MANONMANIAM SUNDARANAR UNIVERSITY
TIRUNELVELI
PG - COURSES – AFFILIATED COLLEGES
Course Structure for M.Sc. Biotechnology
(Choice Based Credit System)
(with effect from the academic year 2016- 2017 onwards)
(44th SCAA meeting held on 30.05.2016)

Sem	Sub 'Pr. No.	Subject status	Subject Title	Hrs/ week	Cre - dits	Marks				
						Maximum			Passing minimum	
						Int.	Ext	Tot.	Ext.	Tot
III	11	Core - 8	Research Methodology and Biostatistics	6	5	25	75	100	38	50
	12	Core - 9	Biology of Immune System	6	5	25	75	100	38	50
	13	Core - 10	Bioprocess Technology	6	5	25	75	100	38	50
	14	Elective – III (Choose anyone)	a). Industrial Biotechnology (or) b).Stem Cell Biology	6	5	25	75	100	38	50
	15	Practical - III	Biology of Immune System, Bioprocess Technology and Biostatistics	6	-	-	-	-	-	-
IV	16	Core - 11	Applied Bioinformatics	6	4	25	75	100	38	50
	17	Core – 12	Proteomics and Genomics	6	4	25	75	100	38	50
	18	Core – 13	Medical Biotechnology	6	4	25	75	100	38	50
	19	Project		6	5	50	50	100	25	50
	20	Practical – III	Biology of Immune System, Bioprocess Technology and Biostatistics	--	4	50	50	100	25	50
	21	Practical-- IV	Applied Bioinformatics Proteomics and Genomics	6	4	50	50	100	25	50

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Research Methodology and Biostatistics

Unit I:

Research methodology: An introduction – meaning, objective and types of research. Defining research problem – selection of problems. Sampling design – random sample. Measurement and scaling techniques, error in measurement.

Unit II:

Methods of data collection – primary data – interview method, questionnaire, secondary data, case study method. Online data base library. The computer and its role in research.

Unit III:

Preparation of scientific documents: Research papers, review articles, format of journals – proof reading. Journals: Standard of research journals, impact factor, citation index, methods of citation. Oral presentation, poster presentation, bibliography, thesis writing

Unit IV:

Measures of central tendency – mean, median, mode, dispersion – range, quartile deviation, mean deviation, standard deviation, coefficient of variation. Standard error, correlation, correlation coefficient, regression.

Unit V:

Hypothesis – definition, basic concepts concerning testing of hypotheses, test of hypotheses and its limitations, significance test and fixing level of significance, Chi square test, student's t test. ANOVA – one way and two way. Use of statistical softwares.

Reference Books

1. Research Methodology, Kothari
2. Statistics for Life Science, M.L. Samuels and J.A. Witmer
3. Statistics, R.S.N. Pillai
4. Design and analysis of Experiments, Montgomery and C. Douglas

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Biology of Immune System

Unit I:

Immune system: Organization, structure and functions of lymphoid organs – Bone marrow, thymus, spleen and lymph nodes; Cells of the immune system – Haematopoeisis, B lymphocytes, T Lymphocytes, TCR, BCR,NK cells, Granulocytes, Types of immunity : Innate and acquired. humoral and cell mediated immune response. Antigen: definition, types, properties, T dependent and T independent antigens, super antigens – antigenicity and immunogenicity, epitopes, haptens and adjuvants.

Unit II:

Immunoglobulins – structure and functions, Theories of antibody formation, Organization and expression of Immunoglobulin Light and Heavy chain genes. Generation of antibody diversity. Antigen-antibody interactions- precipitation and agglutination, Cytokines- Properties and functions, Interleukins and Interferons.

Unit III:

The complement systems: mode of activation, classical and alternate pathway, Membrane Attack Complex (MAC), Major histocompatibility complex (MHC): Structure, functions, general organization and inheritance of MHC, MHC molecules and genes, cellular distribution and regulation of MHC molecules. Mechanisms of antigen processing and presentation-cytosolic and endocytic pathways. Inflammation – mechanism and significance.

Unit IV:

Regulation of immune response**,** Immune response to infectious diseases – bacterial- TB, viral - HIV, protozoan- malaria. Autoimmune disorders, Hypersensitivity reactions – types and pathogenesis, Immuno deficiency diseases, Transplantation immunology, Immunosuppression, Tumour immunology, vaccination- new generation vaccines, Genetically engineered antibodies.

