Placed at the meeting of
Academic Council
held on 26.03.2018

APPENDIX – T

MADURAI KAMARAJ UNIVERSITY

(University with Potential for Excellence)

M.Sc. Biotechnology Semester
Revised Syllabus
(with effect from 2018-19)
SCHEME OF EXAMINATION AND REGULATIONS

1. Introduction of the Programme

Biotechnology is an inter-disciplinary course and its applications are imperative for the betterment of the society and for the livelihood of the living beings. The course has been designed with core subjects in the modern areas of biotechnology in particular life sciences and its applications to foster the student community the scientific attitude and interest towards application oriented teaching and research. The courses are designed to impart the essential basics in Chemistry, Botany, Zoology and Biotechnology. It will help the students to become critical and curious in their outlook. The various courses in the programme is aimed to develop proficiency in the theory as well as practical experiments, common equipments, laboratory practice, Concentrate on Research activities along with the collection, interpretation and presentation of scientific data to compete with the international student community.

2. Eligibility for admission:

Candidates who have completed B.Sc., degree in Botany, Zoology, Biochemistry, Microbiology, Biotechnology or any branch of Life Sciences, Chemistry, Mathematics and Physics with any subject in life sciences as ancillary subject.

Candidates secured at least 60% of marks in aggregate are eligible to apply.

A relaxation of 10% marks in the aggregate will be given to SC/ST/PH students.

Duration of the Course

a) The students will undergo the prescribed course of study for a period of not less than two academic years (four semesters)
b) The maximum duration for completion of the PG Programme shall not exceed eight semesters.
c) Medium of Instruction: English

3. Objectives of the Programme

Biotechnology has the potential to improve the fields including agriculture, food processing, health care, forensics, energy production, health care and environment. The students of Biotechnology can pursue careers in a wide range of areas. To promote an educational philosophy in which technology is fully integrated into the curriculum through active participate of student- centered learning. This programme provide a platform for students and teachers of biotechnology, to articulate their points of view and nurture them as ambassadors to promote safe and appropriate deployment of biotechnology.

4. Outcome of the Programmes

Our courses are designed to produce graduates who will have a solid understanding of science, technology along with the entrepreneurial skills required to exploit technological advances within a competitive environment. As well as explaining the science behind biotechnology, this course also explains how new start-up biotechnology companies are created, how to explore the market potential of products and processes. The scope of careers in Biotechnology graduates with an entrepreneurial spirit who go on to set up companies of their own. This blend of skills will be invaluable to future employers and provides a springboard for the budding biotechnologist in future.

Course Structure:

The course is organized on semester basis with a total of four semesters. A student must secure 90 credits to get the degree.

No	Title of the paper	Sub. Code	Credits	Exam hrs	Marks		Total
					Int	Ext	
Semester I							
1	Biochemistry		4	3	25	75	100
2.	Molecular Genetics		5	3	25	75	100
3	Lab in Analytical Biochemistry		4	3	25	75	100
4	Lab in Molecular Genetics		4	3	40	60	100
5	Subject Elective – 1		5	3	25	75	100
Semester II							
6	Molecular and Developmental Biology		5	3	25	75	100
7	Immunology		5	3	25	75	100
8	Microbiology		4	3	25	75	100
9	Lab in Immunology and Animal Tissue Culture		4	3	40	60	100
10	Subject Elective – 2		5	3	25	75	100
Semester III							
11	Enzymology and Enzyme technology		4	3	25	75	100
12	Plant Molecular Biology & IPR		4	3	25	75	100
13	Recombinant DNA Technology		5	3	25	75	100
14	Lab in recombinant DNA and Microbial Biotechnology		4	4	40	60	100
15	Non-subject Elective – 1		5	3	25	75	100
Semester-IV							
16	Immunotechnology		4	3	25	75	100
17	Animal Biotechnology		5	3	25	75	100
18	Microbiolal Biotechnology & Bioprocess Technology		5	3	25	75	100
19	Lab in Plant Biotechnology		4	4	40	60	100
20	Subject Elective – 3 (Project)		5		25	75	100
	Total		90				2000

5. Core subject papers

1. Biochemistry
2. Molecular Genetics
3. Lab in Analytical Biochemistry
4. Lab in Molecular Genetics
5. Molecular and Development Biology
6. Immunology
7. Microbiology
8. Lab in Immunology and Animal Tissue Culture
9. Enzymology & Enzyme Technology
10. Plant Molecsular Biology & IPR
11. Recombinant DNA Technology
12. Lab in Recombinant DNA and Microbial Biotechnology
13. Immunotechnology
14. Animal Biotechnology
15. Microbial Biotechnology & Bioprocess Technology
16. Lab in Plant Biotechnology

