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

Syllabus
M.Tech. (Biotechnology)

Academic Session: 2019-21

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

M. Tech. (Biotechnology)

(Effective from session 2019-21)

1st year (I Semester)

Course Code	Course/ Title	L	T	P	Cr
BTMT-501	Fundamentals of Biostatistics	3	1	0	4
BTMT-503	Applied Plant and Animal Biotechnology	3	1	0	4
BTMT-505	Advanced Computational Biotechnology	3	1	0	4
BTMT-507	Microbial Biotechnology	3	1	0	4
BTMT-553	Applied Plant and Animal Biotechnology Lab	0	0	3	2
BTMT581	Seminar	0	3	0	2
CSMT-509	Fundamentals of Computers & Programming	2	1	0	0

1st year (II Semester)

Course Code	Course/ Title	L	T	P	Cr
BTMT-502	Advanced Immunotechnology	3	1	0	4
BTMT-504	Advanced Bioprocess Engineering	3	1	0	4
BTMT-506	Applied Recombinant DNA Technology	3	1	0	4
BTMT-522 BTMT-524	Engineering Principles in Biotechnology/ Tissue Engineering	3	1	0	4
BTMT-556	Applied Recombinant DNA Technology Lab	0	0	3	2
BTMT-582	Seminar	0	3	0	2

2nd year (III Semester)

Course Code	Course/ Title	L	T	P	Cr
BTMT-601	Bioinstrumentation	3	1	0	4
BTMT-603	Downstream Processing and Bioseparation	3	1	0	4
BTMT-605	Food Engineering and Quality Control	3	1	0	4
BTMT-621 BTMT-623	Metabolic Engineering/ Nanobiotechnology	3	1	0	4
BTMT-671	Minor Project	0	0	4	2
BTMT-681	Seminar	0	3	0	2

2nd year (IV Semester)

Course Code	Course/ Title	L	T	P	Cr
BTMT-692	Dissertation	0	0	28	14

Total Credits-74

Program Outcomes (POs):

PO 1. Biochemistry Majors will gain proficiency in basic laboratory techniques in both chemistry and biology, and be able to apply the scientific method to the processes of experimentation and hypothesis testing.

PO 2. Senior Biochemistry Majors will be able to demonstrate an understanding of fundamental biochemical principles, such as the structure/function of biomolecules, metabolic pathways, and the regulation of biological/biochemical processes.

PO 3. Students in the Biochemistry Major will be able to apply and effectively communicate scientific reasoning and data analysis in both written and oral forums.

PO 4. Students in the Biochemistry Major will understand and practice the ethics surrounding scientific research.

PO 5. Graduates will be able design, perform experiments, analyze and interpret data for investigating complex problems in biochemical engineering and related fields.
PO 6. Graduates will be able to decide and apply appropriate tools and techniques.
PO 7. Graduates will be able to justify societal, health, safety and legal issues and understand his responsibilities in biotechnological engineering practices
PO 8. 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 9. Use the techniques, skills, and modern engineering tools necessary for engineering practice.
PO 10. Design system, components or processes to meet realistic needs of society, environment, health and safety, and sustainability.
PO 11. Recognize the need for, and an ability to engage in life-long learning.
PO 12. Graduates will be able to demonstrate knowledge of project and finance management when dealing with Biochemical problems.

Program Specific Outcomes (PSOs):

PSO 1. Demonstrate proficiency in basic science and foundation engineering courses.
PSO 2. Demonstrate a working knowledge of advanced biochemistry and life science for the industrial applications and human welfare.
PSO 3. Demonstrate the application in biotechnology and allied industries designing, developing and providing solutions for product/processes/technology development.

SEMESTER-I

FUNDAMENTALS OF BIOSTATISTICS

BTMT-501

Unit I:

Mean, Median, Mode, Variance and Deviation: Measure of central tendency and location (mean, median, mode and location averages), relation between mean, median and mode with numerical examples.Statistics of dispersion: variability, range, mean deviation, deviation about median, standard deviation, variance, coefficient of quartile deviation, coefficient of variation, coefficient of dispersion, four central moments, skewness and Kurtosis. Relationship of life sciences with mathematics.

Unit II:

Probability and Probability Distribution: Review of set theory, basic terminology, definition of probability, addition and multiplication rule of probability, conditional rule of probability, Bayes' theorem, probability mass function and probability density function, binomial distribution, Poisson distribution, hyper geometric, uniform, exponential and normal distribution

Unit III:

Testing Hypothesis: Types of errors, testing means, Significance of difference between means using Z- score; large sample test based on normal distribution- test based on 't' and F distributions, $\chi 2$ (chi square) test for goodness of fit and $\chi 2$ (chi square) test for independence of attribute , homogeneity and variance of a normal population.

