Shobhit
Institute of Engineering & Technology
Deemed to-be-University
EDUCATION EMPOWERS

Syllabus
M.Sc. Biotechnology

Approved and adopted in year 2018 (Board of Studies, August 10, 2018)
by 23rd Academic council (Agenda no-3.2 e)

SCHEME OF TEACHING – M.Sc. (Biotechnology) 2020-2022,
FIRST YEAR
SEMESTER-I

Course Code	Course / Title	L	T	P	Credit
BTMS-101	Principles of Microbiology	3	1	0	4
BTMS-102	Biochemistry	3	1	0	4
BTMS-103	Fundamentals of Bioinformatics	3	1	0	4
BTMS-104	Enzymology	3	1	0	4
BTMS-105	Intellectual property rights, Biosafty &Bioethics	2	0	0	2
BTMS-151	Principles of Microbiology Lab.	0	0	2	1
BTMS-152	Biochemistry Lab.	0	0	2	1
BTMS-107	Fundamentals of Computer & IT	3	1	0	4
Total		**17**	**5**	**4**	**24**

SEMESTER-II

Course Code	Course / Title	L	T	P	Credit
BTMS-201	Food & Dairy Technology	3	1	0	4
BTMS-202	Immunotechnology	3	1	0	4
BTMS-203	Genetics	3	1	0	4
BTMS-204	Cell Biology	3	1	0	4
BTMS-251	Food & Dairy Technology Lab	0	0	2	1
BTMS-252	Immunotechnology Lab	0	0	2	1
BTMS- 206	Bioenergy Engineering	2	0	0	2
BMMS-203	Molecular Oncology	3	1	0	4
Total		**17**	**5**	**4**	**24**

SECOUND YEAR

SEMESTER-III

Course Code	Course / Title	L	T	P	Credit
BTMS-301	Plant Biotechnology	3	1	0	4
BTMS-302	Recombinant DNA Technology	3	1	0	4
BTMS-303	Animal Biotechnology	3	1	0	4
BTMS-304	Environmental Biotechnology	3	1	0	4
BTMS-351	Plant Biotechnology Lab	0	0	2	1
BTMS-352	Recombinant DNA Technology Lab.	0	0	2	1
BTMS- 311	Biostatistics	2	0	0	2
BMMS-301	Pharmacology & Toxicology	3	1	0	4
Total		**17**	**5**	**4**	**24**

SEMESTER-IV

Course Code	Course / Title	L	T	P	Credit
BTMS-481	Seminar	0	0	04	2
BTMS-491	Dissertation	0	0	24	12
	Total	**0**	**0**	**28**	**14**

Program Educational Objectives (PEOs):

PEO1. Apply basic knowledge of Cell Biology, Microbiology, Biotechnology, Genomics, Recombinant DNA Technology, Biostatistics and Research Methodology, and interdisciplinary engineering concepts to solve problems related to field of Biotechnology.

PEO2. Demonstrate the application of biotechnology practices and engineering principles through development of innovative products that are of beneficial for the human welfare and the nation.

PEO3. Exhibit skills of designing and production of different products based on biotechnology engineering.

PEO4. Exhibit strong, independent learning, analytical and problem solving skills with special emphasis on design, communication, and ability to work in teams.

PEO5. Pursue higher education and research in reputed institute at national and international level.

Program Outcomes (POs):

PO 1. Graduates will gain and apply knowledge of Biotechnology, Science and Engineering concepts to solve problems related to field of Biotechnology.

PO 2. Graduates will be able to identify, analyze and understand problems related to biotechnology Engineering and finding valid conclusions with basic knowledge in biotechnology Engineering.

PO 3. Graduates will be able to design and develop solution to Biotechnology Engineering problems by applying appropriate tools while keeping in mind safety factor for environmental & society.

PO 4. Graduates will be able design, perform experiments, analyze and interpret data for investigating complex problems in biotechnology Engineering and related fields.

PO 5. Graduates will be able to decide and apply appropriate tools and techniques in biotechnological manipulation.

PO6. Graduates will be able to justify societal, health, safety and legal issues and understand his responsibilities in biotechnological engineering practices

PO7 . Graduates will be able to understand the need and impact of biotechnological solutions on environment and societal context keeping in view need for sustainable solution.

PO 8. Use the techniques, skills, and modern engineering tools necessary for engineering practice.

PO 9. Design system, components or processes to meet realistic needs of society, environment, health and safety, and sustainability.

PO 10. Recognize the need for, and an ability to engage in life-long learning.

PO 11. Acquire knowledge of contemporary issues.

PO 12. Graduates will be able to demonstrate knowledge of project and finance management when dealing with Biotechnology Engineering problems.

Program Specific Outcomes (PSOs):

PSO1: Able to apply fundamental knowledge of basic Interdisciplinary content ((Physical andMathematical)alongwith appliedbiosciencecourses toapply the knowledgein followingstate of art subjects Bioinformatics and Computational Biology, Structural biology, Drug de-signing,GenomicsandProteomics.

PSO2: Able to apply basic knowledge and skills of various aspects of biotechnology to address the problems of food security, healthy food production, diseases etiology and environment.

PSO3: Able to pursue research in industry and institutions related animal, plant ,environmentbiotechnology or to be able to pursue higher studies in diverse fields of biotechnology andinterdisciplinary programs by applying principles of management,environmental, ethical, andsocialissues.

PSO4: Able to apply principles of soft computing skills, problem solving, creative thinking,group dynamics, team building,leadership skills, decision making skills, contributing tooverallpersonality,careerdevelopmentandinnovation.

SEMESTER I

PRINCIPLES OF MICROBIOLOGY

BTMS-101

Unit I:

Introduction of microbes, taxonomy and classification

Introduction to bacteria, fungi, and viruses, structural and cellular organelles differences among different types and classes ; biochemical/microscopic/molecular methods to differentiate archaea, eubacteria and eukaryotes; microbial evolution, systematics and taxonomy- new approaches to bacterial taxonomy, classification including ribotyping, characteristics of primary domains, taxonomy, nomenclature and Bergey's manual, ribosomal RNA sequencing.

Microbiology Techniques

Important milestones in microbiology, methods in microbiology-principles of microbial nutrition, culture media, theory and practice of sterilization, pure culture techniques, minimal and enrichment culture techniques.

Unit II:

Growth and nutrition:

Prokaryotic growth patterns and functions - microbial nutrition and growth - arithmetic and geometric growth expression, growth kinetics, growth curve, measurement of growth and growth yields, synchronous growth, continuous culture, diauxic growth, culture collection and maintenance of cultures.

Unit III:

Microbial Genetics:

Microbial regulation of gene expression (attenuation and negative regulation with e.g. trp and lac operon), transfer of genetic material: plasmids, transposons, transduction, transformation and conjugation. Mutations and their chemical basis; mutagens and their use in biotechnology; modes of recombination; comparative prokaryotic genomics.

Unit IV:

Host-microbe interaction:

Normal micro flora of skin, oral cavity, gastrointestinal tract; entry of pathogens into the host, types of toxins (exo, endo, entro) and their mode of actions, plant -microbe interactions, microbial pathogenesis -disease reservoirs; epidemiological terminologies; infectious disease transmission.

Unit V:

Microbes based therapies:

Antimicrobial agents, sulfa drugs, antibiotics -penicillin and cephalosporins, broad spectrum antibiotics, antibiotics from prokaryotes.antifungal antibiotics; mode of action, resistance to antibiotics. Bacteriophage therapy. Potential targets for drug design.

Course outcome (COs):

CO1	Identify microbiological techniques, the defining characteristics of the major groups microorganisms and apply to study microbial phylogeny
CO2	Classify the nutritional types of microorganisms and measure microbial growth
CO3	Evaluate how microorganisms interact with the environment in beneficial or detrimental ways
CO4	Assess impact of plant- microbe interaction on agriculture in both beneficial and detrimental ways. Identify industrially important microbes
CO5	Determine ways in which microorganisms play an integral role in disease, and the microbial and immunological methodologies are used in disease treatment and prevention
CO6	Apply the scientific method by stating a question; researching the topic; determining appropriate tests; performing tests; collecting, analyzing, and presenting data and effective communicate with both specialist and non-specialist audiences/community

REFERENCE BOOKS:

1. Willey, J.M., Sherwood, L.M. and Woolverton, C.J. 2008. Prescott, Harley and Klein's Microbiology (7theds.). McGraw Hill, USA
2. Subbarao, M.S. 2007. Soil Microbiology (4theds.). Oxford and IBH, New Delhi.
3. Pelczar, M.J., Chan, E.C.S. and Kreig, N.R. 2008. Microbiology (5theds.). Tata McGraw Hill, New Delhi
4. Dubey, R.C. and Maheswari, D.K. 2008. A text book of Microbiology (2ndeds.). S. Chand Publications
5. Stanier, R.Y. 2008. General Microbiology (5theds.). Mac Millan Press, Replica Press Pvt. Ltd.
6. Sullia, S.B. and Shantaram, S. 2005. General Microbiology (2ndeds.). Oxford and IBH Publications.
7. Nicklin, J. Instant Notes- Microbiology (2ndeds.). Viva Books Pvt Ltd.
8. Waites, M.J., Morgan, N.L. and Rocky, J.S. 2007. Industrial Microbiology (An Introduction), Indian eds., Backwell Publishers.
9. Kannan, N. 2002. Laboratory manual in general microbiology (2ndeds.). Panima Publishers.
10. Frazier. 2008. Food Microbiology (4th eds.), McGraw Hill, USA.