Unit V:

Immunological techniques – WIDAL,VDRL, pregnancy and Rheumatoid factor tests, Coomb's test, Well Felix test, Brucella agglutination test, Principle and applications of Radioimmuno assay (RIA), Enzyme Linked Immuno Sorbant Assay (ELISA), ELISPOT assay, chemiluminesence assay, Immunodiffusion, Immunoelectrophoresis, Immunofluorescence, Monoclonal antibody – production and applications. Immunohistochemical methods – Direct, indirect, Peroxidase-Antiper Oxidase (PAP) method, Avidin-Biotin Complex (ABC) method, Labelled Streptavidin Biotin (LSAB) method, Electron Microscopic (EC) method.

Reference Books

1. Kuby Immunology (2007) by Thomas J. Kindt, Richard A. Goldsby and Barbara A. Osborne. W.H.Freeman and Company
2. Immunology (2006) by David Male, Jonathan Brostoff, David B Roth and Ivan Roit. Elsevier Publishers.
3. Essentials of Clinical Immunology (2006) by Helen Chapel, Mansel Haeney, Siraj Misbah and Neil Snowden. Blackwell Publishing.
4. Immunology (2006) by C. Vaman Rao. Narosa Publishing House Pvt, Ltd
5. Immunobiology (The immune system in health and disease) (2005) by Charles A. Janeway, Paul Travers, Mark Walport and Mark Sholmchik. Garland Publishing.
6. Immunology of Infectious Diseases (2002) Edited by Kaufmann, Sher and Ahmed. ASM Press.

7. Understanding Immunology (2001) by Peter Wood. Pearson Education Limited
8. Roitt's Essential Immunology (2001) by Ivan M. Roit and Pete J. Delves. Blackwell Science Ltd.
9. Antibody Engineering (2006) by Ed Harlow and David Lane. Panima Publishing Corporation.

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Bioprocess Technology

Unit I:

Introduction to Bioprocess Engineering, Bioreactors, Isolation, Screening Preservation and Maintenance of Industrial Microorganisms, Kinetics of microbial growth and death. primary and secondary metabolites. Media for Industrial Fermentation, Air and Media Sterilization.

Unit II:

Types of fermentation processes: Batch, Fed-batch and continuous bio reactions, stability of microbial reactors, analysis of mixed microbial populations, specialized bioreactors (pulsed, fluidized, photo bioreactors etc., Measurement and control of bioprocess parameters.

Unit III:

Downstream Processing: Introduction, Removal of microbial cells and solid Matter, foam separation, precipitation, filtration, centrifugation, cell disruptions, liquid-liquid extraction, chromatography, Membrane process, Drying and Crystallization. Effluent treatment: B.O.D. and C.O.D. treatment and disposal of effluents

Unit IV:

Whole cell Immobilization, protein immobilization and their Industrial Applications, Industrial Production of Chemicals: Alcohol (ethanol), Acids (citric, acetic and gluconic), solvents (glycerol, acetone, butanol), Antibiotics (penicillin, streptomycin, tetracycline), Amino acids (lysine, glutamic acid), Single cell Protein, Use of microbes in mineral beneficiation and oil recovery.

Unit V:

Introduction to Food Technology, Elementary idea of canning and packing, sterilization and Pasteurization of food Products, Technology of Typical Food/Food products (bread, cheese, idli) - Food Preservation.

Reference Books

1. Biochemical Engineering, Aiba, S., Humphrey, A.E. and Millis, N.F. Univ. of Tokyo Press, Tokyo
2. Biochemical Reactors, Atkinson, B., Pion Ltd., London
3. Biochemical Engineering Fundamentals, Baily, J.E. and Ollis, D.F., McGraw- Hill Book Co. New York
4. Bioprocess Technology: Fundamentals and Applications, KTH, Stockholm.
5. Process Engineering in Biotechnology, Jackson, A. T., Prentice Iiall, Engelwood Cliffs
6. Bioprocess Engineering: Basic Concepts, Shuler, M.L. and Kargi, F., Prentice Hall, Engelwood Cliffs
7. Principles of Fermentation Technology, Stanbury, P.F and Whitaker, A., Pergamon Press, Oxford
8. Bio reaction Engineering Principles, Nielson,J. and Villadsen, J., Plenum Press
9. Chemical Engineering Problems in Biotechnology, Shuler, M.L. (Ed.), AICHE
10. Biochemical Engineering, Lee, J .M., Prentice Hall Inc.
11. Bioprocess Engineering - Kinetics, Mass Transport, Reactors and Gene Expression, Vieth, W.F., John Wiley & Sons, Inc.