Unit IV:

Correlation Regression and Analysis of Variance (ANOVA): Karl Pearson correlation coefficient , rank correlation, linear and multiple regressions, one way and two way classification of ANOVA- application from biological sciences- case studies.

Unit V:

Mathematical models in Bio and Chemo system: General linear model; Optimal prediction models; Genetical theory of Natural selection: Darwin, Lamarck and Mendel's contribution; Population growth: Logistic equation/Verhulst-Pearl model; Ecological predator-prey model: Lotka-Volterra model.

REFERENCE BOOKS:

1. Zar, J.H. 2009. Biostatistical Analysis (5^{th} eds.). Pearson Education Inc.2.
2. Miller, I.R., Freund, J.E. and Johnson, R. 1992. Probability and Statistics for Engineers (4^{th} eds.), Prentice- Hall of India Pvt. Ltd.
3. Grafen, A. and Hails, R. 2008. Modern Statistics for the Life Sciences, Oxford University Press.

4. Montgomery, D. C. and Runger, G. C. 1994. Applied Statistics and Probability for Engineers (3rd eds.), John-Wiley and Sons.
5. Falconer, D. S., and Mackay, T. F. C. 2009. Introduction to Quantitative Genetics (1st eds.), Pearson Education Inc.

APPLIED PLANT AND ANIMAL BIOTECHNOLOGY

BTMT-503

Unit I:

Cell and tissue culture: Brief history of plant tissue culture, basic techniques of plant tissue culture, media formulation and sterilization, callus culture, cell suspension culture, protoplast culture and somatic hybridization, cybrids, Anther culture, pollen culture, development of androgenic haploids, somaclonal and gametoclonal variations, micro-propagation, embryo culture and embryo rescue, secondary metabolites in plant culture.

Unit II:

Animal Cell and Tissue Culture Technology: Characterization, scaling-up, cloning and selection of cultured cells, separation of cells, organ culture, histotypic culture.

Applications of animal tissue culture, development of transgenics, development, maintenance of cell lines, stem cells and their uses, tissue engineering (artificial skin, bone and cartilage other organs), elementary idea of molecular pharming, embryo transfer in humans, animal cloning, hybridoma technology.

Unit III:

Methods for gene transfer in plants: *Agrobacterium* mediated gene transfer T_i plasmid and R_i plasmid mediated gene transfer, geminivirus and RNA plant virus mediated gene transfer, vector less or direct DNA transfer viz. electroporation, biolistics, microinjection, liposome mediated transformation siliconcarbide whisker mediated gene transfer, marker genes, transgene stability, expression and gene silencing.

Unit IV:

Methods for gene transfer in animals: Gene transfer methods in animal cell, chemical tranfection, physical transfection: ultrasound transfection, use of viruses as gene transfer vectors: Aderoviral, Baculoviral, unarmed herpes, retroviral and vaccinia viral vectors, direct gene transfer,

Unit V:

Biotechnology in live stock production: Selected traits and their breeding into livestock, diagnosis, elimination and breeding strategies of genetic diseases, hybridization based markers, PCR based markers, properties of molecular markers, transgenic breeding strategies.

REFERENCE BOOKS:

1. Bhojwani, S.S. and Razdan, M.K. 2004. Plant tissue culture: Theory and Practice, (2nd eds.). Panima Publications.
2. Hartmann, H.T. and Kester, D.E. 2002. Plant propagation principles and practices (6th eds.). Prentice Hall India.
3. Ramawat, K.G. 2008. Plant biotechnology (3rd eds.). S. Chand Publications, New Delhi.
4. Singh, B.D. 2008. Biotechnology- Expending Horizons (2nd eds.). Kalyani Publications.
5. Gupta, P.K. Elements of Biotechnology, Rastogi Publications.