BIOCHEMISTRY

BTMS-102

Unit I:

Interaction in biological system: Importance of water, pH and buffer, cell structure and organelles, structure of biomolecules: structure of amino acids and proteins (primary, secondary, tertiary and quaternary structure, reverse turn), Ramachandran plot, peptide synthesis, protein sequencing, protein folding kinetics and cooperativity.

Unit II:

Lipids: Types, structure and function, oxidation of fatty acids- mitochondrial and peroxisomal oxidation, oxidation of unsaturated and odd chain fatty acids, ketone bodies, lipoproteins, rancidity, acid value, saponification value, iodine number, acetyl number, R.M. number. Biosynthesis of fatty acids, phospholipids and glycosphingolipids- synthesis.

Unit III:

Metabolic pathways and their regulation: Glycolysis/glycogenolysis, citric acid cycle, pentose phosphate pathway, oxidative phosphorylation, amino acid metabolism, basic nucleic acid structure, biosynthesis of purines and pyrimidines, glyoxalate cycle, CAM, and metabolomics.

Unit IV

Enzymes: Classification of enzymes; quantification of enzyme activity and specific activity. Effect of pH and temperature on enzyme activity, estimation of Michaelis-Menten parameters, kinetics of inhibition. Mechanism of enzyme catalysis with reference to chymotrypsin, lysozyme, metalloenzyme and the role of metals in catalysis with reference to carboxypeptidases. Allosteric enzymes: kinetics and examples. Techniques of enzyme immobilisation-matrix entrapment, ionic and cross linking, column packing.

Unit V

Enzyme Purification and Applications of Enzymes: Extraction of commercially important enzymes from natural sources; commercial applications of enzymes in food, pharmaceutical and other industries; enzymes for diagnostic applications. Industrial production of enzymes.Applications of enzymes in analysis; design of enzymeelectrodes and case studies on their application as biosensors in industry, healthcare and environment.

Course outcome (COs):

CO1	Demonstrate an understanding of various biochemical process and cell metabolism.
CO2	Distinguish between different metabolic processes and their impact in metabolism of biomolecules.
CO3	Select particular metabolic pathway involved in carbohydrate, protein and fat related metabolic issues
CO4	Apply and analyse the knowledge related to bioenergetics in living system.

REFERENCE BOOKS:

1. Nelson, D.L. and Cox, M.M. 2007. Lehninger Principle of Biochemistry (4theds.). W. H. Freeman and Co.
2. Berg, J.M., Tymoczko, J.L. and Stryer, L. 2007. Biochemistry (6theds.). W.H. Freeman and Co.
3. Voet, D.J., Voet, J.G. and Pratt, C.W. 2008. Fundamentals of Biochemistry (3rdeds.). John Wiley Sons Inc.
4. Satyanarayana, U. and Chakrapani, U. 2007. Essentials of Biochemistry (2ndeds.). Books and allied Pvt. Ltd.
5. Murray, R.K., Granner, D.K. and Rodwell, V.W. Harper's illustrated biochemistry (27theds.) McGraw Hill, USA.
6. Hames, D. and Hooper, N. 2008. Instant notes on biochemistry (3rdeds.). Taylor and Francis.

FUNDAMENTALS OF BIOINFORMATICS

BTMS-103

Unit I:

History of Bioinformatics Introduction, Sequence File Formats, Flat File, Biological Databases, Primary, Secondary, Composite databases, Homology and Analogy, Sequence analysis.:

Unit II:

Nucleotide and Protein sequence databases: NCBI, GeneBank, EMBL, DDBJ etc; Specialized sequence databases of EST, Unigene, ACeDB, SGD, Data retrieval with ENTREZ, SRS, DBGET.

Protein sequence databases: Protein primary sequence databases: UniProt, PIR, SwissProt, MIPS, TrEMBL, Expasy, etc. Secondary databases Pfam, PROSITE, BLOCK, PRINTS

Unit III:

Application tools: Primer designing. Molecular imaging and design, Tools for molecular mapping, Protein Information Sources, PDB, SWISSPROT, TREMBL, Understanding the structure of each source and using it on the web. Prediction of 3- dimensional structure of proteins.

Unit III:

Pairwise Sequence Alignment

Pair wise alignment: Local alignment, Smith Waterman algorithm , Global alignment &Needleman and Wunsch algorithm, Semi global alignment – Algorithms, Dot matrix, Dynamic Programming, Heuristic alignment algorithm: BLAST, FASTA.

Unit IV:

Multiple Sequence Alignment

Multiple Sequence Alignment: Progressive method and Iterative method, Scoring matrices, Profile analysis, BLOCK analysis, Pattern, Searching databases with multiple alignments.

Unit V:

Protein structure prediction: Secondary and tertiary structures; Homology Modelling, ORF prediction, Gene prediction, Micro array data analysis.

Course outcome (COs):

CO1	Explain the theoretical knowledge of database system and algorithms.
CO2	Analyze and discuss the results in light of molecular biological knowledge (sequence alignment and phylogenetic tree plot)
CO3	Collect the proficient knowledge to solve biological system- a multi-disciplinary problem
CO4	Develop the key skills of molecular modeling techniques currently practiced in any pharmaceutical research and development unit.

REFERENCE BOOKS:

1. David W. Mount. Bioinformatics: Sequence and Genome analysis, Cold Spring Harbor Laboratory Press.
2. Jones, N.C. and Pevzner, P. A. 2004. An Introduction to Bioinformatics Algorithms. The MIT Press.

ENZYMOLOGY

BTMS-104

Unit I:

Basics in enzymology: Nomenclature of enzymes, physiochemical characteristics of enzymes determination of M_r (relative molecular mass), determination of primary, secondary, tertiary and quarternary structure of enzymes, transient state kinetics of enzymes, stability of enzymes, allosterism, isoenzymes, importance of enzyme.

Unit II:

Enzyme engineering: Enzyme stabilization by genetic engineering, isolation and purification of enzymes (intra- and extracellular enzymes) and their methods, specific examples of enzyme engineering, tyrosyltRNAsynthetase, dihydrofolatereductase, subtilisin, enzyme turn over, abzymes, ribozymes.

Unit III:

Enzyme immobilization: Methods of immobilization: entrapment, covalent, membrane confinement, adsorption, reactor design for immobilization of enzymes, process design for immobilized enzyme reactors, enzymatic reaction kinetics, biotransformation, uses of immobilized enzymes.

Unit-IV:

Cytoplasmic membrane systems and protein trafficking: Synthesis of secretary, lysosomal or plant vacuolar proteins, integral membrane protein on rough endoplasmic reticulum, glycosylation in rough ER, vesicular transport, glycosylation in golgi complex.

Unit-V:

Cell cycle: Steps in cell cycle, cell cycle regulation and control; Cell communication and signaling: Cell receptors, signal transduction pathways in prokaryotes and eukaryotes, secondary messengers, GPCRs; Structure and function of intracellular cell organelles; Membrane structure and function;

Course outcome (COs):

Understand the growth kinetics, Monod equation and explain the role of various factors affecting the process of growth. They will also be able to define the media for submerged and solid-state fermentation process and sterilization
State the significance of application of process technology on enzyme production, enzyme kinetics, solve the mass balance of production process, learn the process of oxygen transfer rate, agitation systems
Collect the proficient knowledge of design of fermenter and operation of fermentation process, methods of translation of laboratory data to pilot scale process

REFERENCE BOOKS:

1. Goldsby, R.A., Kindt, T.J. and Osborne, B.A. Kuby's Immunology (4^{th}eds.). W H Freeman and Company.

2. Willey, J.M., Sherwood, L.M. and Woolverton, C.J. 2008. Prescott, Harley and Klein's Microbiology (7^{th}eds.). McGraw Hill, USA.