6. Subject Electives

	Hrs	**Credits**
1. Bioinformatics	6	5
2. Biophysics and Structural Biology	6	5
3. Genomics and Proteomics	6	5

7. Non-subject Elective

(Offered in Biotechnology Department for other subject students)

	Hrs	**Credits**
1. Modern Biotechnology	6	5

8. Unitization

Semester-wise List of Papers, Hours & Credits

	Papers	**Hours**	**Credit**
Semester I	5	30	22
Semester II	5	30	23
Semester III	5	30	22
Semester IV	5	30	23
Total	**20**	**120**	**90**

9. Pattern of semester exam
10. Scheme for Internal Assessment

1. The pattern for internal valuation may be : two tests – 30 marks each: average 30 marks (Average of the two)
2. Group discussions/Seminar/Quiz – 5 marks
3. 2 Assignments: 5 marks each: average 5 marks
4. 3rd test may be allowed for absentees of any one of the two tests.
5. If the college opts quiz, 2 Quiz should be conducted.

Passing minimum – 50% (aggregate)
No pass minimum for internal
27/60 (45%) is the minimum in External

12. Question Paper Pattern

The pattern of Question Paper (External) will be as follows:
Time : 3 Hours and Maximum Marks : 60

Section A: (10 x 1 = 10 marks)
Question No. 1 to 10 (Multiple choice or Objective type)
1. Two questions from each unit
2. Four Choices in each multiple choice question (No 'none of the above' choice).
One mark objective questions are also acceptable.

Section B: (5 x 4 = 20 marks)
Answer all questions choosing either (a) or (b)
Answers not exceeding one page
(One question from each unit)

11 (a)	or	11 (b)
12 (a)	or	12 (b)
13 (a)	or	13 (b)
14 (a)	or	14 (b)
15 (a)	or	15 (b)

Section C: (3 x 10 = 30 marks) Questions 16 – 20
Answers not exceeding four page
Answer any three out of five (one question from each unit)

13. Scheme for Evaluation
The Internal and External marks will be in 40:60 ratio.

External exam
The pattern of Question Paper (External) will be
Time : 3 Hours and Max.Marks : 60

Section A: (10 x 1 = 10 marks)
Question No. 1 to 10 (Multiple choice or Objective type)

Section B: (5 x 4 = 20 marks)
Answer all questions choosing either (a) or (b)

Section C: (3 x 10 = 30 marks)
Answer any three out of five (one question from each unit)

Subject Papers

1. Biochemistry

Unit I: Principles of Bioenergetics-Glycolysis and catabolism of hexoses- The citric acid Cycle.
Unit II: Oxidation of fatty acids-Oxidation of amino acids-Oxidative phosphorylation - Photophosphorylation – Biological membranes and transport.
Unit III: Carbohydrate biosynthesis-Lipid biosynthesis- Biosynthesis of amino acids, nucleotide and related molecules-Chemical synthesis of peptides and oligosaccharides.
Unit IV: Prostaglandins, leukotrienes, thrombaxanes – Inteferons and interleukins
Unit V: Antibiotics, alkaloids – Animal pigments – Cytoskeletal organization

References:

1. Principles of Biochemistry by A.L. Lehninger, D.L. Nelson and M.M. Cox. (1993) Worth Publishers, New York
2. Biochemistry by L. Stryer (1994) Freeman & Co., New York
3. Biochemistry by G. Zubay (1988), Macmillan Publishing Co, New York
4. The Vital force: A study of Bioengergetics by F.M. Harold (1986) Freeman & Co., New York
5. A Biologist's Physical Chemistry by J. G Morris (1968) Edward and Arnold Publishers, London
6. Harper's Biochemistry by R. K. Murray, P.A. Mayes, D. K. Granner, and V.W. Rodwell (1990) Lange Medical Book

2. Molecular Genetics

Unit I: identification of DNA as the genetic material, Gene as the unit of mutation and recombination. Mutations: Molecular nature; mutagenesis by nitrous acid, hydroxylamine, alkylating agents, intercalators and UV. Origin of spontaneous mutations and control. Reversion and suppression – suppression of nonsense, missense and frameshift mutations. Para sexual process in bacteria: transformation, transduction and conjugal gene transfer: the phenomena mechanisms and applications. Recombination: model, mechanism and control.

Unit II: Gene as the unit of expression. Colinearity of gene and poly – peptide. Elucidation of the genetic code, Wobble hypothesis. DNA damage and repair: DNA damage by UV, alkylating agent, cross linkers, Mechanism of repair – photo reactivation, excision repair, recombi- national repair, SOS, Adaptive responses and their regulation Heat shock response.