MSU / 2016-17 / PG –Colleges / M.Sc. (Biotechnology) / Semester –III / Ppr.no.14 / Elective - III (a)

Industrial Biotechnology

Unit I:

Strain selection, media design and inoculums development, types of microbial products (biomass, primary and secondary metabolites, bioconversion products), strain selection and improvement methods, principles of microbial nutrition and media formulations for cell growth and product formulations

Unit II:

Factors influencing the choice of various carbon and nitrogen sources, vitamins, minerals, precursors and antifoam agents. Importance of media pH and temperature, development of inoculation for industrial fermentations.

Unit III:

Bioreactors and aseptic operation: Basic design and construction of bioreactors and accessories – types of industrial reactors and modes of operations (stirred tank, air lift, bubble column, bed, packed bed). Methods of sterilization – thermal death kinetics, logarithmic and non-logarithmic), batch and continuous sterilization, air sterilization – design and air filter, aseptic operation of fermentor.

Unit IV:

Immobilization Technology: Merits and demerits of cell and enzyme immobilization, methods of preparation of immobilizing agents – properties and applications of immobilized enzyme and microorganisms, biotransformations, characterization of immobilized biocatalyst

Unit V:

Fermentation Technology: Various unit operations involved in upstream and downstream processing of microbial products: antibiotics, organic acids, alcoholic bevarages and industrial enzymes. Production of baker's yeast, Single Cell Protein, biofertilizers and biopesticides, microbial bioconversion (production of α-hydroxyl progesterone, L-phenyl alanine, L-sorbose etc).

Reference books

1. Biotechnology – the biological principles, Trevan
2. Basic Biotechnology, S. Ignacimuthu
3. Principles of Biotechnology, R.D. Old and S.B. Primrose
4. Plant Biotechnology – Recent Advances, P.C. Triveni

MSU / 2016-17 / PG –Colleges / M.Sc.(Biotechnology) / Semester –III / Ppr.no.14 / Elective - III (b)

Stem Cell Biology

Unit I:

Stem Cell Basics: Stem cells, embryonic stem cells, embryonic germ cells, bone marrow stem cells, adult stem cells, differentiation. Introduction to concepts in stem cell biology – renewal, potency etc. Stem cell characterizations: Isolation and characterization, markers and their identification, growth factor requirements and their maintenance in culture. Pluripotency and reprogramming.

Unit II:

Hematopoietic Stem Cell, Induced Pluripotent Stem (iPS) cell technology, epigenetic memory in iPS cells, epigenetic controls of stem cells. Early embryonic development, Lymphoid cell differentiation and maturation, cell cycle regulators in stem cells. Molecular mechanisms of self-renewal, pluri/multipotency and lineage differentiation. Molecular basis of pleuripotency and stem cell niche.

Unit III:

The human umbilical cord: A source of stem cells. Isolation of mesenchymal stem cells (MSCs) from the umbilical cord, *in vitro* differentiation potential of umbilical cord mesenchymal stem cell. In vivo applications umbilical cord stem cells, cord blood stem cells transplantation – advantages and disadvantages, cord blood banking.

Unit IV:

Generation and manipulation of mouse embryonic stem cells. Generation and manipulation of human embryonic stem cells, animal models of regeneration – Hydra, Planaria, earth worm, zebra fish etc.

Unit V:

Cancer stem cell – origin of cancer stem cells, impact of cancer stem cell, concept on cancer therapy. Epigenetics and reprogramming in stem cell biology. Stem cell gene therapy, stem cell therapy for neurodegenerative diseases. Stem cell therapy for cardiac regeneration, clinical cell transplantation for leukemia. Ethical issues associated with stem cell biology.

Reference Books

1. Immunology, T.J. Kindt, R.A. Goldsby and B.A. Osborne
2. Roitt's Essential Immunology, P. Delves, S. Martin, D. Burton and I. Roitt
3. Cellular and Molecular Immunology, A.K. Abbas, A. Lichtman and J.S. Pober
4. Immunology, C.A. Janeway, Jr, p. Travers, M. Walport and M.J. Shlomchik