3. Playfair, J. and Bancroft, G. 2007. Infection and Immunity (3^{rd}eds.). Oxford University Press.

4. Chakravarty, A.K. 2008. Immunology and Immunotechnology (3rdeds.). Oxford University Press.

5. Tizard. 2008. Immunology: An introduction (4theds.). Cengege learning.

6. Rao, C.V. 2008. Immunology: A text book. Narosa Publishing House.

7. Cell (A Molecular approach): Cooper, G. M.

8. Cell and Molecular Biology (1996) Karp, G.

INTELLECTUAL PROPERTY RIGHTS, BIOSAFTY & BIOETHICS

BTMS-105 **Cr L T P**
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Unit I:
Introduction to IPR:
Copyrights - Nature of Copyright, Author & ownership of Copyright, Rights Conferred by Copyright, Assignment, Transmission, Licensing of Copyrights, Copyright Societies, Office, Board, Registration of Copyrights & Appeals, International Conventions, Copyright pertaining to Software/Internet, Database, Copyright Protection/Database Protection, IP issues in cyber space, Legal Position in USA/Indian Law/WIPO Copyright Treaty

Trademarks- Meaning of Trademarks, Different kinds of marks (brand names, logos, signatures, symbols), Use of a Mark, Registration of Trademarks-Procedure, Opposition to Registration-Procedure, What Marks are Registrable/Not Registrable, Concurrent Registration, Similarity of Marks, Assignment/Transmission/Licensing of Trademarks, Infringement of Trademarks, Passing off Action.
Patents-
i. General Introduction: Definition, Product / Process /Design Patents Claims, Dates Associated with patent, Patent Life and Geographical Boundaries, Patent Infringement, Utilization of Intellectual Assets, Ownership of Patents.
ii. Patent Search, Patent Databases & Library (USPTO, WIPO, EPO), Practical Search Training.
iii. Patent Terminology: (Abstract, Summary, Background, Drawings, Description, Claims)

Unit II:
Patent Filing Procedures: National & PCT filing procedure; Time frame and cost; Status of the patent applications filed; Precautions while patenting–disclosure/non-disclosure; Patent licensing and agreement Patent infringement.

Unit III:
Highlights of Indian patent Law(as amended in 2005) Elements of patentability: Patentable subject matter, Utility, novelty and non-obviousness, Patentability of biotechnological inventions –, biochemical and softwareParis Convention, World Trade Organization, World Intellectual Property organization, TRIPS Agreement, PCT, UPOV convention, Convention on Biological Diversity, Biopiracy, Traditional knowledge and benefit sharing**.**

Unit IV:
Biosafety: Introduction to Biological Safety Cabinets; Biosafety Levels of Specific Microorganisms; Biosafety guidelines:Definition of GMOs & LMOs;

Unit V:
Bioethics: Ethical implications of biotechnological products and techniques, Social and ethical implications of biological weapons.Bioethical guidelines and regulation in India as given by ICMR.

Course outcome (COs):

CO1	To understand and follow the regulatory framework important for the product safety and benefit for the society.
CO2	To devise business strategies by taking account of IPRs
CO3	To acquire adequate knowledge in the use of genetically modified organisms and its effect on human health
CO4	To gain more insights into the regulatory affairs.

REFERENCE BOOKS:

1. Dubey, R.C. 2007. A textbook of Biotechnology. S. Chand and Company Lld.
2. Gupta, P.K. 2008. Biotechnology and Genomics.Rastogi Publications.
3. Singh, B.D. 2008. Biotechnology-Expending horizons.Kalyani Publications.
4. Rao, R., Rao, A. and Bhanoji. 2008. Intellectual Property Rights- A Primer. Eastern Book Company.
5. Acharya, N.K. 2006 Text Book on Intellectual Property Rights. Asia Law House, Hyderabad.
6. Chawala, H.S. 2009 Introduction to Plant Biotechnology. Oxford and IBH.

PRINCIPLES OFMICROBIOLOGY LAB

MTMS-151

1. Laboratory rules and safety practices.
2. Microscopy and micrometry.
3. Identification of molds and yeast by simple staining.
4. Identification of bacteria by simple staining, differential staining (Gram staining, acid fast staining) and special staining (negative and endospore staining).
5. Sterilization of equipments, glass wares, media and other accessories used in microbiology laboratory.
6. Preparations of culture media: nutrient broth and nutrient agar

7. Culturing of micro organisms: liquid culture, solid culture in slants and plates (streak plate and pour plate cultures)
8. Isolation and identification of micro organisms from different sources – air, soil, water and milk.
9. Growth curve observations and growth characteristics of bacteria and yeast.
10. Effect of different parameters of bacterial growth, pH, temperature, antibiotics, carbon and nitrogen sources
11. Quantitation of fungi by dry weight method.
12. Test for degrading enzymes (cellulose, pectolytic enzyme, urease)
13. Testing of microbiological qualities of milk and water.
14. Anti-microbial sensitivity test.

Course outcome (COs):

CO1	Identify microbiological techniques, the defining characteristics of the major groups of microorganisms and apply to study microbial phylogeny
CO2	Classify the methods to measure microbial growth
CO3	Evaluate how microorganisms interact with the environment in beneficial or detrimental ways
CO4	Identify industrially important microbes

BIOCHEMISTRY LAB

MTMS-152

1. General guidelines for working in biochemistry lab.
2. Units of volume, weight, density and concentration measurements and their range in biological measurements. Demonstration of proper use of volume and weight measurement devices.
3. Preparation of different types of buffer.
4. Qualitative method for carbohydrates-distinguishing reducing from non-reducing sugar and keto- from aldo- sugar.
5. Quantitative and chromatographic method for amino acids estimation using ninhydrin reagent for distinguishing amino from imino acid.
6. Protein estimation by Biuret, Bradford and Lowry method.
7. Extraction of chloroplastic pigments, anthocyanin, carotenoids estimation and qualitative analysis by paper chromatography.
8. Estimation of sugars by anthrone method.
9. Determination of enzyme activity and effect of different factors.
10. Determination of permeability of β-cyanins across the membrane.
11. Determination of K_m and $V_{max.}$

Course outcome (COs):

CO1	To apply knowledge of biochemistry in various cellular functions, inculcate a knowledge of various issues related to life processes and the application

	of research involved in functioning of the different cell organelles and accessories.
CO2	To design and analyze the experiments related with the different molecules involved in biochemistry.
CO3	To identify, formulate, and solve problems arisen due to the inefficient functioning of the various life processes and anatomical aspects of plants and animals.
CO4	To use the techniques, skills, and modern tools necessary for imbalances in various life processes, design a research project, collect and analyze data, and interpret results

FUNDAMENTALS OF COMPUTER & IT

BTMS-107

Unit-I

Introducing Computer System: Evolution Of Computers, Generations of Computer, Characteristics Of Computers, Functions Of Computers, Advantages, Disadvantages Of Computers, Computer Applications ,The parts of a Computer system, Types Of Computers.
Storing Data: Types of storage devices, Memory Hierarchy.Essential computer hardware, software.
Computer Input Devices: Keyboard, Mouse, Webcam, Joystick and Output devices: Monitor, Printer, Plotters.

Unit-II

Input and Output Devices: Input devices: Keyboard, MICR, OCR, OMR, Digitizer, mouse, light pen, and offline input devices; Output Devices: Printers-impact printers: line-character printers, Non impact printers -ink-jet, laser printers; Display devices- Raster scan, Vector scan and storage tube display.
Input Output Ports: Power connectors-AT, ATx connectors. Monitor socket, VGA connector, serial parallel, USB, PS-2 ports, PCI/MCI socket, and keyboard socket, External storage connectors-IDE connectors, FDD connector; Power supplies: Basic terms, Power conditioning devices, SMPS.
Number System: Decimal , binary, octal, hexadecimal numbers and their inter-conversions; Representation of information inside the computers, Integer representation- Signed 1's and signed 2's complement representation, Floating point representation; Character Codes: BCD, ASCII, ISCII and Unicode, Concept of parity bit.

Unit-III

Basics of Programming Languages and Operating Systems: Low level programming languages: Machine and Assembly languages, High level languages-procedure oriented languages, problem oriented languages. Translation process- Assembler, Complier, Interpreter.Popular programming languages.

Unit-IV

Graphical User Interface and Windows- Working with windows operating systems, Introduction to system software systems, Operating System Principles- Concept of process, multiprogramming, Functions of an operating system, Processor Management (scheduling), Memory Management, Device Management, File Management, Difference between Buffering and Spooling, Types of Operating Systems.