Unit III : Extrachromosomal heredity: Biology of plasmids discovery, types and structure of F, RTF, Col-Factor and Ti plasmid, replication and partitioning. Incompatibility and copy number control, Natural and artificial plasmid transfer and their applications.

Unit IV: Transposable genetic elements – Identification of transposition – IS elements, composite transposons, Tn3, Tn5, Tn9, Tn10 and Mu phage. Mechanism of transposition. Transposable elements in eukaryotes: Maize – Ac & Ds, Spm & dspm, Drosophila – p elements. Retro transposons.

Unit V: Genetics of Eukaryotes: Gene linkage and chromosome mapping. Crossing over - there point cross, tetrad analysis. Organisation of chromosomes, specialized chromosomes, chromosome abnormalities, quantitative inheritance, population genetics. Development of genetics using Drosophila as model system. Somatic cell genetics.

References:

1. Molecular Biology – David Friefelder
2. Molecular Biology of the Gene – JD. Watson.
3. Genetics – Gardener and Snustad
4. Microbial Genetics – SR. Maloy, JE. Croman and David Friefelder.
5. Molecualr Genetics of Bacteria – J.W. Dale.
6. Basic Genetics – D.L. Hartl.

3. Lab in Analytical Biochemistry

1. Theory and applications of calorimeter, spectrophotometer, pH meter and buffers.
2. Methods of Protein estimation (Lowry and Bradford).
3. Thin layer chromatography
4. Screening and identification of industrially important microorganisms.
5. Production of an extracellular enzyme from bacteria/fungus and downstream processing a) Ultrafiltration, b) Ammonium Sulphate precipitation c) Dialysis d) Ion exchange chromatography e) Gel permeation chromatography etc.
6. Polyacrylamide gel Electrophoresis.
7. Radioactive labelling and measurement of radioactivity.
8. Demonstration of GLC and HPLC.

References:

1. Principles of Instrumental analysis by D.S. Skoog (1985) H.L. Saunders.
2. Laboratory Manual of Biochemistry by J. Jayaraman (1988) Wiely Eastern.
3. William, B.L and Wilson K., Principles and techniques of practical biochemistry (1995) Edward Arnold.

4. Lab in Molecular Genetics

1. Single colony isolation and checking for genetics markers
2. Measurement of growth rate
3. One step growth curve using a T even phage
4. Induced mutagenesis and mutants
5. Enrichment methods for auxotrophic and antibiotic resistant mutants;
6. Genetic mapping by P1 transduction;
7. Genetic mapping by conjugation;
8. Isolation of specialized trasducing phage;
9. Transposan mutagenesis of chromosomal DNA ;
10. Transposan of plasmid DNA;
11. Experiments with gene fusion.

References:

1. A short course in Bacterial Genetics by J.M. Miller (1992) Cold Spring Harbor Laboratory.

5. Molecular and Developmental Biology

Unit I: Cell theory, prokaryotic and eukaryotic cell structure and ultra structure and functions of intra cellular organelles. Organisation of cytoskeleton – organization of intermediate filaments, microtubules and actin filaments. Molecular aspects of cell division and cell cycle, mitosis, cytokines – Cell cycle – Cell fusion – Nuclear cytoplasmic interaction.

Unit II: Structure of DNA and RNA. DNA melting and unwinding kinetics – cot curve replication of DNA: enzymology, models of replication, kinetics and control.

Unit III: Transcriptions – Enzymology, prokaryotic and eukaryotic transcription, mechanism of transcription, post transcriptional modifications, export of mRNA. Transcription and process of rRNA and tRNA.

Unit IV: Translation – Mechanism and regulation, post translational modifications, protein secretion. Regulation of gene expression: Regulation in prokaryotes – Operon concepts, Lac, Trp and Ara. Regulation in eukaryotes – Transcriptional regulation, transcription factors, hormonal regulation, loss, amplification and rearrangement. RNA mediated regulation.

Unit V: Mechanism of signal transduction – G protein, cAMP and calcium ion channel. Cancer – Introduction, types and oncogenesis, mitogens. Oncogenes, suppression of Oncogenes.

References:

1. Molecular Biology of the Cell by Alberts *et al.,* (2003) Garland Publishing, New York
2. Molecular cell biology by Lodish *et al.,* (2003) Scientific American Press.
3. Principles of Cell and Molecular Biology by Kleinsmith and Kish (1995) Harper Collins College Publishers, New York.

6. Immunology

Unit I: History and scope of immunology. Types of immunity – innate, acquired, passive and active, Physiology of immune response-H1 and CMI specificity and memory.

Unit II: Antigen-Antibody reactions, types of antigens, hapten, immuno-globulins, types, structure, distribution and functions. Molecular biology of Ig synthesis.

