, IR, Raman for small molecules.

Module:2	**Emission spectroscopy and other spectrometric techniques**	**5 hours**

Working principle,instrumentation, sample preparation, and its applications– AES,Fluorescence, Phosphorescence, Chemi / Bioluminescence, MS, XRD for small molecules.

Module:3	**Separation techniques**	**4 hours**

Theory of chromatography and types (TLC, PC, HPTLC, GC, HPLC, and 2D) – their principlesand applications.

Module:4	**Electrophoresis**	**3 hours**

Principles, instrumentation, sample preparation, and applications of 2D – Rotophore, Opticaldensitometry.

Module:5	**Microscopic techniques**	**3 hours**

Basics of light microscopy, Instrumentation - confocal and fluorescence microscopy, sample preparation for fluorescence microscopy, super resolution microscopy.

Module:6	**Electron Microscopy**	**3 hours**

Basics of SEM and TEM, Specimen preparation for SEM and TEM.

Module:7	**Flow cytometry and other recent techniques**	**5 hours**

Cell sorters and their applications. Hyphenated techniques, tracer techniques – solid, liquid scintillation, Alternative to radioactive techniques.

Module:8	**Contemporary Issues**	**2 hours**
	Total Lecture hours:	**30 hours**

Text Book(s)			
1.	Keith Wilson, John Walker (2015) Principles and Techniques of Biochemistry and MolecularBiology, 7th Edition.		
Reference Books			
1	Skoog, Holler, Crouch (2015) Principles of Instrumental Analysis 6th edition Cengage Learning. Fifield FW (2015) Principles and Practice of Analytical Chemistry, Blackwell, Scientific		
2.	Publishers Avinash Upadhyay, Kakoli Upadhyay, Nirmalendu Nath (2015) Biophysical Chemistry: (Principles and Techniques), Himalaya Pub. House Mumbai		
3.	Nag A (2016) Analytical Techniques In Agriculture Biotechnology And Environmental Engineering, Prentice Hall India, New Delhi.		
Mode of Evaluation: Continuous assessment test, written assignment, Quiz and Final assessment test			
Recommended by Board of Studies	27-07-2022		
Approved by Academic Council	No. 67	Date	08-08-2022

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Course Code	Course Title	L	T	P	C
MBIT503L	Bioprocess Technology	3	0	0	3
Pre-requisite	NIL	Syllabus version			
		1.0			

Course Objectives

1. To understand the media design and statistical media optimization for maximum production of metabolites
2. To acquaint students with the basics of sterilization and mass transfer coefficients
3. To understand the various growth kinetics, production kinetics, various reactors involved, scale up and scale down process in bioreactors

Course Outcome

The student will be able to

1. Formulate medium using statistical tool for the maximum production of metabolites and biocatalyst for various commercial use
2. Demonstrate various mass transfer coefficient required to increase yield
3. Design bioreactor configurations and operation modes based upon the nature of bio products
4. Model the kinetics of living cells and to develop a strategy to solve the issues emerging during fermentation processes
5. Evaluate own model required for the microbial growth and can design own batch thermal sterilization
6. Develop a research career or to get job in biotechnology industry with strong foundation in bioreactor design and scale-up or to become entrepreneur.

Module:1	Media Design	6 hours

Design of media for commercial and industrial applications.

Module:2	Statistical medium optimization	6 hours

Plackett Burman design, Response surface methodology – Central composite design.

Module:3	Sterilization for Fermentation processes	7 hours

Kinetics of thermal death of cells & spores, Design of batch and Continuous thermal sterilization, Coupling of Arrhenius equation and cell death kinetics, Sterilization of air and filter design, Radiation and chemical sterilization.

Module:4	Mass Transfer	6 hours

Principles of molecular diffusion, Fick's law of diffusion, diffusion of gases and liquids, theories of mass transfer, concept of mass transfer coefficients. Mass transfer and power requirement in stirred tank reactors.

Module:5	Kinetics of Microbial Growth and Product Formation (Unstructured Model)	6 hours

Kinetics of cell growth and product formation; Simple unstructured kinetic models for microbial growth; Growth associated and non-growth associated product formation kinetics; Monod and Leudeking-Piret models.

Module:6	Kinetics of Microbial Growth and Product Formation (structured Model)	6 hours

Introduction to Structured Models for growth and product formation using Penicillin V as a casestudy.

Module:7	**Reactors, Scale – up of reactors**	**6 hours**
Design for homogeneous systems, Batch, Continuous and Fed-batch systems. Reactors in series -Non-Ideality in reactors. Scale up criteria -procedure and scale-down.		
Module:8	**Contemporary Issues**	**2 hours**
	Total Lecture hours:	**45 hours**

Text Book(s)	
1.	Michael L. Shuler, Fikret Kargi, Matthew DeLisa 2017. Bioprocess Engineering, 3rd Edition, Prentice Hall International Series.
2	Peter Stanbury, Principles of Fermentation technology 2015, third edition, Butterworth- Heinemann.
Reference Books	
1	Shigeo Katoh and Fumitake Yoshida, 2010, Biochemical Engineering - A Textbook for Engineers, Chemists and Biologists, WILEY-VCH Verlag GmbH & Co. KGaA, Weinheim.

Mode of Evaluation: Continuous assessment test, written assignment, Quiz and Final assessment test

Recommended by Board of Studies	27-07-2022		
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Course code	Course Title	L	T	P	C
MBIT503P	Bioprocess Technology Lab	0	0	4	2
Pre-requisite	Nil	Syllabus version			
		1.0			

Course Objectives

1. To provide hands on training to design and conduct experiments and to analyze and interpret data.
2. To understand the operations of bioreactor and to apply the knowledge of mass transfer and kinetics in bioprocess.

Course Outcome

1. Demonstrate the effect of different process parameters on growth of microorganisms
2. Screen process variables by using single dimensional search, Plackett Burman design and RSM
3. Assess enzyme activity on immobilized and free enzyme
4. Successfully carry out aseptic fermentations using a bioreactor

Indicative Experiments

1.	Growth kinetics in Batch culture
2.	Product kinetics in Batch culture
3.	Classical method of media optimization
4.	Statistical method of media optimization(Plackett Burman)
5.	Statistical method of media optimization (Response Surface Methodology
6.	Thermal death kinetics of microorganisms
7.	KLa determination by dynamic degassing method
8.	Flow reactors – Air-lift, Packed –bed and Fluidized bed reactors

Total Laboratory Hours **30**

Mode of assessment: Continuous assessment, FAT, Oral examination

Recommended by Board of Studies	27-07-2022		
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Course Code	Course Title	L	T	P	C
MBIT504L	Computational Biology	3	0	0	3
Pre-requisite	NIL	Syllabus version			
		1.0			

Course Objectives

1. Study about the open access biological databases and sequence alignment algorithms
2. Learn about the heuristic algorithms, phylogenetic analysis and structure prediction
3. Gain knowledge on the latest trends in new drug discovery.

Course Outcome

The students will be able to

1. Demonstrate deposition and retrieval of sequences from nucleotide and protein databases
2. Determine sequence alignments and interpret the salient features
3. Explain the different methods employed for multiple sequence alignment and identify strengths of each method
4. Compare and derive meaningful information using heuristic algorithms
5. Relate the molecular evolutionary relationships among sequences and organisms
6. Model the structure of proteins from sequence information and employ *in-silico* procedures for drug discovery.