Unit-V

Computer Network: Applications of Networks, Point-to-Point network and Broadcast Network, LAN, MAN, WAN and Wireless LAN, Network structure and architecture, the OSI reference model, TCP/IP Architecture, Networks topology, Layer's design issues. Connecting Devices:Repeaters, Amplifiers, Hubs, Head End, Bridges, Switches, Routers, Gateway

Course outcome (COs):

CO1	Demonstrate the use of mathematical software and solve simple mathematical problems.
CO2	Explain the needs of hardware and software required for a computation task.
CO3	State typical provisions of cyber law that govern the proper usage of Internet and computing resources.
CO4	Explain the working of important application software and their use to perform any engineering activity.
CO5	Demonstrate the use of Operating system commands and shell script

REFERENCE BOOKS:

1. Sharma, A.K. *Fundamentals of Computers and Programming with C*. DhanpatRai Publications, New Delhi, 2005.
2. Williams, Brian K. and Stacy C. Sawyer. *Using Information Technology*. TMH, New Delhi, 2003.
3. Curtin, Dennis P., Kim Foley, KunalSen, and Cathleen Morin. *Information Technology* TMH, 1998.
4. King, K.N. *C Programming – A Modern Approach*. WW Norton & Co., 1996.
5. Ritchie, Dennis M. and Brian W. Kernigham. *The C Programming Language*.PHI, New Delhi, 1988.

SEMESTER II

FOOD & DAIRY TECHNOLOGY

BTMS-201

Unit1:

Industrial Food fermentations: Starter cultures their biochemical activities, production and preservation of the following fermented foods: Soy sauce fermentation by Moulds, Fermented vegetables – Saurkraut, Fermented Meat – Sausages, Production and application of Bakers Yeast, Application of microbial enzymes in food industry

Unit 2:
Quality assurances in foods: Foodborne infections and intoxications; bacterial with examples of infective and toxic types –Clostridium, Salmonella, Shigella, Staphylococcus, Campylobacter, Listeria. Mycotoxins in food, Quality assurance: Microbiological quality standards of food. Government regulatory practices and policies. FDA, EPA, HACCP, ISI.

Unit 3:
Food preservation methods
Radiations - UV, Gamma and microwave, Temperature, Chemical and naturally occurring antimicrobials, Biosensors in food industry.

UNIT 4:
Microbial spoilage of various foods:
Principles, Spoilage of vegetables, fruits, meat, eggs, milk and butter, bread, canned Foods.

Unit 5:
Food borne diseases:
Food intoxications: Staphylococcus aureus, Clostridium botulinum and mycotoxins; Food infections: Bacillus cereus, Vibrio parahaemolyticus, Escherichia coli, Salmonellosis, Shigellosis, Yersinia enterocolitica, Listeria monocytogenes and Campylobacter jejuni.

Course outcome (COs):

CO1	To understand the science behind processing of foods and its impact on nutritive value of food stuffs.
CO2	To provide in-depth knowledge on production of processed food products.
CO3	To enable students to acquire skill in processing of various food items.
CO4	To improve the students entrepreneurial skill.

REFERENCE BOOKS:

1. Food Microbiology. 2nd Edition By Adams

2. Basic Food Microbiology by Banwart George J.
3. Food Microbiology: Fundamentals and Frontiers by Dolle
4. Biotechnology: Food Fermentation Microbiology, Biochemistry and Technology. Volume 2 by Joshi.
5. Fundamentals of Dairy Microbiology by Prajapati.
6. Essentials of Food Microbiology. Edited by John Garbult.Arnold International Students Edition.
7. Microbiology of Fermented Foods. Volume II and I. By Brian J. Wood.ElsieverApplied Science Publication.
8. Microbiology of Foods by John C. Ayres. J. OrwinMundt. William E. Sandinee. W. H. Freeman and Co

IMMUNOTECHNOLOGY

BTMS-202

Unit I:

Introduction to Immunology: History and terminology, innate and acquired immunity, active and passive immunity, immune responses, cells (T-cells, B-cells) and organs of immune system, cell mediated and humoral immunity, cytokines, toll-like receptors.

Unit II:

Antibody: Classification, isotypes, fine structure**,** biosynthesis of immunoglobulin, rearrangement of genes and class switching, complement system.
Antigen: Nature of antigens, haptens, adjuvants, vaccines.

Unit III:

MHC complex: Function, structure and MHC restriction.

Unit IV:

Principles of virulence and pathogenicity: Host-parasite interactions.
Transplantation and tumor immunology: Tumor cell immunity, transplantation of tissues and organs, relationship between donor and recipient, role of MHC molecules in allograft rejection, bone marrow and haematopoietic stem cell transplantation, tumor antigen, tumorimmunoprophylaxis.
Autoimmune diseases: Autoimmune hemolyticanemia, systemic lupus erythematosus, multiple sclerosis, rheumatoid arthritis, AIDS, diabetes mellitus.
Inflammation and hypersensitivity: Hypersensitivity reactions, inflammasome.

Unit IV:

Vaccinology: Active and passive immunization; live, killed, attenuated, sub unit vaccines; vaccine technology- role and properties of adjuvants, recombinant DNA and protein based vaccines, edible vaccines, reverse vaccinology; peptide vaccines, conjugate vaccines; Antibody genes and antibody engineering- chimeric and hybrid monoclonal antibodies; catalytic antibodies and generation of immunoglobulin gene libraries.

Course outcome (COs):

CO1	To apply knowledge of immunology in various cellular functions, inculcate knowledge of various issues related to immunological reactions eg the application of and research involved in functioning of the different molecules and moieties in the reactions.
CO2	To design and analyze the experiments related with the different molecules involved in immunology and use of the various techniques in the immunology to study the kinetics and rationale behind each phenomenon.
CO3	To identify, formulate, and solve problems arisen due to the inefficient functioning of the various immunological phenomenon leading to various immunological dieases.
CO4	To use the techniques, skills, and modern tools necessary for imbalances in various life processes, design a molecular cell biology research project, collect and analyze data, and interpret results

REFERENCE BOOKS:

1.Willey, J.M., Sherwood, L.M. and Woolverton, C.J. 2008. Prescott, Harley and Klein's Microbiology (7th eds.). McGraw Hill, USA.

2.Playfair, J. and Bancroft, G. 2007. Infection and Immunity (3rd eds.). Oxford University Press.

3.Chakravarty, A.K. 2008. Immunology and Immunotechnology (3rd eds.). Oxford University Press.

4.Tizard. 2008. Immunology: An introduction (4th eds.). Cengege learning.

5. Rao, C.V. 2008. Immunology: A text book. Narosa Publishing House.

GENETICS

BTMS-203

Unit I:

Mendelian genetics: Mendel's law of inheritance, Mendelian ratio, linkage, crossing over, chromosomal theory of inheritance.

Chromosome mapping: linkage analysis, two point test cross, three point test cross, interference, coefficient of coincidence, chi-square analysis.

Unit II:

Structural and numerical changes in chromosomes: Chromosomal aberration (deletion, duplication, translocation and inversion), euploidy and aneuploidy, aneuploidy in human.

Mutations: Natural and induced mutations, physical and chemical mutagens, Ames test, uses of mutations in genetic studies, human health and crop improvement.

Biochemical and microbial genetics:*Neurospora* as model system, one gene one enzyme hypothesis.

Unit III:
Sex determination: Sex linked inheritance, determination of sex and dosages compensation.
Chloroplast and mitochondrial genetics: Cytoplasmic inheritance, chloroplast inheritance in plants, mitochondrial genes in yeast.
Human genetics: Inborn errors of metabolism, Genetic diseases in human- Phenyl ketonuria, Alkaptonuria, Albinism, Lesch-Nyhan syndrome, Tay-Sachs disease, Cystic fibrisis, genetic counseling.

Unit IV:
Population and evolutionary genetics: Gene pool and gene frequencies, Hardy-Weinberg law, inbreeding, genetic equilibrium, genetic basis of evolution and speciation, molecular evolution, evolution of multigene families.

Unit V:
Epigenetics mechanism: DNA methylation, mechanism of transcription repression, histone modification (acetylation, methylation, phosphorylation and ubiquitylation), histone code, paramutation in maize.
Genomic imprinting: Features of imprinted genes, isoparental embryo, uniparentaldisomy, imprinting of Igf2 and H19 genes (a model), CTCF and BORIS as imprint regulators, loss of imprinting in cancer (LOI).
Examples of genomic imprinting: Angelman syndrome (AS), Prader-Willi syndrome (PWS), Beckwith Weidmann syndrome (BWS).