6. Chawla, H.S.2003. Plant biotechnology. Special Indian edition.Oxford and IBH Publishers.Primrose, S.B. and Twyman, R.M. 2008. Principles of gene manipulation and genomics (7th eds.).
7. Kaushik, A. and Kaushik, C.P. Plant Genetic Engineering. New Age International Publishers.
7. Arora, J.K. Biotechnology in Agriculture Environment, Mc Millan India Limited.
8. Masters, J.R.W. 2000. Animal cell culture (3rd eds.). Oxford University Press.
9. Brown, T.A. 2008. Gene cloning and DNA analysis (5th eds). Blackwell Sciences Ltd.
10. Satyanarayana, U. 2008. Biotechnology. Uppala Author Publisher Interlink.
11. Srivastava, A.K., Singh, R.K. and Yadav, M.P. 2006. Animal Biotechnology. Oxford and IBH Publishing Co. Pvt. Ltd., New Delhi.

ADVANCED COMPUTATIONAL BIOTECHNOLOGY

BTMT-505

Unit I:

Introduction to major Bioinformatics resources on the web:

Biological databases, specialized databases, nucleic acid sequence databases, GenBank, EMBL, DDBJ, protein sequence databases, PIR-PSD, ExPASy, SwissProt, TrEMBL, GenBank, GenPept, database searches, text-based searching, simple and advanced forms, manipulation of displays, Entrez/SRS- query engines, exploring EMBOSS series.

Unit II:

Sequence-alignment related problems and pattern analysis in sequences

Similarity matrices, pairwise and MSA, statistical significance of alignment, phylogenetics, distance based approaches, maximum parsimony,analysis of domains, motifs and folds in sequences, consensus sequences, regular expressions, Markov models, regulatory sequence identification using MEME, gene identification and its validation.

Unit III:

Structural analysis

Representation of molecular structures prediction of structure of RNA, protein structure by comparative modeling, homology modeling, threading, Ab initio structure prediction, force fields, energy minimization, molecular dynamics, protein ligand docking, CADD, QSAR, protein-protein interaction, structural classification (SCOP, CATH), visualization software (Pymol, Rasmol).

Unit IV:

Systems Biology basics and applications

System-level understanding of biological systems, use and integration of data from transcriptomics, proteomics and metabolomics; concepts in glycomics, interactomics and fluxomics

Unit V:

Introduction to languages used in Bioinformatics

Perl, Python, Unix and Linux, basic commands and syntaxes in the three. Understanding of file systems. Application of languages in Biological data

REFERENCE BOOKS:

1. Pevzner, P.A. 2000. Computational Molecular Biology: An Algorithmic Approach.
2. Clote, P. Formerly and Backofen, R., 2000. Computational Biology: An Introduction. John Willy and Sons Ltd.
3. Fasman D., 1989. Prediction of Protein Structure and Principle of Protein Conformation, Plenum Press, New York.
4. Tisdall J. 2001. Beginning Perl for Bioinformatics, O'Reilly Publisher.

MICROBIAL BIOTECHNOLOGY

BTMT-507

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.

REFERENCE BOOKS:

1. Reed G. 1997. Industrial Microbiology. CBS Publishers. AVI Publishing Co.
2. Stanbury PF, Whitekar A. and Hall 1995. Principles of Fermentation Technology. Pergaman. McNeul and Harvey.
3. Bhosh, Fiecht er and Blakebrough 1999. Advances in Biochemical Engineering. Springer Verlag Publications.
4. Creuger and Creuger 2001. Biotechnology- A textbook of Industrial Microbiology, Sinaeur Associates.
5. Casida LE 1997. Industrial Microbiology, Wiley Eastern. 6th edition

APPLIED PLANT AND ANIMAL BIOTECHNOLOGY LAB.

BTMT-553

1. Introduction to Cell Culture lab and aseptic skill; (Use of Biosafety cabinet, CO_2 incubators, Microscopes, Sterile Conditions),
2. Preparation of Cell Culture Media and other supplements & Additives,
3. Isolation and Culturing of MNCs from Peripheral blood,
4. Cell counting & cell morphology,
5. Introduction to type of bioreactors & their operation; (Spinner Flask, Rotating vessel, Perfused Column and Perfused Chamber),
6. Culture and cell growth study in bioreactor,
7. Cell Survival & Function; Live/Dead Fluorescence Assay; MTT Viability Test; Cell Viability Test by Trypan Blue staining method.

FUNDAMENTALS OF COMPUTERS & PROGRAMMING.

CSMT-509

Unit-I

Computer networking: Computer networking**:** Introduction to networking: various terminologies. Associated hardware devices, gadgets (Router, Switch etc.), tools, services, and resources. Network Topologies and Protocols.LAN, WAN and MAN, World Wide Web (WWW) Network security: fire

walls. Search engines: Google, Yahoo etc.Concepts in text-based searching. Searching Medline, bibliographic databases.