Module:1	**Biological databases and sequence alignment**	**2 hours**
File formats (Genbank, uniport, PDB) - Biological Sequence comparison - Dot plot.		
Module:2	**Dynamic Programming**	**3 hours**
Smith and Waterman and Needleman and Wunsch algorithms - sequence formats and tools		
Module:3	**Multiple sequence alignment**	**3 hours**
Methods – algorithms – tools - applications - Profiles and Hidden Markov Models, Protein Motifsand Domain Prediction.		
Module:4	**Similarity Searches on Sequence Databases**	**5 hours**
Heuristic algorithms - BLAST and its types, FASTA – Algorithms - Sensitivity, specificity,applications.		
Module:5	**Molecular Phylogeny**	**5 hours**
Phylogram construction– Distance based method,Character-BasedMethods-Maximum parsimony method, Maximum likelihood- Phylogenetic Tree Evaluation – Jackknifing and Bootstrapping – applications.		
Module:6	**Structural Bioinformatics**	**5 hours**
Conceptual model of protein structure, protein structure prediction and modelling – Homology Modeling, Threading, Ab initio- Protein Structure Visualization, Comparison and Classification.		
Module:7	**Bioinformatics in the Pharmaceutical Industry**	**5 hours**
Structure-Based Rational Drug Design and discovery – Chemoinformatics		
Module:8	**Contemporary Issues**	**2 hours**
	Total Lecture hours:	**30 hours**

Text Book(s)			
1.	Teresa K. Attwood, David J. Parry-Smith (2015) Introduction to bioinformatics, PearsonEducation. Hodgman Andrew, David R Westhead (2014) Bioinformatics, Taylor And Francis.		
Reference Books			
1	Baxevanis AD, Francis Ouellellette BF (2014) Bioinformatics - a Practical Guide to theAnalysis of Genes and Proteins Wiley India Pvt Ltd.		
2.	Mount D (2014) Bioinformatics: Sequence and Genome Analysis, Cold Spring HarborLaboratory Press, New York.		
Mode of Evaluation: Continuous assessment test, written assignment, Quiz and Final assessment test.			
Recommended by Board of Studies	27-07-2022		
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Course code	Course Title	L	T	P	C
MBIT504P	Computational Biology Lab	0	0	2	1

Pre-requisite	NIL	Syllabus version
		1.0

Course Objectives:

1. Analyze, interprete and predict macromolecular structures and sequences

Expected Course Outcome:

1. Perform in silico analysis of nucleic acids and compare various sequence alignment algorithm.
2. Analyze protein sequence and prediction and analysis of protein structures using bioinformatics tools

Indicative Experiments

1.	Nucleotide sequence from nucleic acid collaboratory resources
2.	Protein sequence from Universal protein consortium
3.	Protein structure from research collaboratory for structural bioinformatics
4.	Access of secondary biological data
5.	Pairwise alignment using dot plot algorithm
6.	Pairwise alignment using dynamic programming
7.	Heuristic Sequence Alignment
8.	Multiple sequence alignment
9.	Construction of phylogentic tree
10.	Gene prediction analysis
11.	Prediction of secondary structure of protein
12.	Protein structure analysis

Total Laboratory Hours	**30 hours**

Mode of assessment: Continuous assessment, FAT and Oral examination

Reference Book: Prepared protocols and reference materials collections

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Course code	Course Title	L	T	P	C
MBIT505L	Genetic Engineering	3	0	0	3
Pre-requisite	Nil	Syllabus version			
		1.1			

Course Objectives:

1. The students will understand the components required for gene manipulation
2. The students will understand transformation of a genetic material at molecular and cellular levels, and
3. The students will understand the methods of change of a genetic material and construction of transgene organisms with the given properties.

Expected Course Outcome:

The student will be able to

1. Construct the recombinant vector and develop genetically modified organisms.
2. Outline the pros and cons of GMOs,
3. Make use of gene cloning principles,
4. Utilize tool enzymes for commercialization,
5. Utilize mapping genome or pDNA,
6. Demonstrate the methods to transfer foreign genes

Module:1	DNA modifying Enzymes	5 hours

Polymerases, ligases, endo and exo nucleases, restriction enzymes and its types, adapters and linkers, homopolymer tailing, reverse transcriptase, phosphatase, polynucleotide kinase, RecA, zinc finger nucleases.

Module:2	Vectors	5 hours

Plasmid and phage vectors, YAC, BAC, M13 vector, Plant, animal and yeast cloning vectors, vectors for chloroplasts.

Module:3	Expression vectors and systems	5 hours

His-tag; GST-tag; MBP-tag; Intein-based vectors. Expression of foreign proteins in *E. coli*, *Bacillus*, Yeast, Insect cells and Mammalian cells.

Module:4	Labelling of DNA and detection techniques	6 hours

Nick translation, Random priming, Radioactive and non-radioactive probes. Southern hybridization, Northern hybridization, Western blotting. cDNA and genomic DNA library construction and screening. Sequencing (NGS, RNA Seq).

Module:5	Reporter genes and PCR	6 hours

Role and mechanism of GFP, CAT, luciferases and β-galactosidases. PCR – Principle and applications (gene isolation, clinical diagnostics and detection, forensics, environmental and industrial applications). Different types of PCR. Real-time PCR (SYBR Green assay, Taqman Probes, Molecular beacons).

Module:6	Gene Transformation	8 hours

Methodologies in plants, animals and microbes. **Advanced cloning methods:** multi-gene cloning, assembly cloning. **Gene silencing techniques:** Principle and application of gene silencing; siRNA technology; Micro RNA; Gene knockouts and Gene Therapy.

Module:7	Application of Genetic Engineering:	8 hours

In agriculture, human medicine, environment, industrial production of recombinant proteins, food and pharmaceutical industry. Biosafety guidelines for GMOs.

Module:8	**Contemporary issues:**		**2 hours**
	Total Lecture hours:	**45 hours**	

Text Book(s)	
1.	Primrose, S.B. and Twyman, R.M., 2012. Principles of Gene Manipulation and Genomics. 8th Edition, Blackwell Publishing Co. UK
2.	T. A. Brown, 2016 Gene Cloning and DNA analysis: An introduction. 7th Edition, John Wiley and Sons Ltd. UK
Reference Books	
1.	Dominic W.S. and Wong, 2015. The ABCs of Gene Cloning, 2nd Edition, Springer International, The Netherlands.
2.	Christopher Howe, 2015. Gene Cloning And Manipulation, 2nd Edition, Cambridge University Press, UK
3.	Frank Kempken and Christian Jung, 2010. Genetic Modification of Plants, Springer International, The Netherlands.

Mode of Evaluation: Continuous assessment test, written assignment, Quiz and Final assessment test			
Recommended by Board of Studies	27-07-2022		
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Course code	Course Title	L	T	P	C
MBIT505P	Genetic Engineering Lab	0	0	4	2
Pre-requisite	Nil	Syllabus version			
		1.0			

Course Objectives

1. Develop skills pertaining to gene identification, manipulation, and engineering techniques.

Expected Course Outcomes

1. Demonstrate isolation the recombinant vector and develop genetically modified organisms
2. Utilize molecular extraction and manipulation techniques.

Indicative Experiments

1.	Isolation of a gene from different source, cloning, screening, expression of the recombinant protein
2.	RNA extraction / DNA extraction
3.	cDNA synthesis and preparation of vector
4.	PCR amplification of the gene of interest
5.	Cloning and preparation of competent cell
6.	Transformation of the cloned product
7.	Screening to identify recombinant clones - PCR
8.	Isolation of the plasmid DNA from the recombinant clone
9.	Confirmation of positive clones by restriction digestion
10.	Recombinant Protein expression
11.	Real time PCR

Total Laboratory Hours	60

Mode of assessment: Continuous assessment, FAT, Oral examination

Recommended by Board of Studies	27.07.2022		
Approved by Academic Council	No. 67	Date	08-08-2022

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Course Code	Course Title	L	T	P	C
MBIT506L	Immunotechnology	3	0	0	3
Pre-requisite	Nil	Syllabus version			
		1.0			

Course Objectives

1. To acquire knowledge in immunology and immunotechnology
2. To understand the concepts of immunology
3. To translate the concepts in better diagnosis of diseases and their probable treatment

Course Outcome

The student will be able to

1. Demonstrate the structure and functions of immune systems
2. Formulate and execute projects in immunology
3. Make use of cellular activity in defining immune system
4. Translate the immune mechanisms in determining infection and immunological disorders
5. Develop different diagnostic techniques and applications
6. Appraise different therapeutic techniques and applications

Module:1	Immune system overview	6 hours

Innate and adaptive immunity, Haematopoiesis, haematopoietic growth factors and regulation. Cells and organs of the immune system. Stem cells and its clinical uses.

Module:2	Antigens and MHC	6 hours

Antigens, structure of antigen and its different types. Antibody structure and types. Antigen processing and presentation, mechanism of antigen recognition, MHC organization – Class I, II and III and MHC restriction.

Module:3	Biology of T and B lymphocytes	6 hours

T and B lymphocytes, T helper cells , Cytotoxic T cells, Importance of co-stimulatory molecules in B and T cell activation.

Module:4	Complement and Immunological disorders	7 hours

Complement system, pathways. Cytokines, Autoimmunity and autoimmune disorders, hypersensitivity reactions, transplantation and tumor Immunology, immunotherapy for tumors and auto-immune disorders, immunodeficiency diseases.

Module:5	Preventive Immunology	6 hours

Vaccines – active and passive immunization, DNA and plant based vaccines, AIDS vaccine,recombinant antigen as vaccine.

Module:6	Immuno-Diagnosis	6 hours

ELISA, Immunoelectrophoresis, Immunoblotting,immunohistochemistry,and munofluorescence.