Course outcome (COs):

CO1	Able to describe the different methods of genetic testing
CO2	Demonstrate Knowledge and practical skills of molecular genetic analysis of genetic diseases
CO3	Performing of polymerase chain reaction, cloning and transformation
CO4	Construction of pedigrees and analysis of pattern of inheritance in the families
CO5	Updating current Knowledge regarding genetics, genomics, genomic medicine etc.

REFERENCE BOOKS:

1. Gardner, E.J., Simmons, M.J. and Snustad, P.D. 2007. Principles of Genetics (8^{th}eds.). Wiley's India, New Delhi.
2. Gupta, P.K. 1999. Cell and molecular biology (1^{st}ed.). Rastogi Publications
3. Hartl, D.R. and Jones, J. 2008. Genetics, Analysis of Genes and Genomes (5^{th}eds.). Johns and Barttlett Publishers.
4. Tamarin, R.H. 2006. Principles of Genetics (7^{th}eds.). TMH Publications.
5. Strickberger, M.W. 2007. Genetics (3^{rd}eds.). Prentice Hall of India.
6. Prasad, S. 2004. Elements of biostatistics (1^{st}eds.). Rastogi Publication.
7. Russell, P.J. 2006. *i*Genetics: a molecular approach (2^{nd} eds.). Pearson Benjamin Cummings.

CELL BIOLOGY

BTMS-204

Unit I:

Structure and function of intracellular cell organelles: Cell wall, nucleus, nucleolus, endoplasmic reticulum, golgi complex, plastids, ribosomes, mitochondria, lysosome, peroxisome, vacuoles, structure and function of cytoskeleton and its role in motility.

Unit II:

Membrane structure and function: Structure of model membrane, lipid bilayer, membrane lipids, carbohydrates, protein, fluidity, diffusion, osmosis, ion channels, active transport, ion pumps, electrical properties of membranes, membrane potential and nerve impulse, neurotransmission.

Unit III:

Cytoplasmic membrane systems and protein trafficking: Synthesis of secretary, lysosomal or plant vacuolar proteins, integral membrane protein on rough endoplasmic reticulum, glycosylation in rough ER, vesicular transport, glycosylation in golgi complex, types of vesicular transport in golgi complex, COPII, COPI and clathrin coated vesicles, targeting vesicles to a particular compartment, protein destruction in proteosomes.

Unit IV:

Cell cycle: Steps in cell cycle, cell cycle regulation and control.

Unit V:

Interaction between cells and environment: Extra cellular matrix, integrins, focal adhesion, hemidesmosomes, selectins, cadherins, cell adhesion receptors, tight junctions, gap junctions and plasmodesmata

Cell communication and signaling: Cell receptors, signal transduction pathways in prokaryotes and eukaryotes, secondary messengers, GPCRs, tyrosine kinase receptor, signaling pathways in plants, apoptosis, quorum sensing.

Course outcome (COs):

CO1	Apply knowledge of cell biology in various cellular functions, inculcate a knowledge of various issues related to cell biology, the application and research involved in functioning of the different cell organelles.
CO2	Design and analyze the experiments related with the different molecules involved in cell biology and use of the various techniques in the cell biology to study the kinetics and rationale behind each phenomenon.
CO3	Identify, formulate, and solve problems arisen due to the inefficient functioning of the various life processes like cell to cell communication, cell cycle regulation, movement processes of a cell or system.
CO4	Use the techniques, skills, and modern tools necessary for imbalances in various life processes, design a cell biology research project, collect and analyze data, and interpret results

REFERENCE BOOKS:

1. Cooper, G.M. and Hausman, R.E. The Cell- A molecular approach (4theds.). A S M Press, Sinauer Associate Inc.
2. Karp, G. Cell and Molecular Biology, Concepts and Experiments, John Wiley and Sons.
3. Alberts, B., Johnson, A., Lewis, J., Raff, M., Roberts, K., Walter, P. 2008. Molecular Biology of Cell (5th eds.). Garland Sciences.
4. Benjamin Lewin. 2008. Genes IX. Oxford University Press.
5. Lodish, H., Berk, A., Kaiser, C.A., Krieger, M., Scott, M.P., Bretscher, A., Ploegh, H. and Matsudaira, P. 2008. Molecular Biology (6theds.). W H Freeman and co.
6. Power, C.B. 2008. Cell Biology (3rdeds.). Himalaya Publishing House.
7. Gupta, P.K. 1999. Cell and Molecular Biology.Rastogi Publication, Meerut.

FOOD & DAIRY TECHNOLOGY LAB

BTMS-251

1. Production and estimation of lactic acid by Lactobacillus Sp. or Streptococcus Sp.
2. Extraction and estimation of diacetyl.
3. Sauerkraut fermentation
4. Isolation of food poisoning bacteria from contaminated foods, Dairy products
5. Extraction and detection of afla toxin for infected foods.
6. Preservation of potato/onion by UV radiation
7. Production of fermented milk by Lactobacillus acidophilus.
8. Rapid analytical techniques in food quality control using microbial Biosensors.

Course outcome (COs):

CO1	To make the students familiar with operations in food and dairy units
CO2	To acquire knowledge on dairy processing techniques.
CO3	To enable the students familiar with food processing techniques.
CO4	To develop the skill involved in Food and Dairy Processing Techniques through doing the experiments.

IMMUNOTECHNOLOGY LAB

BTMS-252

1. Blood film preparation and identification of cells.
2. Identification of blood group.
3. RBC and WBC count by hemocytometer.
4. Lymphoid organs and their microscopic organization.
5. Immunization, collection of serum.
6. Different types of antigen–antibody cross reaction.

7. Immunodiffusion and Immunoelectrophoresis.
8. ELISA (Enzyme linked immunosorbent assay).

Course outcome (COs):

CO1	Apply knowledge of immunology, inculcate a knowledge of various issues related to immunology eg vaccines etc. and immunological techniques.
CO2	Design and conduct experiments, as well as to analyze and interpret data of different immunological methods. To identify, formulate, and solve problems arisen due to the inefficient functioning of the immune system.
CO3	Use the techniques, skills, and modern tools necessary for detection of the immunological diseases, design a immunology research project, collect and analyze data, and interpret results.
CO4	Demonstrate knowledge and understanding of the engineering principles and apply these to manage projects work a recognition of the need for and an ability to engage in life-long learning.

BIO-ENERGY ENGINEERING

BTMS- 206

Unit I:

Biomass Sources, Characteristics & Preparation: Biomass Sources and Classification, chemical composition and properties of different biomass materials and bio-fuels, sugar cane molasses and other sources for fermentation ethanol, sources and processing of oils and fats for liquid fuels, energy plantations, preparation of woody biomass: Size reduction, Briquetting of loose biomass, Drying, Storage and Handling of Biomass.

Unit II:

Biogas Technology: Feedstock for biogas production, aqueous wastes containing biodegradable organic matter, animal residues, microbial and biochemical aspects, Operating parameters for biogas production, Kinetics and mechanism, dry and wet fermentation, digesters for rural application, high rate digesters for industrial waste water treatment.

Unit III:

Bio-Ethanol and Bio-Diesel Technology: Production of Fuel Ethanol by Fermentation of sugars, gasohol as a substitute for leaded petrol, trans-esterification of oils to produce bio-diesel.

Unit IV:

Pyrolysis and Gasification of Biomass: Thermo-chemical conversion of ligno-cellulose biomass, biomass processing for liquid fuel production, pyrolysis of biomass, pyrolysis regime, effect of particle size, temperature, and products obtained, thermo-chemical gasification principles, effect of pressure, temperature and of introducing steam and oxygen, design and operation of fixed and fluidized bed gasifiers.

Unit V:

Combustion of Biomass and Cogeneration Systems: Combustion of woody biomass, theory, calculations and design of equipments. Cogeneration In Biomass Processing Industries. Case Studies: Combustion of Rice Husk, Use of Bagasse for Cogeneration.

Course outcome (COs):

CO1	Demonstrate general knowledge and understanding of some of the basic facts, concepts and principles relating to plants, in particular the composition and properties of plants and the different ways in which plant products have been utilized by humans
CO2	Analysis of bioenergy systems and their potential in future energy supply.
CO3	Make sense of information presented in different ways, including textual, numerical, graphical, multimedia and web-based material.
CO4	Working with cross-cutting problems related to bioenergy -
CO5	Planning processes linked to the establishment of bioenergy facilities.