Unit-II

Programming concepts: Algorithms, flowcharts & programming concepts: Algorithms: Concepts & definitions, Converting algorithms to flowcharts, coding: flowcharts to programs, comparing algorithms, flowcharts & programs.

Unit-III

Operating systems:

Introduction to operating systems: operating system concept, Windows 98/XP, Windows server NT/2000, UNIX /Linux & servers. Data processing & presentation**:** Introduction, MS office (World, Excel & Power Point).Computer viruses**:** An overview of Computer viruses. What is a virus? Virus symptoms, How do they gettransmitted? What are the dangers? General precautions

Unit-III

Generation of computers:

History: Evolution, Generation of computers (I, II, III, IV, V).Classification of computers (mainframes, mini computers, microcomputers, special purpose) Comparison with respect to memory, power, cost, size. Modern computers**:** The work station, The Minicomputer, Mainframe. Computers, Parallel processing Computer & the Super Computer.

REFERENCE BOOKS:

1. Introduction to Computers Data processing & Networking
2. Computer Fundamentals – P.K. Sinha
3. Programming in C- E.Balaguru Swamy.
4. C++ from Scratch. J.Liberty.

   How computers work. 2000. ron White. Techmedia.

SEMESTER-II

ADVANCED IMMUNOTECHNOLOGY

BTMT-501

Unit I:

Fundamentals of Immunology:

Components of innate and acquired immunity; phagocytosis; complement and inflammatory responses; haematopoesis; organs and cells of the immune system- primary and secondary lymphoid organs; Lymphatic system; Lymphocyte circulation; Lymphocyte homing; mucosal and cutaneous associated lymphoid tissue.(MALT & CALT); Mucosal Immunity; Antigens - immunogens, haptens; Major Histocompatibility Complex - MHC genes, MHC and immune responsiveness and disease susceptibility, HLA typing.

Unit II:

Molecular basis of Immune responses:

Humoral immune response: Immunoglobulins-basic structure, classes and subclasses of immunoglobulins, antigenic determinants; multigene organization of immunoglobulin genes; B-cell receptor; immunoglobulin superfamily; principles of cell signaling; immunological basis of self –non-self discrimination; Kinetics of immune response, memory; B cell maturation, activation and differentiation; generation of antibody diversity; Cell-mediated immune responses: T-cell maturation, activation and differentiation and T-cell receptors; Functional T Cell Subsets, ADCC; cytokines-properties, receptors and therapeutic uses; antigen processing and presentation- endogenous antigens, exogenous antigens, non-peptide bacterial antigens and super-antigens; Cell-cell co-operation, Hapten-carrier system, plantibodies.

Unit III:

Antigen-antibody interactions and Immonotechniques

Precipitation, agglutination and complement mediated immune reactions; Advanced immunological techniques - RIA, ELISA, western blotting, ELISPOT assay, immunofluorescence, flow cytometry and immunoelectron microscopy; Surface plasmon resonance, Biosenor assays for assessing ligand –receptor interaction, CMI techniques- lymphoproliferation assay, mixed lymphocyte reaction, cell cytotoxicity assays, apoptosis, microarrays, transgenic mice, gene knock out animals, hybridoma technology.

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.

Unit V:

Clinical Immunology and human health

Immunity to infection: bacterial, viral, fungal and parasitic infections (with examples from each group); Hypersensitivity – Type I-IV; autoimmunity; types of autoimmune diseases; Treatment of autoimmune diseases; Transplantation – Immunological basis of graft rejection; clinical transplantation and immunosuppressive therapy; Tumor immunology – Tumor antigens; Immune response to tumors and tumor evasion of the immune system, Cancer immunotherapy; immunodeficiency-primary immunodeficiencies, acquired or secondary immunodeficiencies.

Course Outcomes (COs):

1. Describes the basics of modern immunotechnology, the development of the products of the immunotechnology, the application of immunological methods in biotechnology, pharmacy, diagnostics, therapy and scientific investigation;
2. Explains the connection between immunotechnology and other nature sciences.
3. Explains the importance of immunotechnology for the development of other sciences, the input of immunotechnology to the biotechnology.
4. Explains the basic use of the concepts of immunotechnology, adapting them to the laboratory work; analyzes and summarizes the scientific information.