Module:7	Immuno-technology	6 hours

Stem cell transplantation technology, Gene knock out animal models, Monoclonal antibodies and their use in diagnosis.

Module:8	Contemporary issues	2 hours

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			Total Lecture hours:	**45 hours**
Textbook(s)				
1.	Janis Kuby (2016), Immunology, 7th edition. By Owen, Punt and Stranford Textbook. W.Hfreeman and company.			
Reference Books				
1.	Tizard (2015), Immunology, 2nd edition. Saunders College publishing company.			
2.	Sites(2016) ,Medical immunology, 10th edition , McGraw Hill, international Ltd.			
Mode of Evaluation: Continuous Assessment Test, Digital Assignment, Quiz and Final Assessment Test				
Recommended by Board of Studies		27-07-2022		
Approved by Academic Council		No. 67	Date	08-08-2022

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Course Code	Course Title	L	T	P	C
MBIT601L	Industrial Biotechnology	3	0	0	3
Pre-requisite	Nil	Syllabus version			
		1.0			

Course Objectives

1. To apprehend the methods of screening significant microbes from the natural environment for commercial application
2. To learn the different methods of strain improvement for the overproductionof bioproducts
3. To comprehend the industrial method of fermentation for various primary and secondary metabolites and biocatalysts

Course Outcome

The student will be able to

1. Demonstrate knowledge and critical awareness of current issues arising in the practice of industrial biotechnology and the role of industrial biotechnology in the global bio- economy
2. Select industrially important microbes from environment
3. Explain the overall upstream and downstream process involved in the industries for theproduction of metabolites
4. Analyze potential business opportunities in fermentation-based biotechnology
5. Utilize methods to improve the production of bioproducts
6. Elaborate the biological and technological principles which govern actual and potential bio-business

Module:1	Overview and milestone	5 hours

Fermentation process and its development, case study of Penicillin as a milestone inbioprocess development, Case-study involving an engineered organism.

Module:2	Production Strain for Industrial Fermentations	6 hours

Techniques for isolation and screening of modeling, microorganisms for industrial scaleproduction; strain improvement and selection.

Module:3	Primary Metabolites	7 hours

Production of commercially important primary metabolites like organic acids, amino acids andalcohol.

Module:4	Secondary Metabolites	7 hours

Production of commercially important secondary metabolites like vitamin B12, steroids andantibiotics.

Module:5	Mass production of enzymes	6 hours

Important enzymes and their bulk production relevant to leather, textile, baking,brewing, detergent and food industry.

Module:6	Biospeciality products	6 hours

Production of biopolymers, biopesticides, biofertilizers andbiopreservatives.

Module:7	Immobilization	6 hours

Techniques of immobilization of enzymes and their applications in industry, Kinetics ofimmobilized enzymes.

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Module:8	**Contemporary issues**	**2 hours**
	Total Lecture hours:	**45 hours**

Textbook(s)	
1.	Stanbury, P.F., Whitaker, A. and Hall, S.J., 2013. Principles of fermentation technology.Elsevier.
2.	Prescott, S.C. and Dunn, C.G., 1949. Industrial microbiology
3.	Crueger, A., Crueger. A. and Brock. T., 2005. Biotechnology: A textbook of Industrialmicrobiology, Sinauer Associates Inc
Reference Books	
1.	Shuler, M.L. and Kargi, F., 2002. Bioprocess Engineering: Basic Concepts. Prentice HallInternational Series.
2.	Ratledge, C. and Kristiansen, B. eds., 2006. Basic biotechnology. Cambridge UniversityPress.

Mode of Evaluation: Continuous assessment test, written assignment, Quiz and Final assessment test			
Recommended by Board of Studies	27-07-2022		
Approved by Academic Council	No. 67	Date	08-08-2022

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Course Code	Course Title	L	T	P	C
MBIT602L	Nanobiotechnology	3	0	0	3
Pre-requisite	Nil	Syllabus version			
		1.0			

Course Objectives

1. Basic theoretical and practical knowledge related to modern materials chemistry, materials physics, energy physics and nanotechnology
2. To introduce students to inter- and multi-disciplinary science and engineering
3. Get exposed to potential applications of nanobiotechnology in sensing and biomedical applications

Course Outcome

The student will be able to

1. Discover basic concepts and theories of the subject
2. Relate and explain the importance of reduction in materials dimensionality, and its relationship with materials properties
3. Demonstrate applications of analytical techniques in examining nanostructures/ particles
4. Demonstrate the potential of nanobiotechnology in consumer and biomedical applications
5. Evaluate journal papers on nanoscience/nanotechnology
6. Formulate strategies for risk assessment of nanostructures/ particles in various applications

Module:1	Properties of the "Nano" world	6 hours

Origin and concepts, interfacial phenomenon, Surface & quantum effects, chemical and biological principles involved in nanomaterial performance.

Module:2	Nanoscale fabrication engineering	6 hours

Approaches, nanolithography, self assembly, physical, chemical and biological methods, theiradvantages and drawbacks, biomimetic synthesis technologies based on Bacterial complex-S layer protein, Microbial alginates, bacterial spores, Magnetosomes.

Module:3	Nanomaterial properties:	6 hours

Structure property relationships with respect to mechanical, electrical, optical, electrochemical, chemical sensing & magnetic, rheological and thermodynamic properties.

Module:4	Nanometrology and manipulation -	6 hours

Relevance of Probe microscopies, STM, AFM, SEM, TEM. Spectroscopic and X ray diffractionanalysis

Module:5	Biologically important nanomaterials:Structures, properties and biological applications of	6 hours

2D and 3D materials including CNT, Fullerenes, pure metal and core shell nanoparticles, quantum dots, liposomes and dendrimers.

Module:6	Nanotoxicology	6 hours

Routes of exposure and limits of nanomaterials, Nanopathology project and its relevance, theirinteractions at cellular level and cell responses, HARN.

Module:7	Nanobiotechnology in health care, medicine and recent advances	7 hours

Devices, instruments and materials used in doctor patient interface, medical research labs, hospital environments,

pharmaceutical industry. The present state of art and future potential, business contexts and regulatory constraints. Nanobots, nanosensors and nanomedicine.		
Module:8	**Contemporary issues**	**2 hours**
	Total Lecture hours:	**45 hours**

Textbook(s)	
1.	Ramsden J, 2011, Essentials of Nanotechnology, Ramsden and Ventus Publishing ApS.
Reference Books	
1.	Ramsden J, 2011, Nanotechnology: An introduction, William Andrew publisher. Niemeyer CM
2.	Mirkin CA 2005 Nanobiotechnology I: Concepts, applications andperspectives, eds., Wiley-VCH Verlag GmbH & Co., KgaA, Weiheim.
3.	Niemeyer CM, Mirkin CA 2007 Nanobiotechnology II: More concepts, applications and perspectives, eds. Wiley-VCH Verlag GmbH & Co., KgaA, Weiheim.

Mode of Evaluation: Continuous assessment test, written assignment, Quiz and Final assessment test			
Recommended by Board of Studies	27-07-2022		
Approved by Academic Council	No. 67	Date	08-08-2022

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Course Code	Course Title	L	T	P	C
MBIT603L	Protein Engineering and Technology	3	0	0	3
Pre-requisite	Nil	Syllabus version			
		1.0			

Course Objectives

1. To explain advanced methods and strategies used in proteins and
2. The student will be equipped to engineer proteins based on nanotechnology principles
3. The student will be equipped to engineer the proteins by various methods.

Course Outcome

The student will be able to

1. Understand and explain differences between rational design and directed evolution
2. Apply protein engineering knowledge for industrial applications
3. Make use of various beneficial proteins that are industrially and clinically important.
4. Understand various economically important proteins
5. Understand various industrially important enzymes
6. Modify proteins by various methods

Module:1	Factors affecting stability of proteins	6 hours

Intrinsic and extrinsic factors contributing to stability; effect of chaotropes, kosmotropes and compatible solutes in stabilising proteins; role of water in stabilising proteins; analytical methods to determine the structure and stability of proteins.

Module:2	Protein Flding	6 hours

In vivo and in vitro folding; chaperones in folding; co-expression of proteins for proper folding; protein aggregation; folding related diseases.

Module:3	Mutagenesis Types	5 hours

Rational vs irrational; amino acid scanning and multi-codon scanning mutagenesis.

Module:4	Evolution of Enzymes	6 hours

In vitro evolution; expanding the codon size; residue specific incorporation of non-natural aminoacids.

Module:5	Immobilisation:	6 hours

Production of amino acids, antibiotics, biosensor, biofuel cell design and wired enzymes,enzymes in reverse, microarray.