REFERENCE BOOKS:

1. Klass, D.L. and Emert, G.M. Fuels from Biomass and Wastes. Ann Arbor Science pub. Inc. Michigan.

2. Chakraverthy, A. Biotechnology and Alternative Technologies for Utilization of Biomass or Agricultural Wastes. Oxford & IBH publishing Co., New Delhi.

3. Mital, K.M. Biogas Systems: Principles and Applications, New Age International Publishers Pvt. Ltd.

4. Ramana, P.V. and Srinivas, S.N. 1996. Biomass Energy Systems. Tata Energy Research Institute, New Delhi.

5. Khandelwal, K.C. and Mahdi. Bio-gas Technology. Tata McGraw-Hill pub. Co. Ltd., New Delhi.

6. Chawla, O.P. 1970. Advances in bio-gas Technology, I.C.A.R., New Delhi.

MOLECULAR ONCOLOGY

BMMS-201

Unit I:

Introduction to Cancer: The Cancer Problem Epidemiology, Environmental carcinogens and risk factors, life style, changing patterns, the Indian scenario. Mechanisms of Carcinogenesis Various theories, multi-step and multistage processes, Initiation, Promotion and Progression. Role of DNA damage, repair and mutations by physicochemical agents and viruses, interaction of various agents. Differentiation: hyperplasia and precancerous lesions. Strategies of chemoprevention.Tumor types and leukemia Benign and malignant tumors, localized and metastatic disease, Schemes of classification, WHO classification, staging and grading, degree of malignancy. Classification of leukemia, types of chromosomal translocations.

Unit II:

Tumor Immunology and cell death: Immune suppression and role of immune survelliance in growth of tumors. Tumor specific antigens and immune response.Modulation of immune response and immunotherapy, cancer vaccines. Modulation of the Eukaryotic Cell Cycle in cancer Cell cycle and its control: Mechanism of deregulation of cell cycle during cancer. Apoptosis, Necrosis, Proapoptotic and Antiapoptotic proteins and mechanism of action.

Unit III:

Tumor suppressor genes and Viral oncogenes : Mechanisms of P53, Rb, Ras action in normal and transformed cells and viral oncogenes, Role of oncogenes in gene regulation using examples erb, rel, jun-fos, large Tantigen etc.

Unit IV:

Signalling pathways and Cell Interactions: Growth factor-signalling pathways in cancer Relationship between oncogene products and growth factors, using example of Src, Wnt, Abl, GAP and growth factors. Effect of viral infection on signal transduction.Cell-cell interaction, integrins, invasions, invasions by cancerous cells. Angiogenesis, Neoarrgiogenesis, Stem Cell Differentiation, Morphogens

Unit V:

Experimental Model and Emerging Therapy in Cancer Research: Microbial Models, Primary Cell Cultures, Established Cell Lines, Organ Cell Cultures, Spheroids. Cellular, tissue and molecular markers, potential targets for Cancer Therapy, Drug Discovery Strategy.

Course outcome (COs):

CO1	To demonstrate transformed phenotype and its molecular and cellular basis, the pathogenesis of cancer, including the interactions with the microenvironment and the immune system, and molecular cancer progression up to the metastatic diffusion.

CO2	Identification of the phases of development and the tumor types relevant to human oncology and define molecular targets for innovative targeted therapies.
CO3	To demonstrate the pathogenetic mechanisms of the main immune pathologies (immunodeficiency, allergy, autoimmunity), as well as the role of the immune system in the natural and vaccine-elicited immunity to infectious agents, cell and organ transplants, and cancer.

REFERENCE BOOKS:

1. Genes by Benjamin Lewin Ed. 7th; Oxford; 2000.

2 Principles of Genetics by Eldon J. Gardner and Michael J. Simmons and D. Peter Snustad; Ed. 8th; John Wiley, 2005.

3 Molecular cell biology by Harvey Lodish and Arnold Berk, Chris A. Kaiser, and Monty Krieger; Ed. 6th; W H Freeman and Company; New York; 2008.

SEMESTER III

PLANT BIOTECHNOLOGY

BTMS-301

UNIT - I

Introduction to Plant Tissue culture: Micropropagation: Introduction, Stages of micropropagation, advantages and disadvantages of micropropagation.

Techniques: Axillary bud proliferation- methodology, advantages, disadvantages and applications. Organogenic differentiation- introduction, methodology and applications. Virus –free plant production. Embryo culture- methodology and significance.Somaclonal variations: Nomenclature, methods, applications and disadvantages. Somatic Embryogenesis: methods and applications, Artificial/ synthetic seeds.

UNIT – II MICROPROPAGATION Cell tissue and organ culture, Plant regeneration and hardening .Micro propagation of disease free plants, Production of haploid plants.

UNIT - III PROTOPLAST CULTURE & PRESERVATIONS

Cryopreservation, Protoplast culture and applications, Somaclonal variation

UNIT - IV

Plant Transformation studies:

Ti and Ri plasmid vectors, Binary vectors, Genetic markers, viruses and transposable elements.

UNIT - V TRANSGENIC PLANTS AND BIOSAFETY

Physical methods of transfer of genes to plant, vector less and vector mediated transformation; Transgenic plants and their commercialization, Development of insect resistance herbicide, salt and draught resistance plants; IPRs and biosafety guidelines; Molecular breeding and DNA fingerprinting.

Course outcome (COs):

CO1	Demonstrate the knowledge about the techniques of Plant Tissue Culture techniques', Lab organization & measures adopted for aseptic manipulation and nutritional requirements of cultured tissues.
CO2	Apply knowledge for large scale clonal propagation of plants through various micropropagation techniques and Production of secondary metabolites under *in vitro* conditions .
CO3	Develop skill in raising the production of secondary products of pharma industries
CO4	Develop skill in raising transgenics resistant to biotic & abiotic stresses & quality characteristics and their role in crop improvement.
CO5	Design and implement experimental procedures using relevant techniques

REFERENCE BOOKS:

1. Principles and Practices in Plant Science. Walton, P.D. Prentice Hall 1988.
2. Plant Tissue Culture: Application and Limitations. Bhowjwani, S.S. 1990.

RECOMBINANT DNA TECHNOLOGY

BTMS-302

Unit I:

Introduction and Scope:

Introduction, History, Scope and milestones of genetic engineering; Biosafety and bioethics in genetic engineering; Overview of gene cloning; Isolation of nucleic acid and protein

Unit II:

Tools of Genetic Engineering:

Enzymes: Nucleases, Modifying enzymes (Restriction Endonuclease, Ligase, Alkaline phosphatase, Polymerases, Polynucleotide kinase etc.); Cloning vectors based on plasmids, phages, hybrid vectors, artificial chromosome (e.g. YAC and BAC),yeast, Ti plasmid, and viruses; Expression vectors: prokaryotic and eukaryotic expression vectors

Unit III:

Gene Cloning and Expression:

Cloning & Screening strategies in different vectors; Linker, adaptors, directional cloning and fusion proteins; Promoters; Expression of gene in heterologous system: Prokaryotic (e.g. IPTG Inducible and T7 expression systems in E.coli) and Eukaryotic.

Construction of cDNA and genomic libraries.

Unit IV:

Techniques of Genetic Engineering:

DNA sequencing; PCR, real-time PCR and other variants; Site directed mutagenesis; DNA markers (e.g. RFLP. RAPD, AFLP, SNP etc.); Site directed mutagenesis; Electrophoresis; Blotting techniques: southern, northern and western blotting; Probe labeling and hybridization; Chromosome walking; Microarray; DNA-proteininteraction, Protein-protein interaction.

Unit V:

Applications of Genetic Engineering:

Transgenic animal and plants; Knockouts; Gene therapy; DNA finger printing and DNA bar-coding for phylogenetic relationship; Production of recombinant therapeutics (vaccines/insulin); Geneediting technology (CRISPR-CAS).Human Genome Project.

Course outcome (COs):

CO1	Apply the principles of molecular biology techniques
CO2	Analyze the experimental data to select a suitable PCR for a particular application
CO3	Evaluate selectivity and specificity of vectors for cloning genes and their expressions
CO4	Examine gene function, gene modulation and their effects on improvement of crops and animals.

REFERENCE BOOKS:

1. Primrose, S.B. and Twyman, R.M. 2006. Principles of gene manipulation and genomics (7th eds.). Blackwell Publishing.
2. Winnacker, Ernst-L. 2003. From Gene to Clone Introduction to gene technology. Panima publishing Corp., New Delhi.
3. Old, R.W. and Primrose, S.B. 1985. Principles of gene manipulation: An introduction to genetic engineering. Blackwell Science Publication.
4. Brown, T.A. 2008. Gene Cloning and DNA analysis (5th eds.). Blackwell Sciences LTD.
5. Gupta, P.K. 2008. Biotechnology and Genomics (1st ed.). Rastogi Publication.