Lab in Biology of Immune System Bioprocess Technology and Biostatistics

1. Blood film preparation and identification of cells
2. Preparation of serum
3. Purification of IgG from serum
4. Blood grouping
5. Total leucocyte count
6. Total RBC count
7. Single and double immune diffusion
8. Immuno-elctrophoresis
9. Rocket Immunoelectrophoresis
10. ELISA
11. Estimation of total solids in the effluent sample
12. Determination of total dissolved solids in polluted water
13. Determination of Dissolved Oxygen (DO) of polluted water
14. Determination of Biological Oxygen Demand (BOD) of polluted water
15. Determination of Chemical Oxygen Demand (COD) of polluted water
16. Estimation of nitrate in drinking water
17. Isolation of coliforms from sewage
18. Analysis of water for potability and determination of MPN
19. Preparation of bar diagram (single, multiple, subdivided, percentage), line diagram and pie diagram using MS EXCEL
20. Calculation of Central Tendency – Mean, Geometric mean, Harmonic mean, median using MS EXCEL
21. Calculation of Dispersion – Mean Deviation, Quartile Deviation and Standard Deviation using MS EXCEL
22. Calculation of correlation using MS EXCEL
23. Finding the regression equation using MS EXCEL
24. Calculation of ANOVA (one-way) using MS EXCEL

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Applied Bioinformatics

Unit I:

Bioinformatics – an overview, scope and applications. Algorithm – definition and examples – types of Algorithm – iterative, recursive, fast and slow algorithms. Introduction of digital computers: File management, data mining, dataware housing, organization; low-level and high-level languages; binary number system. Flow charts and programming techniques.

Unit II:

DNA data bank – the EMBL nucleotide sequence data bank – genbank – DDBJ. Enzyme databases – cloning vector data bases, BLAST, FASTA, algorithm to analysis sequence data. Pairwise alignment and multiple alignment of nucleic acids and protein sequences, CLUSTAL W.

Unit III:

Secondary structure prediction of RNA, homology modelling, threading. RASMOL, MOLMOL, protein docking, drug designing. Mathematical modelling of protein, access of web based bioinformatics tools.

Unit IV:

Biophysics – Definition, scope and methods. Atomic structure, atomic orbital, wave functions, electronic structure of atoms, spin of particles – relationship between atomic structure and chemical properties. Molecule – different types of bonds – molecular orbital, chirality in biological systems.

Unit V:

Proteins: Protein structure - primary, secondary, tertiary and quartenary, globular, fibrous proteins, Ramachandran plot. Three dimensional structure and confirmation using physical methods – ORD, CD, ESR, PAGE, SDS-PAGE, diagonal electrophoresis. DNA-protein interactions; DNA-drug interactions

Reference Books

1. Introduction to Computers, Balaguruswamy
2. Nucleic acid and protein sequence analysis and structural studies, M.A. Bishop and C.I. Rawlings
3. An introduction to Bioinformatics algorithms, N.C. Jones and P.A. Pevzner
4. General Biophysics, Volkones
5. Molecular Biophysics, B. Pullman and M. Voino

MSU / 2016-17 / PG –Colleges / M.Sc.(Biotechnology) / Semester –IV / Ppr.no.17 / Core-12

Proteomics and Genomics

Unit I:

Proteomics: Introduction and scope of proteomics; Protein separation techniques: ion exchange, size-exclusion and affinity chromatography; Electrophoresis techniques-Polyacrylamide gel electrophoresis, 1D and 2D gel electrophoresis, isoelectrofocusing. Fundamentals of mass spectrometry [basic theory, ionization techniques and mass analyzers, electrospray ionization (ESI)] and matrix adsorption laser dissociation ionization (MALDI).

Unit II:

Reversed phase HPLC and microcapillary LC, protein and peptide separation technique, proteome database. Qualitative and quantitative proteome analysis. Shot gun proteomics for proteome profile (whole proteome and sub-proteome analysis). Expression of proteome analysis (isotope labelling and label free approaches). *In vivo* proteome analysis.

Unit III:

Proteomic analysis of post translational modifications (Phosphorylation, ubiquitination, acetylation, nitration and glycosylation etc). Proteome analysis of protein-protein, protein-DNA interactions (identification of ligand receptor pairing and transcriptional regulators). Proteomics approaches for investigation of therapy resistance in cancer (identification of new factors and protein expression profiles associated with anticancer therapy resistance).

Unit IV:

Genomics: Overview of genome; methods of preparing genomic DNA – shot gun cloning method, DNA sequence analysis methods – Sanger and Dideoxy method and fluorescence method; gene variation and single nucleotide polymorphism (SNPs); genetic analysis, linkage mapping, Expressed Sequenced Tags (ESTs), gene disease association.

Unit V:

Recombinant DNA technology: DNA cloning basics, Polymerase Chain Reaction (PCR), FISH, RFLP, RAPD. Human Genome Project, Genome wide association studies, metagenomics.