Module:6	Protein design- Case study	6 hours

Insulin structure; need for insulin engineering; prolonged acting insulin; fast acting insulin; glucose sensitive insulin; insulin mimetics; Engineering growth factors for regenerative medicine applications.

Module:7	Nano(bio)technology based on Engineering proteins	8 hours

Spider silk; antifreeze proteins; adhesive proteins; viral ion channels, Use of protein engineering to meet the industrial demands: detergent industry, food industry, leather industry, pharmaceuticalindustry.

Module:8	Contemporary issues	2 hours

			Total Lecture hours:	**45 hours**
Textbook(s)				
1.	Paulo Almeida, Proteins: Concepts in Biochemistry (2016) First Edition, Garland SciencePublishers, USA.			
Reference Books				
1.	David Whitford, 2013, Proteins – Structure and Function, John Wiley and Sons Ltd.,Pravin Kaumaya, 2012, Protein Engineering, InTech Publishers.			
Mode of Evaluation : Continuous assessment test, written assignment, Quiz and Final assessment test				
Recommended by Board of Studies		27-07-2022		
Approved by Academic Council		No. 67	Date	08-08-2022

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Course Code	Course Title	L	T	P	C
MBIT604L	Programming For Biologists	3	0	0	3
Pre-requisite	Nil	Syllabus version			
		1.0			

Course Objectives

1. Learn about the computer architecture, operating systems and shell scripts
2. Understand the scope of PERL and Python programming for biological tasks
3. Acquire knowledge on digital technologies for medical and biological applications

Course Outcome

The student will be able to

1. Compile the hardware's for digital and analog computers
2. Utilize Linux for biological data acquisition, submission and analysis
3. Develop shell scripts for biological sequence alignment and comparison
4. Design programs based on PERL for biological string manipulation
5. Utilize PERL for complex biological data analysis
6. Work on Python environment using biological data and design digital tools for industrial use

Module:1	**Computer Architecture and Elements:**	**6 hours**

Evolution of Computer Technology, Types of Computers, Digital and Analog computers, Generations of Computers, Computer Languages and operating systems.

Module:2	**Unix:**	**6 hours**

Learning the essentials, the Unix tree, the terminal, Unix commands- print the working directory,change directories, man command, make a new directory. Fire the editor – the nano editor.

Module:3	**Shell Scripting:**	**6 hours**

The power of shell scripts - sticking to the script, hello.sh, $PATH, permission - chmod , Grep –pipe, heads and tails, counting with grep.

Module:4	**Perl basics:**	**6 hours**

Programming environment, Scalar variables, Operator Precedence, Conditional statements, Stringcomparison operators in Perl, Matching Operators.

Module:5	**Programming in Perl:**	**6 hours**

Arrays - common array functions array indexes, loops - for loop, foreach loop, while loop, do loop, Hashes - keys and values.

Module:6	**Python basics:**	**7 hours**

Introduction and environment, Running Python programs, Storing strings in variables , Toolsfor manipulating strings – Concatenation, string length and changing case.

Module:7	**Python programming:**	**6 hours**

Problems in biological sequence analysis: Counting DNA nucleotides, Transcribing DNA intoRNA, Complementing a strand of DNA, Computing GC content and calculating protein mass.

Module:8	**Contemporary issues**	**2 hours**

		Total Lecture hours:	**45 hours**
Textbook(s)			
1.	Campbell, Gries, Montojo, and Wilson. 2010 “Practical Programming: An Introduction toComputer Science Using Python” Published by Pragmatic Bookshelf.		
Reference Books			
1.	Bal, Harshawardhan P. 2013, PERL programming for Bioinformatics. Tata McGraw-HillEducation.		
2.	Blum, Richard, 2010. Linux command line and shell scripting bible. Vol. 481. John Wiley &Sons.		
Mode of Evaluation : Continuous assessment test, written assignment, Quiz and Final assessment test			
Recommended by Board of Studies	27-07-2022		
Approved by Academic Council	No. 67	Date	08-08-2022

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Course Code	Course Title	L	T	P	C
MBIT605L	Food Process Technology	3	0	0	3
Pre-requisite	Nil	Syllabus version			
		1.0			

Course Objectives

1. To understand the conventional and non-conventional methods of food processing.
2. To understand the basics in food packaging.
3. To comprehend the various steps involved in food product development.

Course Outcome

The student will be able to

1. Make use of the knowledge on Biotechnology to the science of food.
2. Demonstrate the scope of food processing
3. Explain the principles involved in food processing
4. Make use of the knowledge for understanding preservation of food
5. Create or design a food product with innovative technologies
6. Apply for employment in food processing industries

Module:1	Introduction	5 hours

Potentiality, scope and relevance of Food process industry; Principles and salient features of foodprocessing methods.

Module:2	Thermal Processing	7 hours

Blanching, pasteurization, sterilization (canning and bottling), evaporation, extrusion, dehydration and spray drying, dielectric and infrared heating.

Module:3	Non- thermal processing	6 hours

Chilling or refrigeration, freezing, freeze drying, minimal processing of foods; vacuum cooling offoods; and fermentation.

Module:4	Emerging technologies in food processing	7 hours

High pressure processing of foods, enzyme assisted food processing, PEF technology, foodirradiation-principle, process.

Module:5	Packaging for processed food products	6 hours

Scope of packaging industry; traditional packaging; modern packaging materials- Case study –Nano packaging.

Module:6	Food Product Development	5 hours

Overview of food product development- concept, design, sensory testing; shelf life assessment for food products and Commercialization of food products.

Module:7	Food Quality and Safety Assurance	7 hours

Key concepts in quality control; National (FSSAI) and International quality programs (HACCP,ISO22000); Case Study-Safety aspects of food nano-materials.

Module:8	Contemporary issues	2 hours

			Total Lecture hours:	**45 hours**
Textbook(s)				
1.	P.J. Fellows. 2016. Food Processing Technology. 4th Edition. Woodhead Publishing. P.1152.			
Reference Books				
1.	Theodoros Varzakas, Constantina Tzia(Eds.) 2015. Handbook of Food Processing: Food Preservation.p.706.CRC Press.			
2.	Contantinos A. Georgiou (Editor), Georgios P. Danezis (Editor). 2017. Food Authentication:Management, Analysis and Regulation. Wiley-Blackwell. 568 pages.			
Mode of Evaluation: Continuous assessment test, written assignment, Quiz and Final assessment test				
Recommended by Board of Studies		27-07-2022		
Approved by Academic Council		No. 67	Date	08-08-2022

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Course Code	Course Title	L	T	P	C
MBIT606L	Natural Product Technology	3	0	0	3
Pre-requisite	Nil	Syllabus version			
		1.0			

Course Objectives

1. Explain the importance of natural products
2. Learn the chemical and biological synthesis of metabolites
3. Demonstrate drug discovery and development

Course Outcome

The student will be able to

1. Demonstrate key concepts related to classification, collection and processing of natural products from different organisms
2. Develop the detailed knowledge about chemistry of medicinal compounds of natural origin
3. Relate the processing, extraction and purification of different kinds of natural products
4. Make use of the recent developments in the subject
5. Elaborate the scale up process
6. Relate the sustainable usage of bio resources and its natural products for the welfare of mankind

Module:1	Natural product and their Importance	6 hours

Classification of natural products. Collection and processing methods of extraction – Purification and concentration - Identification.

Module:2	Secondary Metabolites I	6 hours

Chemistry, biological synthesis and types of Terpenoids, Sterols, glucosides, phenolics and Alkaloids, vitamins, Biosynthetic pathway and fatty acid metabolism, shikimic acid pathway

Module:3	Secondary Metabolites II	6 hours

Essential oils, volatile oil, Poisonous plants sources and toxic manifestations of poisonous plants.

Module:4	Pigments and Natural Dyes	6 hours

History, importance, chemistry and types, dye extraction and fabric dye process, Application of Technology for the production of natural dyes and colourants.

Module:5	Herbal Products	6 hours

Medicinal plant and herbal practice in India – Introduction – History - Herbal Practice - Study of different traditional medicine – Conservation sustainable utilization.

Module:6	Marine Natural Products	5 hours

Introduction, sources, examples, antibiotics, bioactivity. Isolation methods, processing methods – Applications.

Module:7	Microbial Natural Products	8 hours

Sources, extraction, biological activity and mass cultivation – bioreactor, applications – food, agriculture, pharmaceuticals, cosmetics industry. Recent trends and research in natural products technology: Biotechnological methods to improve production, case studies.