ANIMAL BIOTECHNOLOGY

BTMS-303

UNIT - I PRINCIPLES OF CELL AND TISSUE CULTURE

History of tissue culture, advantages and disadvantages of tissue culture, cell markers, cellular morphology, types of cell culture, primary and established cell lines, kinetics of cell growth, genetics of cultured cell, application of animal tissue culture

UNIT – II TECHNIQUES OF CELL AND TISSUE CULTURE

Sources of cells, techniques of cell culture, basic requirements for animal tissue culture, animal tissue culture media, preparation of embryonic extract, chemically defined media, culture procedures, organ culture, whole embryo culture

UNIT – III ANIMAL DISEASES AND THEIR THERAPY

Animal diseases and their therapy; Micromanipulation of embryos: Introduction, Basics and methodology; Valuable genes for animal biotechnology-insulin, interferon, somatostatin, Immunoglobulin etc;

UNIT – IV TRANSGENIC ANIMALS

Transgenic animals: Retroviruses and DNA microinjection method, transgenic mice, catte, sheep, goat, pig and birds; Importance of transgenic animals in biotechnology.

UNIT - V ARTIFICIAL ANIMAL BREEDING

Artificial insemination and germ cell storage, ectogenesis, amniocentesis, significance amniocentesis, transplantation, gene therapy, genetic counseling, *in vitro* fertilization and embryo transfer, embryo transfer objectives and application of ET,super ovulation,

physiological basis of superovulation, factor influencing superovulation, hazards of animal breeding.

Course outcome (COs):

CO1	To demonstrate foundational knowledge of Cell culture techniques and competence in laboratory techniques. Student can set up a tissue culture lab to carry out research.
CO2	To acquire knowledge in animal cloning and its applications by various methods.
CO3	To acquire adequate knowledge in the use of genetically modified organisms and its beneficial uses.
CO4	To gain more insights into the ethical issues and regulatory affairs.

REFERENCE BOOKS:

1. B. Hafez and E.S.E Hafez, Reproduction in farm animals, 7th Edition, Wiley Blackwell, 2000
2. G.E. Seidel, Jr. and S.M. Seidel, Training manual for embryo transfer in cattle (FAO Animal
3. Production and Health Paper-77), 1st Edition, W.D. Hoard and sons FAO, 1991
4. Gordon, Laboratory production of cattle embryos, 2nd edition,CAB 2003

ENVIRONMENTAL BIOTECHNOLOGY

BTMS-304

Unit I:

Environmental Pollution:

Types of pollution, methods for the measurement of pollution, Methodology of environmental management- the problem solving approach, its limitations. Air pollution and its control through Biotechnology.Water pollution ant its control: Water as a scarce natural resource. Need for water management, Measurement of water pollution, sources of water pollution.

Unit II:

Bioremediation : Removal of spilled oils using naturally occurring and genetically engineered microbes (GEM), bioremediation of agricultural pesticides, biosensors to detect environmental pollutants, In-situ bioremediation of soil and ground water contamination, bioaugmentation,

bioventing, biosparging, bioremediation techniques ex situ, GEM for detecting PAHs in soil, metals bioremediation, GEM for sequestering of heavy metals, gaseous bioremediation, phytoremediation, rhizofiltration, rhizostimulation, phycoremediation.

Unit III:

Restoration of degraded lands: Reforestation through micropropagation, use of microbes for improving soil fertility.

Unit IV:

Bioenergy and biofuels: Fossil fuels, emissions from fossil fuels, greenhouse gases, non-conventional sources of energy, conservation of energy.

Unit V:

Biodiversity and its conservation: In situ and ex situ conservation, gene banks, CBD biodiversity bill in India.

Biotechnology and climate change: Nature of expected climatic changes and their impact, recommendation of IPCC (Inter Governmental panel for Climatic Change), method for dealing with suggested changes to cope with climatic changes.

Course outcome (COs):

CO1	Identify the problems related to environment and the Environment Protection Acts and Legislations
CO2	Apply advanced knowledge on environmental waste management (waste water and solid waste)
CO3	Design techniques for bioremediation process
CO4	Identify and evaluate the importance of biofuels and organic farming
CO5	Apply the scientific method by stating a question; researching the topic; determining appropriate tests; performing tests; collecting, analyzing, and presenting data and effective communicate with both specialist and non-specialist audiences/community

REFERENCE BOOKS:

1. Gray, N.E. 1989. Biology of wastewater treatment. Oxford University Press, Oxford.
2. Hall, E.A.H. 1990. Biosensors. Open University Press, Milton Kenynes.
3. Head, I.M., Singleton, I. and Milner, M. 2003. Bioremediation: A critical review. Horizon Scientific Press, Norfolk.
4. Satyanarayana, U. 2008. Biotechnology. Uppala Author Publisher Interlink
5. Scragg, A. 2008. Environmental Biotechnology. Oxford University Press.

PLANT BIOTECHNOLOGY LAB

BTMS-351

1.Glassware cleaning and sterilization.

2.Media Preparation.

3. Establishment of suspension culture

4.Micro propagation of any ornamental plant

5.Isolation of Protoplast.

6.Protoplast fusion.

7.Selection of hybrid protoplast.

Course outcome (COs):

CO1	Demonstrate the knowledge about the techniques of Plant Tissue Culture techniques, Lab organization & measures adopted for aseptic manipulation and nutritional requirements of cultured tissues.
CO2	Apply knowledge for large scale clonal propagation of plants through various micropropagation techniques
CO3	Develop skill in raising transgenics resistant to biotic & abiotic stresses & quality characteristics and their role in crop improvement.
CO4	Design and implement experimental procedures using relevant techniques.
CO5	Production of secondary metabolites under *in vitro* conditions.

RECOMBINANT DNA TECHNOLOGY LAB.

BTMS-352

1. General guidelines for working in rDNA technology.
2. Preparation of commonly used chemicals and reagents for rDNA technology lab.
3. Isolation of genomic DNA.
4. Agarose Gel Electrophoresis.
5. Digestion of DNA with restriction endonucleases.
6. Isolation of plasmid DNA.
7. Bacterial transformation.
8. Polymerase chain reaction.
9. Primer designing by software.

Course outcome (COs):

CO1	Apply the principles of molecular biology techniques

CO2	Analyze the experimental data to select a suitable PCR for a particular application
CO3	Evaluate selectivity and specificity of vectors for cloning genes and their expressions
CO4	Examine gene function, gene modulation and their effects on improvement of crops and animals

BIOSTATISTICS

BTMS-311

Unit-I

Data type, classification and summarization of data, diagrams and Graphs, Measures of Dispersion: range, quartile deviation, mean deviation, standard deviation, variance, Frequency distribution and its types, cumulative frequency, Skewness and kurtosis.

Unit-II

Introduction to probability, Laws of probability, Baye's theorem, Binomial distribution, Mean and variance of binomial distribution, introduction to normal distribution, random variable and Poison distribution.

Unit-III

Positive and Negative correlation, rank correlation coefficient, Non parametric tests, Linear and Non linear regression, multiple regression, equation of line of regression, regression coefficient.

Unit-IV

Hypothesis tests, Chi squire tests and F-tests, Variant, analysis of variants, ANOVA.

Unit-V

Principles of experimental design and analysis.

Course outcome (COs):

CO1	An ability to apply knowledge of mathematics and statistics to design and conduct experiments, as well

	as to analyze and interpret data related to domain of biology.
CO2	An ability to design a system, component, or process to performing research in biological system and addressing the challenges associated with the interaction between living systems and non -living materials.
CO3	An ability to apply the knowledge of basic mathematical & statistical tools used in biological research/ biotechnology in industry and research lab.
CO4	An ability to understand the principle and application of Differential Calculus, Differential Equations and various Computational Techniques
CO5	An ability to function in multidisciplinary teams. An ability to identify, formulate, and solve Science/Engineering problems.

REFERENCE BOOKS:

1. George W. and William G., Statistical Methods; IBH Publication.

2. Ipsen J et al; Introduction to Biostatistics, Harper & Row Publication.

3. N.T.J. Baily; Statistical methods in Biology; English University Press.

4. R.Rangaswami; A Text book of Agricultural statistics; New Age Int. Pub.

5. P.S.S.SundarRao; An Introduction to Biostatistics; Prentice Hall.

PHARMACOLOGY AND TOXICOLOGY

BMMS-301

Unit I: Pesticides Brief classification with examples, residual and non-residual pesticides. Mode of entry and mode of action of pesticides in target and non-target organisms; metabolism of pesticides, phase I and phase II reaction, elimination.Pesticide bioaccumulation, biomagnification through food chain.Environmental alteration of pesticides - microbial and solar, fate and dissipation of pesticides residue under tropical and temperature conditions.