Unit II: Lymphoid organs, ontogeny and physiology of immune system, origin and development, differentiation of lymphocytes. Lymphocytes sub-population of mouse and man. Structure and functions of Class I and Class II molecules.

Unit IV: HLA in human health and diseases. Transplantation immunity – Organ transplantation and HLA tissue typing, effector mechanism in immunity – Macrophage activation, cellular interaction in immune response, cell mediated cytotoxicity, hypersensitivity reactions, antigen lymphocyte activation, clonal proliferation, differentiation, interleukins and compliment systems.

Unit V: Immunological tolerance, immunosuppression, history and status of tumour immunology, autoimmune disorders and immunology of infectious disease.

References:

1. Immunology by I.M. Roitt, J. Brostoff and D. K. Male (1993) Gower Medical Publishing, London.
2. Immunology by J. Kuby (1991) Freeman and Company.

7. Microbiology

Unit I: History and scope of microbiology. Ultrastructure and functions of bacteria, fungi, algae, protozoa and viruses. Principles and structure and applications of microscopes.

Unit II: Classification of bacteria, fungi, algae, protozoa and viruses. Molecular taxonomy and current methods of microbial identification for systematic studies.

Unit III: Biology of *Echerichia coli, Bacillus substilis, Bacillus thuringiensis, Stretomyces sp., Rhizobium sp., Agrobacterium tumefaciens, Saccharomyces cervisiae, Aspergillus nidulans, archaeobacteria* and bacteriophages.

Unit IV: Food and diary microbes, Classification of foods, Contamination, preservation and spoilage of foods, Food borne diseases, plant microbes interactions - Rhizobium and Mycorrhizae

Unit V: Human pathogens, nosocomial infections, disinfectants, antibiotics, sterilizaition and environmental microbiology.

References:

1. Methods for General and Molecular Bacteriology by Gerhardt et al. (1994). ASM press.
2. Microbiology by Pelezar, Chan and Creig (1986) McGraw Hill
3. Microbiology by Presestt, Harley and Klein (1996) William C. Brown Press.

8. Lab in Immunology and Animal Cell Culture

1. Preparation of antigens – protocol of immunization, methods of bleeding.
2. Preparation of scrum and complement
3. Antigen- antibody reactions-Haemagglutination, Haemolysis, passive HA, precipitin ring test, immunodiffusion, immunoelectrophoresis.
4. Complement fixation test
5. Enzyme-linked immunoabsorbent assay
6. Plaque forming cell assay, isolation of immunoglobulin, Characterization, Peripheral blood mononuclear cell separation.
7. Lymphocyte subset identification and enumeration
8. Western blotting
9. Preparation of media, preparation of primary culture, maintenance of secondary culture, evaluation of culture dynamics.
10. Cell synchronization – preservation and revival of cells.
11. Hybridoma technology and monoclonal antibody production

References:

1. Hand book of Experimental Immunology Vol.I & II by Weir, D.M. (1986) Blackwell Scientific Publications.
2. Practical Immunology by Hudson, L and Hay, H.C. (1980) Blackwell Scientific Publications.
3. Techniques in clinical immunology by Thompson, R.A. (1977) Blackwell Scientific Publications.
4. Hybridoma techniques: A Laboratory Course by Muthukkaruppan, V.R. Baskar, S. and F. Sinigaglia (1986) Macmillan India Limited.
5. Cell Biology Vol I to III by V.E. Celis (1994) Academic Press.

9. Enzymology and Enzyme Technology:

Unit I: Enzyme classification and nomenclature, General properties of enzymes like effect of pH, temp, ions etc.

Unit II: Extraction, assay and purification of enzymes. Steady state kinetics. Michaelis - Menten, Lineweaver-Burke, Eadie-hofstee and Hanes-Woolf equations and Km value.

Unit III: Enzyme inhibitors, Pre-steady state kinetics. Fast kinetics to elucidate the intermediates and rate limiting steps (Flow and Relaxation methods). Enzyme specificity. Evidences for enzyme substrate complex. Nucleophilic and electrophilic attack. Role of metal ions in enzyme catalysis.

Unit IV: Mechanism of enzyme action eg. Lysozyme, chymotrypsin, DNA polymerases, RNase,. Zymogens and enzyme activation. Allosteric interactions and product inhibition; complex kinetics and analyses, Membrane bound enzymes – Extraction, assay lipid protein interaction and effect of fluidity on enzyme activity.

Unit V: Coenzyme; Clinical and Industrial applications of enzymes. Immobilization of enzymes and their application. Ribozymes and their applications. Enzyme engineering.

Referenes:

1. Biological chemistry by H.R. Mahler and E. Cordes (1986) Harper and Row, New York.
2. Enzymes by Malcolm Dixon and Edwin C Webb (1964) U.S.A Academic Press, New York.