Module:8	Contemporary issues	2 hours

		Total Lecture hours:	**45 hours**
Textbook(s)			
1.	Talapatra S K and Talapatra B. (2015) Chemistry of Natural Products. Springer Publications.		
2.	Kinghorn A D, Falk Hains (ed.) (2016) Progress in the chemistry of organic natural products,Springer Publications.		
3.	Paul M Dewick (2011) Medicinal Natural products: A biosynthetic approach, 3nd Edition,John wiley and sons Ltd.		
Reference Books			
1.	Atta Ur Rahman 2017. Studies in Natural Products Chemistry Vol.25 Elsevier Publications.		
2.	Herwig O Gutzeit, Jutta Ludwig-Müller (2014) Plant Natural Products: Synthesis, Biological Functions and Practical applications, Wiley publishers		
3.	Ilkay Ergogan orhan, (2012) Biotechnological production of plant secondary metabolites.Bentham e books		
Mode of Evaluation: Continuous assessment test, written assignment, Quiz and Final assessment test			
Recommended by Board of Studies	27-07-2022		
Approved by Academic Council	No. 67	Date	08-08-2022

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Course Code	Course Title	L	T	P	C
MBIT607L	Plant Biotechnology	3	0	0	3
Pre-requisite	Nil	Syllabus version			
		1.0			

Course Objectives

1. To provide an understanding of plant physiology, cell to cell communication and plant genomerelated aspects
2. To provide knowledge about plant tissue culture techniques and crop improvement
3. To impart knowledge on different bio technological techniques to alter the plants suited tomodern agriculture and industrial application

Course Outcome

The student will be able to

1. Demonstrate plant tissue culture techniques for the enhancement of secondary metabolitesproduction.
2. Explain the various components involved in developing transgenic plants
3. Illustrate production of new bio-molecules in plant using transgenic technology
4. Compare and apply molecular marker technology in plant breeding
5. Demonstrate the importance of biosafety in developing transgenic plant
6. Improve crop plants through gene transfer methods

Module:1	Tissue culture	6 hours

Totipotency, equipotency, pluripotency and plasticity. Explants. Cultures - single cell, callus, cell- suspension, protoplast, leaf, root, shoot tip and meristems, embryo, anther, microspore and ovary culture. Somatic embryogenesis, organogenesis and hardening. Industrial applications of tissue culture.

Module:2	Designing of a plant based expression cassette	6 hours

Features of a plant transformation vector. Constitutive, inducible and tissue specific promoters, terminators and regulatory elements; Selectable markers and reporter genes; Modification of an heterologous gene (animals, microbes) for plant transformation.

Module:3	Plant transformation techniques	6 hours

Nuclear and plastid transformation; Agrobacterium mediated and direct gene transfer methods.Binary vectors, Gateway vectors and RNAi vectors.

Module:4	Case studies for transgenics	6 hours

Herbicide tolerance [Round Up Ready], Bt crops, Golden Rice, Transgenic crops designed fortolerance to abiotic and biotic stress.

Module:5	Molecular pharming	6 hours

Transgeni systems to derive carbohydrates, plantibodies edible vaccines enzymes, biopharmaceuticals, bioplastics, biofuel, silk and elastin. Gene to functional protein processing steps in plants; Elicited cell cultures for maximizing yield of metabolites

Module:6	Marker assisted breeding	6 hours

Phenotypic, enzyme and molecular markers, co-dominant and dominant markers, Basics- linkage analysis and QTL mapping

Module:7	IPR issues	7 hours

Global status and bio-safety concerns for production and release of transgenic plants. Plant breeder's rights, copyright,

trade mark and patents.		
Module:8	**Contemporary issues**	**2 hours**
	Total Lecture hours:	**45 hours**

Textbook(s)	
1.	Adrian Slater, N. W. Scott and M. Fowler. 2014. Plant Biotechnology: The GeneticManipulation of Plants, Second Edition, Oxford University Press, UK.
Reference Books	
1.	Roberta H. Smith. 2013. Plant Tissue Culture Techniques and Experiments, 3rd Edition,Elsevier Inc., UK.
2.	Bahadur, B., M.V. Rajam, L. Sahijram and K.V. Krishnamurthy. 2015. Plant Biology andBiotechnology, Vol. 2, Springer, New Delhi.
3.	Richroch, A. S. Chopra and S. Fleischer. 2014. Plant Biotechnology, Springer InternationalPublishing, Switzerland.
4.	Alverz and M. Alejandra. 2014. Plant Biotechnology for Health: From Secondary Metabolitesto Molecular Farming. Springer International Publishing, Switzerland.
5.	Fett-Neto, A.G. 2016. Biotechnology of Plant Secondary Metabolism. SpringerScience+Business Media, New York.

Mode of Evaluation: Continuous assessment test, written assignment, Quiz and Final assessment test			
Recommended by Board of Studies	27-07-2022		
Approved by Academic Council	No. 67	Date	08-08-2022

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Course Code	Course Title	L	T	P	C
MBIT608L	Animal Biotechnology	3	0	0	3
Pre-requisite	Nil	Syllabus version			
		1.0			

Course Objectives

1. To perceive the utility of in vitro modification of animal cells
2. To appraise the modern advancement of animal reproductive technology
3. To improve the principle of conservation of farm animals and related ethics.

Course Outcome

The student will be able to

1. Explain the utility of animal cell culture techniques.
2. Apply animal cell culture techniques for research works
3. Make use of advanced animal reproductive technology
4. Utilize and apply transgenic techniques in farm animal productions.
5. Develop interests in conservations of animal resources.
6. Demonstrate interests in reclaiming impaired animals resources and management.

Module:1	Animal cell culture and gentransfer methods	6 hours

Eukaryotic, embryonal, and stem cell culturing techniques; Methods to introduce trans gene into cell, regulation of gene expression, Cell line characterization, Industrial applications of animal cellculture.

Module:2	Manipulations and applications of animal cell culture	6 hours

Cell synchronization, cell immobilization techniques, Cryopreservation. Primary and secondarycell culture, MEFs isolation. Protocols for Immortalization of cells.

Module:3	Advanced Reproductive methods	7 hours

Physiology of reproduction, Artificial Insemination, Estrous synchronization; superovulation; embryo transfer, pregnancy and parturition control; Immunological methods of control reproduction, monitoring reproductive status, in-vitro fertilization, sperm and embryo sexing; pre-implantation; genetic diagnosis.

Module:4	Germ-line modification Procedures and Engineering the progeny	6 hours

Direct manipulation of fertilized egg, Manipulation of early embryonic tissue in place; the use ofembryonic stem cells and tissue engineering. Methods and applications of animal cloning.

Module:5	Genome based knowledge and Conservation Modalities	6 hours

Animal and human Genome projects, NGS and its applications, genetic linkage maps; polymorphic DNA markers; Physical map; integrating genetic linkage and physical map; DNA sequencing.

Module:6	Conservation Methods and ethical treatment of Animals	6 hours

Animal Disease and Extinction, Molecular techniques in genetic conservation of Farm Animals, Introduction to animal ethics; Animal rights and use of animals in the advancement of medical technology; Introduction to laws and regulation regarding use of animals in research. Ethical, Legal and Social Implications.

Module:7	**Animal models and their applications in Health Care Systems**	**6 hours**
Animal models used in biomedical research such as Cancer, Diabetes, Immunology, cosmetics andtoxicology, Updates on gene targeting technology and Gene editing.		
Module:8	**Contemporary issues**	**2 hours**
	Total Lecture hours:	**45 hours**

Textbook(s)	
1.	Primrose SB, Twyman RM (2015): Principles of gene manipulation and genomics, (8th edn). Wiley-Blackwell publishing, Oxford UK.
Reference Books	
1.	Alberts B, Johnson A, Lewis J, Raff M, Roberts K, Walter P (2014): Molecular biology of the cell, Garland Science, 6th edn, New York, USA.
2.	Bernard R Glick, Jack J Pasternak (2010) Molecular biotechnology: principles and applications of recombinant DNA, ASM press, 4th edn, Washington, DC, USA.