Unit II: Pesticide hazards to man Accidental and occupational exposure, entry through air, food and water, Main routes of entry and factors affecting intake, distribution, biotransformation and elimination dynamics.

Unit III: Chemotherapeutic agents: Chemotherapy of microbial diseases, urinary antiseptics, sulfonamides, penicillins, streptomycin, tetracyclines and other antibiotics; antitubercular drugs, antifungal agents, antiviral drugs, antileprotic drugs. Chemotherapy of protozoal diseases, Drugs used in cancer, Disinfectants and antiseptics

Unit IV: Drugs acting on the central nervous system: General anesthetics, adjunction to anesthesia, intravenous anesthetics. Analgesic and non-steroidal anti-inflammatory drugs, narcotic analgesics, antirheumatic and antigout remedies, sedatives and hypnotics, pshychopharmacological agents, anti-convulsants, analeptics.

Unit V: Overall Pharmacological agents .Drugs acting on the blood and blood forming organs, haematinics, coagulants and anticoagulants, haemostatics, blood substitutes and plasma expanders.Drugs affecting renal function- diuretics and antidiuretics.Hormones and hormone antagonists- hypoglycemic agents, antithyroid drugs, sex hormones and oral contraceptives, corticosteroids.

Course outcome (COs):

CO1	Demonstrate the principles of pharmacodynamics and pharmacokinetics
CO2	Illustrate toxicity risk assessment and fate of toxicants in humans
CO3	Evaluate acute and chronic toxicity of environmental chemicals
CO4	Develop competence in handling drugs and toxic materials
CO5	Integrate theoretical and practical knowledge acquired in pharmacology and toxicology for advanced studies

REFERENCE BOOKS:

1. Essential of medical pharmacology; 5th Ed. By K.D. Tripathi; Jaypee Brothers; New Delhi; 2003.

2. Goodman & Gilman's the pharmacological basis of therapeutics by Joel G. Hardman and Lee E. Limbird; 9th Ed.; 1995.

3. Pharmacology H. P. Rang and M.M. Dale and J.M. Ritter and P.K. Moore; Ed.5th; Churchill Livingstone, 2003.

4. Integrated pharmacology by Clive P. Page and M.J. Curtis and M.C. Sutter and M.J. Walker and B.B. Hoffman; Mosby; 1997.

5. Principles of toxicology by Karen E. Stine and Thomas M. Brown; Ed.2nd; CRC Press; 2006

6. Lu's basic toxicology: fundamentals, target organs and risk assessment by Frank C. Lu and Sam Kacew; Ed.4th; Taylor & Francis; 2002

7.Casarett and Dull's toxicology: the basic science of poisons by Curties D. Klaassen; Ed.7th; McGraw Hill; New York; 2007

8. Toxicology by Hans Marquradt and S.G. Schafer and R.D. McClellah and Academic Press; 1999

9. Principles and practice of toxicology in public health by Ira R. Richards; Jones and Bartlett Publishers; 2007 10 Handbook of human toxicology by E.J. Massaro; CRC Press; 1997

IV SEMESTER

BTMS-481 SEMINAR

BTMS-491 DISSERTATION

Course Objective:

The students are expected to utilize their scheduled periods by undertaking the project that would be completed during the semester. Every student shall undertake a major Project. The

major Project shall be undertaken in some biotechnology industry or laboratory of repute. Each student shall be assigned to a faculty who shall continuously monitor the progress of the Project in the concerned laboratory or industry. The faculty, in consultation with the concerned scientist of the industry/laboratory, shall decide the topic of the project. At the conclusion of the project the student shall submit a seminar and a dissertation. The dissertation shall be evaluated by the internal faculty/examiner. The student then shall have to appear for the viva voce examination.

GUIDELINES FOR PROJECT FILE

Research experience is as close to a professional problem-solving activity as anything in the curriculum. It provides exposure to research methodology and an opportunity to work closely with a faculty guide. It usually requires the use of advanced concepts, a variety of experimental techniques, and state-of-the-art instrumentation. Research is genuine exploration of the unknown that leads to new knowledge which often warrants publication. But whether or not the results of a research project are publishable, the project should be communicated in the form of a research report written by the student. Sufficient time should be allowed for satisfactory completion of reports, taking into account that initial drafts should be critiqued by the faculty guide and corrected by the student at each stage. The File is the principal means by which the work carried out will be assessed and therefore great care should be taken in its preparation.

In general, the File should be comprehensive and include:

• A short account of the activities that were undertaken as part of the project;
• A statement about the extent to which the project has achieved its stated goals.
• A statement about the outcomes of the evaluation and dissemination processes engaged in as part of the project;
• Any activities planned but not yet completed as part of the project, or as a future initiative directly resulting
from the project;
• Any problems that have arisen that may be useful to document for future reference.

Report Layout

The report should contain the following components:

Title or Cover Page.

The title page should contain the following information: Project Title; Student's Name; Course; Year; Supervisor's Name.

Acknowledgements (optional)

Acknowledgment to any advisory or financial assistance received in the course of work may be given.

Abstract
A good "Abstract" should be straight to the point; not too descriptive but fully informative. First paragraph should state what was accomplished with regard to the objectives. The abstract does not have to be an entire summary of the project, but rather a concise summary of the scope and results of the project

Table of Contents
Titles and subtitles are to correspond exactly with those in the text.

Introduction
Here a brief introduction to the problem that is central to the project and an outline of the structure of the rest of the report should be provided. The introduction should aim to catch the imagination of the reader, so excessive details should be avoided.

Materials and Methods
This section should aim at experimental designs, materials used. Methodology should be mentioned in details including modifications if any.

Results and Discussion
Present results, discuss and compare these with those from other workers, etc. In writing these section, emphasis should be given on what has been performed and achieved in the course of the work, rather than discuss in detail what is readily available in text books. Avoid abrupt changes in contents from section to section and maintain a lucid flow throughout the thesis. An opening and closing paragraph in every chapter could be included to aid in smooth flow.

Note that in writing the various secions, all figures and tables should as far as possible be next to the associated text, in the same orientation as the main text, numbered, and given appropriate titles or captions. All major equations should also be numbered and unless it is really necessary never write in “point” form.

Conclusion
A conclusion should be the final section in which the outcome of the work is mentioned briefly.

Future prospects

Appendices
The Appendix contains material which is of interest to the reader but not an integral part of the thesis and any problem that have arisen that may be useful to document for future reference.

References / Bibliography

This should include papers and books referred to in the body of the report. These should be ordered alphabetically on the author's surname. The titles of journals preferably should not be abbreviated; if they are, abbreviations must comply with an internationally recognized system. Examples:

For research article:
Voravuthikunchai SP, Lortheeranuwat A, Ninrprom T, Popaya W, Pongpaichit S, Supawita T. (2002) Antibacterial activity of Thai medicinal plants against enterohaemorrhagicEscherichia coli O157: H7. ClinMicrobiolInfect ,**8** (suppl 1): 116–117.

For book:
Kowalski,M.(1976) Transduction of effectiveness in Rhizobium meliloti. SYMBIOTIC NITROGEN FIXATION PLANTS (editor P.S. Nutman IBP), **7**: 63-67

ASSESSMENT OF THE DISSERTATION
Essentially, marking will be based on the following criteria: the quality of the report, the technical merit of the project and the project execution. Technical merit attempts to assess the quality and depth of the intellectual efforts put into the project. Project execution is concerned with assessing how much work has been put in.
The File should fulfill the following **assessment objectives:**

- **Range of Research Methods used to obtain information**
- **Execution of Research**
- **Data Analysis**
  Analyze Quantitative/ Qualitative information Control Quality
- **Draw Conclusions**
- **Reference for further information:**
  Clifford Hawkins and Marco Sorgi; Research: How to Plan, Speak and write about it; Narosa Publishing House, New Delhi 1994

Course outcome (COs):

CO1	Upon completion of the project work the students would have achieved the expected outcome of the research
CO2	Upon completion of the project work the student would have gained knowledge to develop a product which will benefit the society
CO3	Upon completion of the project work the student would have predicted the commercial probability of their product
CO4	Upon completion of the project work the student would gain knowledge about the success rate of the product

CO5	Upon completion of the project work the student would have assessed the impact of the research work