10. Plant Molecular Biology and Intellectual Property Rights

Unit I: Plant genome organization, structural features of a representative plant gene, gene families in plants. Organization of chloroplast genome, nucleus – encoded and chloroplast-encoded genes for chloroplast proteins, targeting of proteins to chloroplast, Organization of mitochondrial genome, nuclear and mitochondria – encoded genes for mitochondrial proteins. RNA editing in plant mitochondria, mitochondrial genome and cytoplasmic male sterility.

Unit II: Seed storage proteins. Maize transposable elements. Organisation and function of transposable elements in transgenic plants. Regulation of gene expression in plant development. Plant hormones and phytochrome.

Unit III: Symbiotic nitrogen fixation in legumes by rhizobia – biochemistry and molecular biology. *Agrobacterium* and crown gall tumours. Mechanism of T-DNA transfer to plants. Ti plasmid vectors for plant transformation. Agroinfection. Classification and molecular biology of plant viruses. Molecular biology of plant stress response.

Unit IV: Genetic engineering in plants, selectable markers, reporter genes and promoters used in plant vectors. Direct transformation of plants by physical methods. Genetic engineering of plants for virus resistance, pest resistance, herbicide tolerance, cytoplasmic male-sterility, delay of fruit ripening.

Unit V: Plant genetic engineering for resistance to fungi and bacteria. Production of antibodies, viral antigens and peptide hormones in plants. Gene silencing in transgenic plants, DNA markers in marker-assisted selection and plant breeding. Management aspects of plant Genetic Engineering. Tagging, mapping and cloning of plant genes. Molecular biology of plant pathogen interactions. Intellectual property rights: Introduction, Principles and importance.

References:

1. Plant Molecular Biology by Grierson and S.N. Covey (1988) Blackie.
2. Plant Biochemistry and Molecular Biology by P.J. Lea and R.C. Leegood (1993) John Wiley & Sons.
3. Plants, Genes and Agriculture by M.J. Chrispeels and D.F. Sadava (1994) Jones and Bartlett.
4. Molecular Genetics of Photosynthesis by B.Anderson, H.Salter and J.Barber (1996), IRL Press, Oxford.
5. Plant Virology (3rd Edition) by R.E.E. Mathews (1991) Academic Press.
6. Post translational control and gene expression in plants. Plant Molecular Biology 32 (1-2) (1996).
7. Trends in Plant Sciences-Current issues.
8. Biochemistry and Molecular Biology of Plants, Buchanan, B.B., W.Gruissen and
9. R.L. Jones (2000), American Society of Plant Biology, Rock wille, MD, USA.

11. Recombinant DNA Technology

Unit I: Introduction to rDNA technology: DNA modifying enzymes and their uses, Restriction enzymes – Discovery, types, use of type II restriction enzymes. Elucidation of restriction site, Restriction mapping. DNA polymerases – Klenow, DNA polymerase I, thermostable DNA Polymerase δ used in PCR. T4/T7 DNA polynucleotide kinases and alkaline phosphatases. RNA polymerases, ligases, nucleases – DNAse I, SI Nuclease.

Unit II: Cloing vectors and their applications: vectors for gram positive and gram negative bacteria, Bacteriophage vectors – Lambda and M13 virus based vectors, Cosmids, phagmids, yeast vectors, Expression vectors, vector facilitating protein purification, Shuttle vectors. Artificial chromosomes – BAC, YAC, HAC. Inteins (Protein introns) Exteins.

Unit III: DNA cloing – sticky ends, blunt ends, homopolymeric tailing use of adaptors and linkers. PCR based cloning. Preparation of radiolabeled/ fluorescent labeled DNA & RNA probes. Chemical synthesis of oligo nucleotides. Blotting & hybridization techniques. Screening of recombinants, alpha complementation and Blue white selection.

Unit IV: DNA sequencing – Maxxam – Gilbert, Sanger methods, short gun sequencing Automated DNA sequencing. PCR technology – concept, types primer design, analysis of products and applications. DNA finger printing. Chromosome jumping, chromosome walking. Site – directed mutagenesis.

Unit V: Strategies for the production of recombinant proteins – insulin, human growth hormone, industrially important proteins. Construction of genomic DNA library and cDNA library.

Reference:

1. Principles of Gene manipulation by Old & Primrose.
2. DNA cloning I and II by DM, Glover and BD. Hames.

3. PCR Strategies by MA. Innis, DH,Gelfand and J.J. Sutuskey
4. Methods in Molecular Biology Vol 62 ed. R.S. Tuan, Humana Press, Totowa, New jersey.
5. Molecular Biotechnology by Bernard R. Glick and Jack J. Pasternak (2002) Panima publishing house, New Delhi.