Mode of Evaluation: Continuous assessment test, written assignment, Quiz and Final assessment test			
Recommended by Board of Studies	27-07-2022		
Approved by Academic Council	No. 67	Date	08-08-2022

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Course Code	Course Title	L	T	P	C
MBIT609L	Pharmaceutical Biotechnology	3	0	0	3
Pre-requisite	Nil	Syllabus version			
		1.0			

Course Objectives

1. Outline the basic theories of biopharmaceutics and pharmacokinetics
2. Discuss, dissect, interpret and build an awareness on pharmacology and biotechnologybased pharmaceutical products
3. Evaluate and apply the fundamental knowledge in biotechnology-based applications in thepharmaceutical and sectors related to drug development and use

Course Outcome

The student will be able to

1. Recall and relate the mechanism of action and illustrate the importance of understanding aboutADME.
2. Develop various formulations based on biopharmaceutical analysis
3. Demonstrate the concepts and outline the importance of nano based drug delivery systems andillustrate the nuances of Good Manufacturing Practices
4. Explain the challenges in new drug development (including biologics) and clinical trials
5. Elaborate upon and assess the regulatory approval criteria for bulk drugs and biologics
6. Explain pharmacology research as a career to develop newer products as well as have a solidfoundation to critically evaluate the cutting edge issues in Pharmaceutical Biotechnology

Module:1	General Pharmacology	6 hours

Sources of drugs, different dosage forms and routes of drug administration, mechanism of action of drugs. Combined effect of drugs, factors modifying drug action, tolerance and dependence,Pharmacogenetics, kinetics - Absorption, Distribution, Metabolism and Excretion of drugs.

Module:2	Bio-pharmaceutics	6 hours

Rate of drug absorption after administration, drug concentration in blood, biological factors in drug absorption, Iodell-chemical factors, dosage form consideration for gastrointestinalabsorption, drug distribution, site seeking and drug elimination, protein - drug interactions.

Module:3	Formulative Pharmacy	6 hours

Manufacturing, quality control, stability testing and storage of tablets, capsules, parenterals, solutions, aerosols and ointments.

Module:4	Good manufacturing practices	7 hours

Organisation and personnel, responsibilities, training, hygiene. Premises: Location, design, plant layout, construction, maintenance and sanitation, environmental control, utilities and services like gas, water, maintenance of sterile areas, control of contamination. Controls on animal house.

Module:5	Nanocarriers	6 hours

Nanomedicine, Fundamentals and rationale sustained/controlled/targeted drug delivery. Liposomes, Dendrimers, Polymeric micelles, Nanoparticles (Polymeric and Lipid based), Nanoemulsions.

Module:6	Biologics	6 hours

rDNA drugs - insulin, subunit Vaccines, Therapeutic proteins, Hormones, Immunobiologicals - Monoclonal antibodies, Interferons, Biosimilars.		
Module:7	**New drug development**	**6 hours**
Concepts, pre-clinical trials, design of clinical trials, phases of clinical trials and testing of drugs in human. ICH, FDA, EMEA and Indian drug regulations **Regulatory Affairs:** Globalization of drug industry, present status and scope of pharmaceutical industry in India. WHO and NABL certification. Regulatory aspects of pharmaceutical and bulk drug manufacture, regulatory drug analysis.		
Module:8	**Contemporary issues**	**2 hours**
	Total Lecture hours:	**45 hours**

Textbook(s)	
1.	Loyd V Allen, Howard C, Ansel, (2013) Ansel's Pharmaceutical Dosage Forms and DrugDelivery Systems, Wolters Kluwer Health.
	Satoskar RS, Bhandarkar SD, Nirmala N Rege, Satoskar RR (2008)
2.	Pharmacology andPharmacotherapeutics, 20th Edition Popular Prakashan (P) Ltd.
	Leon Sharge, Andrew Yu, Susanna Wu-Pong (2012) Applied
3.	Biopharmaceutics &Pharmacokinetics, 6th Edition, McGraw-Hill Education / Medical.
Reference Books	
1.	Laurence Brunton, Bruce A Chabner, Bjorn Knollman (2011) Goodman and Gilman's the Pharmacological Basis of Therapeutics, 12th Edition, and McGraw Hill Education.
2.	Roop K Khar, Vyas SP (2013) Lachman/Liebermans: The Theory and Practice of Industrial Pharmacy, 4th Edition, CBS.
3.	Gregg N Milligan, Alan DT Barrett (2015) Vaccinology: An Essential Guide, 1st Edition, Wiley-Blackwell.
4.	Judy Owen, Jenni Punt, Sharon Stranford (2013) Kuby Immunology, 7th Edition, W. H. Freeman.
5.	Melgardt M de Villiers, Pornanong Aramwit, Glen S (2009) Nanotechnology in Drug Delivery: 10 (Biotechnology:Pharmaceutical Aspects),Kwon Publisher:Springer

Mode of Evaluation: Continuous assessment test, written assignment, Quiz and Final assessment test			
Recommended by Board of Studies	27-07-2022		
Approved by Academic Council	No. 67	Date	08-08-2022

VIT®
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Course Code	Course Title	L	T	P	C
MBIT610L	Environmental Biotechnology	3	0	0	3
Pre-requisite	Nil	Syllabus version			
		1.0			

Course Objectives

1. Analyse environmental pollution and to develop suitable technologies to solve the problems
2. Understand the bases for microbial metabolism of environmental contaminants
3. Apply scientific concepts to environmental problems and their correlation with technologicalconcepts

Course Outcome

The student will be able to

1. Examine the sources of environmental pollutants and their impacts
2. Demonstrate the applications of various fields including chemistry, biochemistry, molecular biology and/or microbiology, in understanding and addressing the above issues, as well as exploringenvironmental resources for new technologies.
3. Outline the biological treatment processes and development of suitable technologies
4. Explain the microbial processes and growth requirements undelaying the activated sludge process, nitrification, denitrification, enhanced phosphorus removal, and anaerobic digestion
5. Evaluate alternative process schemes for combined biological nutrient removal
6. Demonstrate the role of microorganisms in processes such as biofilm formation and mineral leaching and to examine the potential of micro and macro-organism in biodegradation

Module:1	Sources and Treatments of various pollutants	3 hours

Pollutants – nature, sources & classification. Comparison of biotechnological treatment with othermethods. Functions of microbial groups – metabolic pathways of biodegradation

Module:2	Recent Molecular Tools involved in Remediation	5 hours

Biotechnological tools in Environment – Living organisms as indicators of pollution. Molecularanalysis of microbial community - sequence- a nd function-based screening of metagenomic libraries - Community Transcriptomics & metaproteomics. Catalytic evolutionary engineering

Module:3	Conventional methods used in Waste Water Management	5 hours

Air pollution - Methods of odour and VOC Control. Types, structure design and operation of bioreactors, bio-scrubbers, bio-filters. Case studies for odour removal from municipal waste waters and sulphurous emissions.

Module:4	Biofilm based Remediation Technologies I	4 hours

Aerobic and anoxic suspended growth biotechnologies: conventional/high rate activated sludge system, Powder activated & Carrier activated sludge process – Nitrification/ phostrip process. vertical & Attached growth technologies.

Module:5	Biofilm based Remediation Technologies II	2 hours

Trickling/ denitrification RBC/ FBR/ PBR and hybrid systems.

Module:6	Bio-Reactors based degradation	5 hours

Solid-state bioreactors – aerated/mixed/anaerobic – types, operation and optimization. Landfilland composting. Mineral and metal extraction biotechnology.

Module:7	**Remediation by micro and macro-organism**	**4 hours**
Natural Environmental biotechnology – aquaculture treatment: water hyacinth & wetland system, evapotranspiration system. Land treatment – rapid/slow/overland flow systems, subsurface infiltration – algal & vegetative filter system.		
Module:8	**Contemporary issues**	**2 hours**
	Total Lecture hours:	**30 hours**

Textbook(s)	
1.	Scragg, A.H., 2005. Environmental biotechnology. New York: OXFORD university press. Wang, L.K., Ivanov, V., Tay, J.H. and Hung, Y.T. eds.,2010.
2.	Environmentalbiotechnology (Vol. 10). Springer Science & Business Media. Singh, A., 2004.
3.	Biodegradation and bioremediation (Vol. 2). Springer Science & Business Media.
Reference Books	
1.	Rittmann, B.E. and McCarty, P.L., 2012. Environmental biotechnology: principles and applications. Tata McGraw-Hill Education.
2.	Evans, G.M. and Furlong, J.C., 2003. Environmental biotechnology: theory and application IK International Pvt Ltd.
3.	Vallero, D.A., 2015. Environmental biotechnology: a biosystems approach. Academic press.