REFERENCE BOOKS:

1. Moran, A. 2006. Immnunotechnology: Principles, concepts and applications, John Willey and Sons.
2. Rao, C.V. 2008. Immunology: A text book. Narosa Publishing House.
3. R.A., Kindt, T.J. and Osborne, B.A. Kuby's Immunology (4th eds.). W H Freeman and Company.
4. Tizard. 2008. Immunology: An introduction (4th eds.). Cengege learning.
5. Willey, J.M., Sherwood, L.M. and Woolverton, C.J. 2008. Prescott, Harley and Klein's
6. Microbiology (7th eds.). Mc Graw Hill, USA.
7. Roitt et al. 2006. Essentials of immunology 11th edition. Blackwell Publisher.
8. Clackson, T. aand Lwman, B.H. 2004. Phage Display: A practical approach, Oxforford University Press.
9. Andrew George, J. T and Catherine Urch, E. 2000. Diagnostic and Therapeutic antibodies (Methods in Molecular Medicine) Humana Press.
10. John E. Coligan, Barbara Bierer, David H. Margulies, Ethan M. Shevach, Warren Strobe and Richard Coico. 2006. Current Protocols in Immunology, Vol. 1-5., John Wiley and Sons, Inc.

ADVANCED BIOPROCESS ENGINEERING

BTMT-504

Unit I: Kinetics of Microbial Growth, and Product Formation:

Different modes of operation - batch, fed batch and continuous cultivation. Simple unstructured kinetic models for microbial growth, Monod model, product formation kinetics, substrate and product inhibition on cell growth and product formation. Stoichiometry of cell growth and product formation.

Unit II: Media design& Sterilization:

Medium requirements for fermentation processes different types of industrial sterilization, Thermal death kinetics of microorganisms, batch and continuous heat sterilization of liquid media, filter sterilization of liquid media, air sterilization and design of depth filters, design of sterilization equipment - batch and continuous.

Unit III: Reactor Engineering:

General requirements of fermentation processes, basic design and construction of fermentor and ancillaries, reactors of specific applications: packed bed, bubble columns, fluidized bed and trickle bed bioreactors, bioreactor design for animal cell culture, and Bioreactor design for waste treatments. Solid-state fermentations and its applications. Active and passive immobilization of cells, diffusional limitations in immobilized cells, bioreactor considerations in immobilized cell.

Unit IV: Transport Phenomena in Bioprocess Systems:

Gas – Liquid mass transfer in cellular systems, determination of oxygen rates, correlations for mass transfer coefficient and interfacial area, mass transfer across free surface, other factors affecting K_La, heat transfer correlations.

Unit V: Measurement and control of Bioprocess:

On and off-line sensors for a modern bioreactor. Process control, direct regulatory control, cascade control, advanced control strategies.

Industrial Bioprocess: Anaerobic process: ethanol, lactic acid, acetone-butanol production. Aerobic Processes: citric acid, baker's yeast, penicillin, high fructose corn syrup production.

Course Outcomes (COs):

1. Explain the significance of downstream processing in bioprocess industry.
2. Evaluate primary separation techniques for product recovery.

3. Choose the techniques for product enrichment and purification.
4. Utilize membrane based operations for product purification.
5. Apply downstream processing concepts for commercial bio-products.

REFERENCE BOOKS:

1. Shuler, M.L. and Kargi, F. 2002. Bioprocess Engineering: Basic Concepts. 2nd Edition. Prentice Hall,
2. Lee, J.M., 1992. Biochemical Engineering, Prentice Hall Inc.
3. Bailey, J.E. & Ollis, D.F., 1986. Biochemical Engineering Fundamentals, 2nd ed., McGraw-Hill.

APPLIED RECOMBINANT DNA TECHNOLOGY

BTMT-506

Unit I:

Introduction and Scope:

Landmarks in molecular biology and biotechnology, what is genetic engineering and recombinant DNA technology, role of plasmids, phages, *E. coli* and, yeast, and other mammalian cells; genetic engineering guidelines including biosafety and ethics.

Unit II:

Tools in genetic engineering:

Enzymes- DNA polymerases, restriction endonucleases, ligases, reverse transcriptases, nucleases, terminal transferases, phosphatases etc.; different vectors based upon plasmids, bacteriophages and viruses, artificial chromosome, plasmid and hybrid vectors and shuttle vectors; concept of cloning vector and expression vector, different host systems.