Reference Books

1. Principles of Proteomics, R.M. Twyman
2. Handbook of Proteomic Method, P. Michael Conn
3. Proteomics – Introduction to methods and applications, A. Kraj and J. Silberring
4. Genomics, Cantor and Smith
5. Biochemistry, L. Stryer

MSU / 2016-17 / PG –Colleges / M.Sc.(Biotechnology) / Semester –IV / Ppr.no.18 / Core-13

Medical Biotechnology

Unit I:

Molecular aspect of Diseases: Genetic: Huntington's disease, Sickle cell disease, Klinefelter syndrome, Duchenne Muscular Dystrophy, Parkinson's disease, Coronary artery diseases; **Microbial:** Hepatitis, Lyme disease, AIDS, Tuberculosis; **Metabolic:** Diabetes mellitus, Faber's disease, Muscle diseases.

Unit II:

Diagnosis of diseases: Prenatal diagnosis- invasive and non-invasive techniques; Monoclonal antibodies. Protein and enzyme markers, DNA probes, Enzyme probes, Proteomics for diagnosis, Nanodiagnosticts.

Unit III:

Vaccinology: Health care products: rDNA drugs and vaccines- insulin, growth hormone, factor VIII, Tissue Plasminogen Activator, Interferons, Lymphokines and Hepatitis- B vaccines. DNA based vaccines. Current strategies for development of vaccines against HIV, Malaria, Tuberculosis.

Unit IV:

Drugs and their Mechanism: Aspirin, Paracetamol, Avil, Antibiotics, Antiviral drugs, drugs for metabolic diseases, Anticancer drugs,Anti-hypertensive drugs, Bronchodilator drugs and their mode of actions.

Unit V:

Future of Medical Biotechnology: Individualized medicine; Gene therapy, Nanomedicine- Nanoparticles, Nanodevices- Medical microrobotics, Nanomedicine and Nanosurgery- for cancers, neurological disorders, Stem cell therapy.

References Books

1. Medical Biotechnology; Albert Sasson (2006), United Nations Publications.
2. Medical Biotechnology; S.N. Jogland (2000), Himalaya Publication.
3. Medical Devices and Systems in Biomedical Engineering Handbook, Vol 2; Joseph Bronzino and Bronzino and Bronzino.
4. The Proteus effect, Ann B Parson (2006); National Academic Press
5. Biotechnology and Biopharmaceuticals (2003), Rodney J.Y. Hoan milo Gilbaldi, Wiley John and Sons.
6. Stem Cell Now: Christopher Thomas Scott (2005) Penguin group (USA).
7. Biotechnology Demystified Sharon Walker (2006) McGrow Hill Publication.

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MSU / 2016-17 / PG –Colleges / M.Sc.(Biotechnology) / Semester –III / Ppr.no.20 / Practical- III

Lab in Biology of Immune System Bioprocess Technology and Biostatistics

1. Blood film preparation and identification of cells
2. Preparation of serum
3. Purification of IgG from serum
4. Blood grouping
5. Total leucocyte count
6. Total RBC count
7. Single and double immune diffusion
8. Immuno-elctrophoresis
9. Rocket Immunoelectrophoresis
10. ELISA
11. Estimation of total solids in the effluent sample
12. Determination of total dissolved solids in polluted water
13. Determination of Dissolved Oxygen (DO) of polluted water
14. Determination of Biological Oxygen Demand (BOD) of polluted water
15. Determination of Chemical Oxygen Demand (COD) of polluted water
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21. Calculation of Dispersion – Mean Deviation, Quartile Deviation and Standard Deviation using MS EXCEL
22. Calculation of correlation using MS EXCEL
23. Finding the regression equation using MS EXCEL
24. Calculation of ANOVA (one-way) using MS EXCEL

MSU / 2016-17 / PG –Colleges / M.Sc.(Biotechnology) / Semester –IV / Ppr.21 / Practical – IV

Lab in Applied Bioinformatics, Proteomics and Genomics

1. Pairwise alignment – global alignment of DNA and protein using Needleman – Wunch algorithm
2. Perform local alignment of DNA and protein using Smith-Watermann algorithm
3. Multiple alignment of nucleotide and protein
4. BLAST
5. FASTA
6. CLUSTAL W'
7. Protein structure viewing – RASMOL, uniprot, SWISS PDB VIEWER
8. PCR primer designing
9. Cloning vector – univec
10. Drug designing – RASMOL
11. 2D gel electrophoresis
12. Western Blotting
13. Microarray