12. Lab in Recombinant DNA and Microbial Biotechnology

1. Plasmid purification
2. Restriction mapping of a plasmid
3. Extraction of genomic DNA from bacteria, plant and animal tissues, restriction digestion and Agarose gel electrophoresis
4. Southern hybridisation analysis using a non-radioactive probe.
5. Cloning in a plasmid vector with blue/white selection
6. Analysis of recombinant plasmids by restriction digestion
7. Protein expression from a expression vector – SDS-PAGE of a gene
8. Polymerize chain reaction (PCR)
9. Introduction to bioprocess technology parts and designs of bioreactors;
10. Production of biomass; Batch and continuous fed batch fermentation;
11. Scale up recovery of products;
12. Laboratory scale fermentation of antibodies, immobilization of cells and enzymes

References:

1. Molecular Cloning: Laboratory Manual Vol. 1-3, Sambrook, E.F. Fritsch and T. Maniatis. Cold Spring Harbor (1989)
2. Concepts in Biotechnology – Editiors by D. Balasubramanian et al. University Press.
3. Diagnostic Molecular Microbiology, Principles and Application Edited by David H. Persing et al. American Society for Microbiology, Washington D.C.

13. Immunotechnology

Unit I: Hybridoma techniques and monoclonal antibody production. Myeloma cell lines. Fusion of myeloma cells with antibody producing B cells and selection of hybrids. Cloning, production and characterization of monoclonal antibody.

Unit II: T-cell cloning and mechanism of antigen, recognition by T & B lymphocytes. Structure, function and synthesis of lymphokines.

Unit III: Antigen presentation and MHC Class-II molecules in T-cell cloning and application of T-cell cloning in vaccine development.

Unit IV: Immunity to viruses, bacteria and parasites. Genetic control of Immune response.

Unit V: MHC associated pre-disposition, diseases. Infectious diseases– Leprosy, tuberculosis, malaria, filariasis, amoebiasis, rabies, typhoid, hepatitis and AIDS. Principles and strategy for developing vaccines, immunodiagnosis of infectious diseases.

References:

1. Monoclonal Antibodies: Principles and practice by J.W. Goding (1983) Academic Press.
2. Hybridoma technology in the Biosciences and Medicine by T.A. Springer (1985) Plenum Press, New York.
3. Isolation, Characterization and utilization of T. lymphocyte clones by C. Garrison Fathman, F.W. Fitch (1982) Academic Press.
4. Harrison's Principles of Internal Medicine Vo. I & II by E. Branunwald, K.J. Isselbaches, R.G. Petersdorf, J.D. Wilson, J.B. Martuin and A.S. Fauci (1987).
5. Essentials of Infectious Diseases by L.A. Mandell, E.D. Ralph (1985) Blackwell Scientific Publications.

14. Animal Biotechnology

UNIT I: Development and use of transgenic animals – Retroviral vector method, DNA microinjection method and engineered embryonic stem cell method. Transgenic animals-sheeps, goats, pigs, birds, fish, Transformation of animal cells – in vitro fertilization and embryo transfer.

UNIT II: Cloning vectors – Plasmid vectors, lambda vectors, cosmid vectors, phagemid vectors, BAC, PAC vectors, Plant and animal viruses as vectors. YAC vectors, MAC vectors.

Expression vectors- Expression cassettes, baculovirus and expression vectors system for insect cells, virus expression vectors for mammalian cells. Baculovirus as biocontrol agents, Baculo virus for expression of foreign genes.

UNIT III: Molecular diagnosis immunological diagnosis – ELISA, use of Antibodies as immune therapeutic agents. DNA Diagnosis – use of nucleic acid probes in Diagnosis (eg: malaria). Gene therapy.

UNIT IV: Signal transduction and production of recombinant proteins:

Acetylcholine, G-protein, visual pigments, growth factor receptors, steroid receptors, AIDS, Oncogenes and anti oncogenes, production of recombinant proteins – vaccines, blood products, hormones, regulatory proteins, phage display technology.

UNIT V: Human genome mapping, Restriction fragment length polymorphism (RFLP) and its application, ethical issues in Animal Biotechnology, management aspects of biotechnology and genetic engineering.

References:

1. Recombinant DNA – James Watson, Michael Gilman Second edition
2. Molecular Biotechnology principles and Application of rDNA Bernard R. Glick and Jack J. Pasternak third edition

3. Molecular Biotechnology principles and Application of rDNA Bernard R. Glick and Jack J. Pasternak
4. Principles of gene manipulation – Old & primrose
5. Gene Biotechnology S.N. Jogdand
6. Biotechnology and Genomics – P.K. Gupta

15. Microbial Technology and Bioprocess Technology

Unit I: History and scope of microbial technology. Applications of novel microbial products in man, list of microbes and their role in industry, screening of production strains.