Unit III:

Gene cloning and Expression:

Isolation and purification of DNA (genomic, plasmid) and RNA, isolation of gene, restriction digestion and ligation of DNA, linkers, adapters; methods of gene transfer in prokaryotic and eukaryotic cells, recombinant selection and screening methods, expression of cloned DNA molecules and maximization of expression, directional cloning strategy; genomic DNA libraries and cDNA libraries.

Factors in the optimization of expression of cloned gene, heterologous gene expression, vector engineering, codon optimization, host engineering.

Gene expression in bacteria, yeast, insects, mammalian cells and plants.

Unit-IV:

Recombinant DNA techniques and its applications:

Molecular probes and nucleic acid labeling, analysis of gene expression; DNA sequencing basics and Next Generation Sequencing (NGS); PCR and its variants, mutagenesis; molecular markers- DNA fingerprinting, single nucleotide polymorphisms, RAPD, RFLP, AFLP; protein- protein interactions technique- two-hybrid and phage display techniques; detection using GST and other fusion proteins; gene deletion.

Recombinant vaccines and therapeutics; gene therapy in vivo approach, ex-vivo approach; RNAi and antisense technology, ribozyme technology; Transgenics, knock out animals; genetic diversity; genetic disorders-diagnosis and screening; DNA microarrays; The Human Genome Project.

Course Outcomes (COs):

1. Recall and relate the role of genes, genetic code, and genetic engineering in Biotechnology.
2. Describe the role of various enzymes in genetic manipulation.
3. Make the use of the techniques involved in isolation, purification and separation of nucleic acids.
4. Apply rDNA technology in various fields using suitable methodology.
5. Appraise the use of genetic engineering principles for gene therapies.

REFERENCE BOOKS:

1. Primrose, S.B. and Twyman. 2008. R.M. 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. 2009. 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, Meerut.
6. Ramawat, K.G. 2008. Plant biotechnology (3rd eds.). S. Chand Publications, New Delhi.
7. Singh, B.D. 2008. Biotechnology- Expending Horizons (2nd eds.). Kalyani Publications.
8. P.K. 2009. Elements of Biotechnology. Rastogi Publications., Meerut.
9. U. 2008. Biotechnology. Uppala Author Publisher Interlink.

APPLIED RECOMBINANT DNA TECHNOLOGY LAB.

BTMT-556

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.

TISSUE ENGINEERING

BTMS-524

Unit- I **10**

Basic cell culture techniques, Types of cell culture media; Ingredients of media; Physiochemical properties; CO_2 and bicarbonates; Buffering; Oxygen; Osmolarity; Temperature; Surface tension and foaming; Balance salt solutions; Antibiotics growth supplements; Foetal bovine serum; Serum free media; Trypsin solution; Selection of medium and serum; Conditioned media; Other cell culture reagents; Preparation and sterilization of cell culture media, serum and other reagents.

Unit II **10**

Different tissue culture techniques; Types of primary culture; Chicken embryo fibroblast culture; Chicken liver and kidney culture; Secondary culture; Trypsinization; Cell separation; Continuous cell lines; Suspension culture; Organ culture etc.; Behavior of cells in culture conditions: division, growth pattern, metabolism of estimation of cell number; Development of cell lines; Characterization and maintenance of cell lines, stem cells; Cryopreservation; Common cell culture contaminants.

Unit III **10**

Cell cloning and selection; Transfection and transformation of cells; Commercial scale production of animal cells, stem cells and their application; Application of animal cell culture for in vitro testing of drugs; Testing of toxicity of environmental pollutants in cell culture; Application of cell culture technology in production of human and animal viral vaccines and pharmaceutical proteins.

Unit IV **10**

Cell culture reactors; Scale-up in suspension; Scale and complexity; Mixing and aeration; Rotating chambers; Perfused suspension cultures; Fluidized bed reactors for suspension culture; Scale-up in monolayers; Multisurface propagators.

Unit V **10**

Transgenic animal production; Methods of transgene delivery; Integration of foreign genes and their validation; Gene targeting; Methods and strategies; Improving transgene integration efficiency; Cell lineages and developmental control genes in drosophila and mice.

Course Outcomes (COs):

1. Describe the basic techniques to manufacture scaffolds from raw biomaterials and explain the different prerequisites for the biomaterials.

2. Explain nature design concepts in the biomaterials field.
3. Differentiate biomaterials regarding their properties and assess their usage in a specific application.
4. Describe the most common techniques to test cell biocompatibility of biomaterials and apply them on different biomaterials.
5. Correlate the protein structure of a biomaterial with its properties as a biomaterial.