Mode of Evaluation: Assignments, Quiz, Continuous assessment tests and Final assessment test			
Recommended by Board of Studies	27-07-2022		
Approved by Academic Council	No. 67	Date	08-08-2022

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Course Code	Course Title	L	T	P	C
MBIT611L	Aquatic Biotechnology	3	0	0	3
Pre-requisite	Nil	Syllabus version			
		1.0			

Course Objectives

1. Extensive understanding the aquatic ecosystems and their bio-resource potentials
2. To explore and utilize of organisms from marine and fresh waters extensively
3. Apply the genetic principles to aquatic species used in mariculture, aquaculture

Course Outcome

The student will be able to

1. Improve the yields of farmed fish and shellfish through biotechnological approaches.
2. Elaborate and ensure sustainability in mariculture and aquaculture.
3. Develop interests in Blue biotechnology.
4. Utilize of aquatic organisms for biofuels, therapuetics productions.
5. Support interests in reclaiming impaired water resources.
6. Elaborate characterization and management of aquatic genetic resources

Module:1	Scope and Challenges in marine and aquatic biotechnology	7 hours

Global and Indian scenario; Demand for marine bioproducts; market value; marine bioproduct based industries; marine bioeconomy; Marine socio-economics; Entrepreneurship; International and Indian policies; Marine biotechnology parks in various states; R&D institutions, centres and consultation services.

Module:2	Marine and Aquatic Ecology	6 hours

Aquatic Ecosystems; Benthic and Pelagic Zone; Photic, dysphotic and aphotic zones - importance and their significance. Biological divisions of the sea- estuaries and backwaters, lagoons, mangroves, coastal waters, inshore, offshore, deep sea/oceanic zone.

Module:3	Biological Resources and taxonomy	6 hours

Sampling, cultivation and taxonomy of organisms. Metagenomics. Flora, Fauna, Bacteria, fungi, algae and archaea. Extremophilic microorganisms; Fisheries and other aquatic potential.

Module:4	Marine Biogeochemical cycles	6 hours

Role of aquatic and marine organisms in carbon, nitrogen, phosphorous and sulphur cycles.

Module:5	Marine microbial pathogens	6 hours

Microbial pathogens in marine environment – diversity, sources and detection of pathogens in recreational water, impact of harmful algal blooms, microbial pathogens of seafood.

Module:6	Marine Pharmacology	6 hours

Marine derived drugs in preclinical and clinical trials- FDA and EMEA approved marine derived drugs, their use and mode of action. Screening of drugs High-throughput Screening Assays (HTS) Bioassays- Enzyme assays, cytotoxicity assay; antimicrobial assay; DNA laddering assay; Apoptosis assays.

Module:7	Marine Bioprospecting	6 hours

Marine organisms for Biofuels and bioenergy, Bioremediation, Biofouling, Biosurfactants. Marine natural products as cosmetics-cosmeceuticals, algotherapy; Thalassotherapy; Enzymes; food, supplement, nutrition and energy drinks. Marine algae as fish feed, manure and fertilizers.			
Module:8	**Contemporary issues**		**2 hours**
Total Lecture hours:			**45 hours**
Textbook(s)			
1.	Didier Montet and, Ramesh C. Ray (Eds.) 2011, Aquaculture Microbiology and Biotechnology, Vol 2. Science Publishers; 1 edition.		
Reference Books			
1.	George Karleskint, Richard Turner, and James Small (Eds.) Brooks Cole, 2013, Introduction to Marine Biology.; 4th edition.		
2.	Dewan S. Bhakuni and, D.S. Rawat (Eds.)), 2010, Bioactive Marine Natural Products. Springer.		
3.	Munn and Munn, 2011, Marine Microbiology: Ecology and Applications. BIOS, Scientific Publisher.		
Mode of Evaluation: Assignments, Quiz, Continuous assessment tests and Final assessment test			
Recommended by Board of Studies	27-07-2022		
Approved by Academic Council	No. 67	Date	08-08-2022

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Course Code	Course Title	L	T	P	C
MBIT612L	Proteomics	3	0	0	3
Pre-requisite	Nil	Syllabus version			
		1.0			

Course Objectives

1. To exemplify the application of proteomics analysis in various fields
2. To impart basic concepts, interpreting skills in proteomics
3.
4. To identify as many individual proteins as possible in a given biological sample to the development of high-throughput, parallel and quantitative technologies

Course Outcome

The student will be able to

1. Interpret the proteome analysis and discuss the advantages and limitations of different experimental approaches.
2. Identify proteins by peptide mass fingerprinting using MALDI TOF.
3. Discuss how biological systems information relating to genes, proteins and cellular structurescan be used to model living cells, and even to create new synthetic cells
4. Identify and discuss the techniques used in functional genomics and proteomics next generation sequencing technology and Interpret data obtained through high throughput expression studies.
5. Illustrate the different types of genome variation and their relationship to human diseases.
6. Survey the databases that store various data about genes, proteins, genomes and proteomes

Module:1	Proteome analysis:	6 hours

Proteomics work flow, Proteome analysis by single dimension electrophoresis, two-dimensional electrophoresis: solublisation of proteins, protein enrichment strategies, IEF, image analysis, computational tools used in 2D gel electrophoresis, multi-dimensional proteomics.

Module:2	Mass spectrometry:	4 hours

Principles, sample preparation, interpretation of mass spectrometry data, peptide sequence matching; peptide mass fingerprinting.

Module:3	Proteomics approaches	7 hours

Proteomics to study post translational modifications, protein-protein interactions using yeast 2 hybrid systems, structural proteomics, functional proteomics, comparative proteomics, quantitative proteomics, and organelle proteomics: golgi, mitochondria and chloroplast.

Module:4	Proteomics and NGS	7 hours

Top down and bottom-up proteomics, Proteogenomics and re-annotation of genomes, examples of protegeomics approaches, Interactome analysis. Chemical proteomics, Reconciling proteomics with next generation sequencing.

Module:5	Advanced proteome analytical approaches:	6 hours

Gel free proteomics: ICAT, iTRAQ, ICPL, TMT, SILAC, off gel electrophoresis, single cell proteomics,ecological proteomics, positional proteomics, global and targeted proteomics, signature peptides, secretome analysis.

Module:6	Human proteome	6 hours

HPP, proteome biomarkers - discovery and validation, proteome biomarkers in cancer, diabetes, cardiovascular, lung disease and infectious diseases, proteomics in toxicology, serum proteomics, pan-proteomics.		
Module:7	**Proteome databases and tools**	**7 hours**
Protein and proteome databases, softwares and computational tools used in proteomics, Trans-proteomic pipeline, protein de novo sequencing, Sequest, Mascot, Statistical validation of peptide identification, shotgun protein identification, PeptideProphet, Target decoy strategy, protein interaction network mapping.		
Module:8	**Contemporary issues:**	**2 hours**
	Total Lecture hours:	**45 hours**

Textbook(s)	
1.	Richard M Twyman (2013) Principles of proteomics, 2nd Edition, Garland Science Publications. Nawin C Mishra (2010) Introduction to proteomics: Principles and applications, Wiley Blackwell.
Reference Books	
1.	Simon J Hubbard, Andrew R Jones (2010) Proteome bioinformatics, Humana Press.
2.	Tsz-Kwong Man, Ricardo J Flores (2011) Proteomics – Human diseases and protein functions, InTechPublishers.
3.	Oliviero Carugo, Frank Eisenhaber (2010) Data mining for genomics and proteomics, 1st Edition, Humanna Press.
4.	Xiangdong Wang (2013) Bioinformatics for human proteomics. Springer.
5.	Gyorgy Marko-Varga (2014) Genomics and proteomics for clinical discovery and development.Springer.
6.	Rune Matthiesen (2013) Mass spectrometry data analysis in proteomics, 2nd Edition, Humana Press.

Mode of Evaluation**:** Assignments, Quiz, Continuous assessment tests and Final assessmenttest			
Recommended by Board of Studies	29-07-2022		
Approved by Academic Council	No. 67	Date	08-08-2022

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Course Code	Course Title	L	T	P	C
MBIT613L	Cancer Biology	3	0	0	3
Pre-requisite	Nil	Syllabus version			
		1.0			

Course Objectives

1. Demonstrate understanding of the cellular and molecular mechanisms that are dysregulated incancerous cells.
2. Apply the genomic technologies and develop critical thinking skills in cancer research.
3. Analyze and prioritize the traditional chemotherapy and novel targeted therapeutic approachesin cancer

Course Outcome

The student will be able to

1. Demonstrate understanding of the subject related concepts and of contemporary issues
2. Identify, design and conduct experiments, as well as to analyze and interpret data
3. Apply critical thinking and innovative skills
4. Interpret Sense-Making Skills of creating unique insights in what is being seen or observed (Higher level thinking skills which cannot be codified)
5. Make use of techniques, skills and modern engineering tools necessary for clinical practice
6. Apply mathematics and science in engineering applications

Module:1	Mutagens, Carcinogens and mutations	6 hours

Molecular mechanisms of mutagens such as Chemical Carcinogen and radiation. Types of carcinogen and their mode of action with example

Module 2	Oncogene activation; Tumour suppressor inactivation and Cell cycle Dysregulation	6 hours