Unit II: Structure, types and functions of bioreactors. Production of SCP and biomass. Batch and continuous fed fermentation, scale up recovery of products.

Unit III: Bacteria as industrial work horse for the production of immunoglobulin, vaccines, antibiotics, pullulans and pharma products.

Unit IV: Production of proteins in yeast, microbial mining, degradation of toxic chemicals, environmental release and monitoring of genetically modified/engineered microbes.

Unit V: Immobilization of cells and enzymes. Production of primary metabolites, extracellular enzymes, exopolymers and dextrans. Factors affecting biopreoceessing and regulation. Downstream processing of biological.

References:

1. Microbial Biotechnology by Glazer and Nikaids (1995) Freeman press.
2. Comprehensive Biotechnology – Volume 2, 3 and 4 by M. Moo-young (Ed) (1985) Pergamon Press.
3. Fundamentals of Biotechnology by P. Prave. V. Faust, W. Sitting and D.A. Sukatsch (Eds) (1987) WCH Weinhein.
4. Principles of Fermentation Technology by P.F. Stanbury and A. witaker (1984) Pergamon Press.
5. Chemical Engineering by J.M.K. Coulson and J.F. Richardson (1984) Pergamon Press.

16. Lab in Plant Biotechnology

1. Role of hormones in plant morphogenesis
2. Surface sterilization of field-grown tissues|
3. Micropropagation
4. Callus induction, initiation of suspension cultures
5. Regeneration of shoots and roots from callus cultures
6. Conditioning of tissue culture plants, transfer of plants to green house
7. Isolation and purification of protoplasts, Viability test, protoplast culture

8. Induction of tumours by Agrobacterium
9. Introduction of binary vectors into Agrobacerium by triparental mating
10. Leaf disc/leaf transformation using Agrobacterium GUS expression in transformed
    tissues, extraction of DNA from transformed plants
11. Southern hybridization to check plant transformation
12. PCR amplification of T-DNA in transformed plant tissues.

References:

1. Methods in Plant Molecular Biology. A Laboratory Course Manual by Pal Maliga (Ed) (1995) Cold Spring Harbour Laboratory Press.

Subject Elective

1. Bioinformatics

Unit I: Introduction to bioinformatics – Definitions and basic concepts – Genome projects- Biological data complexity – The role of bioinformatics.

Unit II: Biological database – Sequence databases- Sequence assembly – Submission of sequences – Sequence formats – Conversion between formats – Database browsers and Search engines.

Unit III: Sequence Alignment – Pair wise comparison – Sequence comparison scoring systems – Sequence similarity searching algorithms (BLAST & FASTA family of programs) – Similarity searching scores and their statistical interpretation.

Unit IV: Sequence Analysis – Nucleic acid sequence analysis – Reading frames; Codon Usage analysis; Translational and transcriptional signals – Protein sequence analysis – Compositional analysis; Hydrophobicity profiles; Amphiphilicity detection; Introduction to secondary structure prediction methods.

Unit V: Multiple Sequence alignment – Methods available – Iterative alignment, Progressive alignment – ClustalW, T-Coffee –Profile Methods – Clustering and Phylogeny - Methods for Phylogeny analysis: Distance and Character based methods.

References:

1. Introduction to Bioinformatics by Teresa Attwood and David Parry-Smith, (1999) Prentice Hall, UK
2. Instant Notes in Bioinformatics by J. Howard Parish, Richard M. Twyman. (2002) Bios Scientific Publishers Ltd.
3. Introduction to Bioinformatics by Arthur M. Lesk (2008) Oxford University Press

2. Biophysics and Structural Biology

Unit I: Scope and methods of Biophysics – Levels of molecular organization

Unit II: Understanding structures of proteins at different levels-primary, secondary, tertiary and quaternary – conformational analysis and forces. Understanding structures of nucleic acids at different levels.