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 Production and Health Paper-77), 1st Edition, W.D. Hoard and sons FAO, 1991

3. I. Gordon, Laboratory production of cattle embryos, 2nd edition, CAB International, 2003.

4. Louis-Marie Houdebine, Transgenic Animals: Generation and Use 5th Edition, CRC Press, 1997.

SEMESTER-III

BIOINSTRUMENTATION

BTMT-601

Unit I: Spectroscopy: Interaction of EM radiation with matter: Overview of Electromagnetic spectrum; physical phenomenon: Absorption, Resonance fluorescence, Emission, Refraction, Diffraction, Scattering, Raman Scattering, Resonance Raman Scattering

UV-Visible spectroscopy-Electronic transition, Beer-Lambert's Laws, instrumentation, absorption maxima UV-Visible spectrophotometer, working and applications.

Atomic spectroscopy: Principles and application of Atomic Absorption / Emission Spectrometer

Unit II:

Chromatography: Basic principle, Partition coefficient, retention time, Rf value, different types of chromatography viz. Column chromatography, adsorption chromatography, affinity chromatography, partition chromatography, ion exchange chromatography, chromatofocussing, GLC, HPLC, TLC and Paper chromatography.

Electrophoresis: General principle, types of support media, Electrophoresis of proteins and nucleic acids. PAGE and agarose gel electrophoresis, (horizontal and vertical electrophoresis), iso-electric focussing, two-dimensional electrophoresis, capillary electrophoresis, pulse field gel electrophoresis.

Unit III:

Mass Spectrometry- Principle and Instrumentation, ionization techniques-electron impact, chemical ioinisation, fast atom bombardment, and electrospray ionization, MALDI.

Nuclear Magnetic Resonance Spectroscopy- Theory and principle, instrumentation-FTNMR and CWNMR, Chemical shift, Factors affecting chemical shift, Simplification of complex NMR spectra by Double resonance and NOE.

Electron Spin Resonance Spectroscopy-Principle and application, Spectrofluorometry and Atomic absorption spectrophotometry, Raman spectroscopy, IR spectroscopy, Circular dichroism

Unit IV: Localization Techniques:
Microscopy: Resolving power, magnification, principle and applications of optical microscopy (bright field, dark field, phase contrast, interference, polarization, and fluorescence), electron microscopy, STM, AFM.
Diffraction Techniques: X-ray diffraction, electron diffraction and neutron diffraction.

Unit V:
Biosensors: Principles and definition, characteristics of Ideal biosensors, Basic measuring procedure, Biochemical components of biosensors, Enzyme based biocatalyst sensors, Bioaffinity systems, Immunosensors
Application of Biosensors: Clinical laboratory, In vivo determination of metabolites, Environmental monitoring of toxic compound.

DOWNSTREAM PROCESSING & BIOSEPARATION

BTMT-603

Unit I:

Cell lysis and flocculation: biomass removal and cell disruption, chemical lysis, enzymatic lysis, physical and mechanical means of disruption, flocculation.

Sedimentation: sedimentation principles, methods and coefficients, centrifuges, ultra centrifugation, sedimentation of low accelerations.

Unit II:

Membrane separation process: Filtration, filtration principles, ultrafiltration, electrophoresis, electrodialysis and isoelectric focusing, membrane for liquid-liquid extraction, reverse osmosis, separation of liquids, dialysis.

Unit III:

Chromatography: Classification, concepts of retention factor, capacity factor, partition coefficient, column efficiency; ion exchange chromatography, gas chromatography, gel filtration chromatography, HPLC, UFLC, affinity chromatography, adsorption , reverse phase chromatography etc.

Unit IV:

Distillation operations: Basic principles of the following distillation operations, batch, continuous, flash, steam, vacuum, molecular distillations, azeotropic and extractive distillation.

Unit V:

Extraction and Drying: extraction, extraction principles, drying, drying principles, dryer description of operation.**Precipitation:** protein solubility, precipitate formation phenomena, methods of precipitation. **Crystallization:** crystallization principles, batch crystallizers, process crystallization of proteins, lyophilisation.

REFERENCE BOOKS:

1. Treybal E. Robert. 1993. Mass-Transfer operations (3rd eds). McGraw-Hill International Edition, Singapore.
2. Doran M. Paulines. 2003. Bioprocess engineering principles (8th eds). Academic press, New York.
3. Warren, M.L., Julian, S.C. and Peter Harriott. 2001. Unit Operations of Chemical Engineering (6th eds). McGraw-Hill International Edition, New York.
4. Bailey, J. E. and Ollis, D.F. 1986. Biochemical Engineering Fundamentals (2nd eds.). McGraw-Hill Inc.