Function of Oncogene, proto-oncogene, tumor suppressor proteins and oncoviruses. Their role in cancer

Module:3	Evading apoptosis in cancer	6 hours

Apoptotic mechanism, altered pathways in cancer cells that can evade apoptosis. Pathways regulating tumor initiation and/or its progression

Module:4	Genomic instability	6 hours

Types of genomic instability: instability due to micro and mini satellite sequence, Loss of DNA repair mechanisms, Dysfunction of telomeres. Chromosomal aberrations that cause cancer. Single nucleotide polymorphisms and cancer

Module:5	Angiogenesis and Metastasis	5 hours

Tumor angiogenesis, Clinical significance in invasion, Three-step theory of invasion, Proteinasesand tumor cell invasion

Module:6	Cancer Diagnosis	Stem

The stem cell theory of Cancer, tumor heterogeneity, Origin of cancer stem cells and cancercontrol by targeting cancer stem cells. Detection of Cancers, Prediction of aggressiveness of cancer, Advances in cancer detection. Different forms of therapy, Chemotherapy, RadiationTherapy, Targeted therapy: Monoclonal antibody, kinase blockers

Module:7	Cancer therapeutics and Diagnosis	6 hours

Animal models used to study cancer, Nude mice, Transgenic and knock out mice, Cre mice, patient derived xenografts (PDXs). New genomic and proteomic approaches in cancer biology and therapeutics; COSMIC and TCGA databases and

their applications.		
Module:8	**Contemporary issues**	**2 hours**
	Total Lecture hours:	**45 hours**

Textbook(s)	
1.	Robert A Weinberg, 2013, The Biology of Cancer, Garland Science, ISBN: 9780815342205
Reference Books	
1.	Textbook readings; primary literature; in-class discussion. The Molecular Biology of Cancer:A Bridge from Bench to Bedside. Stella Pelengaris, Mike Khan -2nd Edition – 2013
2.	Molecular Biology of Cancer. Lauren Pecorina, 4th edition. Oxford University Press – 2016.Introduction to cancer biology, Robin Hesketh, Cambridge University Press – 2013.

Mode of Evaluation: Written examinations, assignments, research article presentations andquizzes			
Recommended by Board of Studies	27-07-2022		
Approved by Academic Council	No. 67	Date	08-08-2022

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Course Code	Course Title	L	T	P	C
MBIT614L	Medical Biotechnology	3	0	0	3
Pre-requisite	Nil	Syllabus version			
		1.0			

Course Objectives

1. Illustrate on microbes and non – microbial ailments and their treatment strategies
2. Infer the principle and applications of various diagnostic and imaging techniques
3. Demonstrate various therapeutics

Course Outcome

The student will be able to

1. Recall human anatomy and physiology
2. Infer the pathology of various genetic disorders
3. Outline on various microbial infectious diseases and biochemical disorders
4. Translate on prenatal and newborn screening techniques
5. Summarize the influence of genome variation in diseases and diagnostics
6. Demonstrate the applications of stem cell and organ culture and therapeutics

Module:1	Anatomy and Physiology	6 hours

Human Anatomy and Physiology; Introduction to Human Anatomy and Physiology – Major systems.

Module:2	Non-communicable diseases	6 hours

Inherited Non-communicable diseases –genetic disorders like downs syndrome, cystic fibrosis,autism etc.

Module:3	Overview of Non-infectious diseases:	6 hours

Cancer, cardiovascular, diabetes and other chronic diseases.

Module:4	Overview of Infectious diseases:	6 hours

Microbial – Bacterial, Viral, Fungal and Parasitic diseases. Investigation of epidemics. Methods ofculturing and assaying – Bacteria, Fungi, Virus and Parasites – Mode of action of antibiotics

Module:5	Genomic and precision medicine:	6 hours

Genetic screening and diagnosis: prenatal carrier testing and new-born screening for Mendelian diseases, The use of next-generation sequencing for solving diagnostic dilemmas

Module:6	Genomics in Medical Diagnostics	6 hours

Methods used in patient populations to uncover associations between genome variation and common diseases. Predictive tests for common, complex diseases.

Module:7	Stem Cell Culture	7 hours

Transplantation and teratogenesis Embryo culture stem cell culture – organ culture – artificial blood. Diagnostics Clinical – biochemical and immunological – therapeutics .genetic counseling.

Module:8	Contemporary issues	2 hours

			Total Lecture hours:	**45 hours**
Textbook(s)				
1.	Judit Pongracz, Mary Keen (2009) Medical Biotechnology			
Reference Books				
1.	Bernhard Palsson, Sangeeta N Bhatia (2004) Tissue Engineering, 2nd Edition, Prentice Hall,2004.			
2.	Pamela Greenwell, Michelle McCulley (2008) Molecular Therapeutics: 21st centurymedicine, 1st Edition, Sringer.			
Mode of Evaluation**:** Written examinations, assignments, research article presentations andquizzes				
Recommended by Board of Studies		27-07-2022		
Approved by Academic Council		No. 67	Date	08-08-2022

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Course Code	Course Title	L	T	P	C
MBIT615L	Microbial Technology	3	0	0	3
Pre-requisite	Nil	Syllabus version			
		1.0			

Course Objectives

1. The objective of the subject is to impart the knowledge of industrial bioprocesses, industrialproduction of various metabolites using living cells
2. It also illustrates some of important bioproducts produced in industries as case studies

Course Outcome

The student will be able to

1. Relate the subject related concepts and contemporary issues
2. Demonstrate the microbial secondary metabolites having industrial applications
3. Solve the current problems related to antibiotics, vaccines and anticancer drugs
4. Analyze the techniques, skills and modern engineering tools necessary for large scaleproduction of enzymes, recombinant products, food additives and biofuels
5. Elaborate a clear understanding of professional and ethical and social responsibility
6. Adapt to use the technology for the isolation and development of new microbial products

Module:1	**Industrially important microbial products:**	**4 hours**

Biomass – Yeast, Lactobacillus, Spirulina, Primary and secondary metabolites

Module:2	**Medical products**	**5 hours**

Antibiotics – Penicillin, Cephalosporin, Tetracyclins. Vaccines - TT, DPT, BCG, Anticancer compounds from microbes

Module:3	**Enzymes**	**4 hours**

General aspects of enzyme production. Industrial scale production of Protease, Lipase, Cellulase,Pectinase, Amylase

Module:4	**Recombinant products**	**4 hours**

Production of Insulin and Growth hormones. Recombinant enzymes and vaccine production.

Module:5	**Food additives**	**4 hours**

Organic acid Production: Acetic acid, Gluconic acid, Lactic acid. Amino acid production: Lysine and Glutamic acid. Vitamin Production: Pantothenic acid, Riboflavin, Vitamin B12, Ascorbic acid

Module:6	**Biofuels**	**4 hours**

Production of Bioethanol, Biobutanol, Biodisel, Biohydrogen, Methane production

Module:7	**Other Microbial products**	**4 hours**

Biofertilizers, Bioinsecticides, Biofungicides, Biopolymers, Biosurfactants, Microbial pigments

Module:8	**Contemporary issues**	**2 hours**
	Total Lecture hours:	**30 hours**

Textbook(s)	
1.	Textbook of Industrial Microbiology, by W. Crueger and A. Crueger. Publisher: Sinauer Associates
2.	Trivedi, PC (2009) Microbes – Applications and effects, 1st Edition, Aavishkar Publishers.
3.	Antonio Mendez Vilas (2009) Current topics in applied microbiology and microbial biotechnology, 1st Edition, World Scientific Publishers.
Reference Books	
1.	Ralph Mitchell, Ji-Dong Gu (2010) Environmental Microbiology, 2nd Edition, Wiley Blackwell Science.
2.	Heribert Insam Microbes at work – From waste to resources, 1st Edition, Springer.
3.	Alexander N Glazer, Hioshi Nikaido (2007) Microbial Biotechnology, 2nd Edition, Cambridge University Press.
4.	Alexander N Glazer, Hioshi Nikaido (2007) Microbial Biotechnology, 2nd Edition, Cambridge University Press.
5.	Industrial microbiology by G. Reed, Publishers: CBS
6.	Biology of Industrial microorganisms By A. L. Demain
7.	Industrial microbiology by A.H Patel
8.	New Products and New Areas of Bioprocess Engineering (Advances in Biochemical Engineering/Biotechnology, 68) by T. Scheper. Publisher : Springer Verlag

Mode of Evaluation: Written examinations, assignments, research article presentations and quizzes			
Recommended by Board of Studies	27-07-2022		
Approved by Academic Council	No. 67	Date	08-08-2022