NANO-BIOTECHNOLOGY

BTMT-623

UNIT I:

Introduction, History & Applications: Various definitions and Concept of Nano-biotechnology & Historical background. Fundamental sciences and broad areas of Nano-biotechnology. Various applications of Nano-biotechnology Cell – Nanostructure interactions.

Unit II:

Protein-based Nanostructures: Nanobio-machines & Signalling Overview, chemistry and structure, Genetics & Secondary cell-wall polymers, Self-assembly in suspension, Re-crystallization at solid supports, Formation of regularly arranged nano-particles. Cell as Nanobio-machine, link between the signaling pathways & molecular movements as well as neuron function, Concepts in nanobio-machines for information processing and communications.

UNIT III:

Microbial Nanoparticle Production: Overview and concept of microbial nano-particle production, Methods of microbial nano-particle production Applications of microbial nano-particles, Bacteriorhodopsin and its potential in technical applications– overview, structure, photoelectric applications, photochromic applications and applications in energy conversion.

Unit IV:

DNA-Protein Nanostructures: Overview and introduction, Oligonucleotide-Enzyme conjugates, DNA conjugates of binding proteins, Non-covalent DNA-Streptavidin conjugates, DNA-Protein conjugates in microarray technology.

Unit V:

Biomaterials & Bio-electronics: Biomaterials- types, properties and applications, Biomaterial nano-particle systems for bio-electronic & bio-sensing applications, Biomaterial-based Nano-circuitry, Protein-based Nano-circuitry, DNA as functional template for Nano-circuitry.

Course Outcomes (COs):

1. Provide basic understanding about the new branch of biotechnology –Bio nanotechnology.
2. Functioning of Bionanomachines and its advantages and uses.
3. Knowledge about the Biomolecular design and the Biomolecular Structure determination and how it is in bio nanotechnology.

REFERENCE BOOKS:

1. Nanobiotechnology: Concepts, Applications and Perspectives, Christof M. Niemeyer (Editor), Chad A. Mirkin (Editor) , Wiley Publishers, April 2004.
2. Nanotechnology: A Gentle Introduction to Next Big Idea, Mark Ratner and Daniel Ratner, Low Price edition, Third Impression, Pearson Education
3. Nanotechnology, William Illsey Atkinson, JAICO Publishing House, Second Impression-2008.
4. Bio molecular computation for Bio nanotechnology, Liu and Shimohara, Artech House-London,2007.

FOOD ENGINEERING AND QUALITY CONTROL

BTMT-605

Unit-I

Quality factos: appearance, texture and flavor, Apperance factors – size and shape, colour ad gloss, consistency. Textural Factors measuring texture, texture changes.

Unit-II

Flavour Factors – influence of colour and texture on flavor. Taste Panels. Food – related azards – biological hazards, chemical hazards, physical hazards, trace chemicals. Microbiological considerations in food safety.

Unit-III

Food additives – preservatives, atioxidats, sequestrants, surface active agents, stabilizers and thickeners, bleaching and maturing agents, starch modifies, buffers, acids, alkalis, food colours, artificial sweteners, nutritional additives, flavouring agents.

Unit-IV

Food laws: Federal Food Drug and Cosmetic Act (1938), Good Manufacturing Practices (Code of GMP), Fair Packaging and Labeling Act (1966), Federal Meat Inspection Act (1906), International Food, Standards and Codex Alimentarius, HACCP and ISO 9000 series.

REFERENCE BOOKS:

1. Brennan JG, Butter JR, Corell ND & Lilly AVE. 1990. Food Engineering Operations. Elsevier.
2. Charm SE, McCabe WL, Smith JC & Harriott P.1993.Unit Operations of Chemical Engineering. McGraw Hills.
3. Earle RL. 1985. Unit Operations in Food Processing. Pergamon Press.
4. Fellows P. 1988. Food Processing Technology.
5. VCH Ellis Horwood. Heldman DR & Singh RP.1995. Food Process Engineering. AVI Publ.
6. McCabe WL & and Smith JC. 1971. Fundamental of Food Engineering . AVI Publ.
7. Sahay KM & Singh KK. 1994. Unit Operation of Agricultural Processing Vikas Publ. House.
8. Singh RP & Heldman DR. 1993. Introduction to Food Engineering. Academic Press.