Unit III: Analysis of interactions – proteins, nucleic acids and polysaccharides - Association of macromolecules, lipids in biological membranes – Protein in biological membranes – Molecular mechanics and dynamics

Unit IV: Structural Biology: Role and importance – Techniques: CD/ORD. Fluorescence, Spectroscopy, Raman spectroscopy, Electron microscopy, NMR, X-ray crystallography

Unit V: Application of Structural Biology: Understanding regulation and kinetics of biological activity – specific examples

References:

1. Introduction to protein structure by C. Branden, J. Tooze (1991) Garland Publishing Inc
2. Biochemistry by L. Stryer (1999) WH Freeman & Co., New York
3. Biophysical Chemistry Part I, II and III by Cantor and Schimmel (1980), WH Freeman & Co., New York
4. Nucleic acid structure by S. Neidle (ed) (1987) VCH Publishing Weinheim
5. The structure and action of proteins by Dickerson and Geis (1969) Benjamin/Cummings Publishing
6. Biological spectroscopy by I. D. Campbell and Dewk (1984) Benjamin/Cummings Publishing
7. Crystallography made crystal clear by Gale Rhodes (1993) Academic Press
8. Conformation of biological molecules: new results from by NMR by G. Govil, R. V. Hosur (1982) Springer Verlang
9. Crystallographic and modeling methods in molecular design by C. E. Steven E (ed) (1990) Springer Verlang
10. Protein structure: New approaches to disease and therapy by Max Perutz (1992) W. H. Freeman

3. Genomics and proteomics

Unit I: Introduction – Structural organization of genome in Prokaryotes and Eukaryotes, Organelle DNA-mitochondrial, chloroplast; DNA sequencing-principles and translation to large scale projects, Recognition of coding and non-coding sequences and gene annotation, Tools form genome analysis-RFLP, DNA fingerprinting, RAPD, PCR, Linkage and Pedigree analysis-physical and genetic mapping.

Unit II: Genome sequencing projects – Microbes, plants and animals, Accessing and retrieving genome project information from web, Comparative genomics, Identification and classification using molecular markers-16S rRNA typing/sequencing, EST's and SNP's.

Unit III: Proteomics – Protein analysis (includes measurement of concentration, amino-acid composition, N-terminal sequencing), 2-D electrophoresis of proteins, Microscale solution isoelectricfocusing, Peptide fingerprinting, LC/MS-MS for identification of proteins and modified proteins, MALDI-TOF, SAGE and differential display proteomics, Protein-protein interactions, Yeast two hybrid system.

Unit IV: Pharmacogenetics – High throughput screening in genome for drug discovery-identification of gene targets, Pharmacogenetics and drug development

Unit V: Funcitonal genomics and proteomics – Analysis of microarray data, Protein and peptide microarray-based technology, PCR-directed protein *in situ* arrays, Structural proteomics

References:

1. Genomics: the science and technology behind the human genome project. 2000, Ed. C. Cantor and C.L. Smith. Wiley-Interscience.
2. A primer of genome science. 2002. G. Gibson, S.V. muse, Sinauer associates Inc. Publisherss.
3. Protein biochemistry and proteomics. 2006. H. Rehm. Academic Press.
4. Mass Spectrometry, 2nd Ed. 2002. E. de Hoffman and V. Stroobant. Wiley.
5. 2-D Proteome analysis protocols. 1998. Ed. A.L. Link. Humana Press.
6. The proteomics protocols handbook.2005. Ed. J.M. Walker. Humana Press.
7. Research papers from journals giving applications of various techniques

Non-subject Electives:

1. Modern Biotechnology

Unit 1: Basic techniques in molecular biology, cutting and joining DNA, plasmid vectors, screening recombinant plasmids

Unit II: Protein expression vectors, expression of proteins in E. coli. Advantages of Gram-positive bacteria, affinity purification of expressed proteins, expression of human proteins in E. coli.

Unit III: Protein expression in yeast, Pichia and fungi. Expression of proteins in insect and animal cells.

Unit IV: Agrobacterium and crown gall disease, Ti plasmid vectors, transgenic plants with pest resistance, herbicide resistance, virus resistance, delayed fruit ripening, Golden rice. Antibody production in plants.

Unit V: Applications of recombinant DNA technology. New drugs and therapies, protein engineering, metabolic engineering. From genes to genomes.

References:

1. Principles of Gene Manipulation. Sixth Edition. 2001. S.B. Primrose, R.M. Twyman and R.W

15. Model Questions

Madurai Kamaraj University
M.Sc Biotechnology Degree Examination
BIOCHEMISTRY

Time: 3 hours **Maximum : 60 marks**

Section A
Answer all the questions – Multiple choice (10 x 1 = 10 marks)

1. Which of the following vitamins except one participate in the TCA cycle?
   a. Pantothenic acid b. Lipoic acid
   c. Folic acid d. Riboflavin
2. In HMP pathway the xylulose 5-phosphate can be formed from Ribulose 5-phosphate by the action of
   a. glucose-6-Phosphate dehydrogenase. b. transaldolase.
   d. Transketolase. d. phosphopentose epimerase.
3. Which of the following amino acids is not converted to Acetyl Co A upon metabolism?
   a. Tyrosine b. Leucine
   c. Valine d. Tryptophan
4. Which of the following is a common compound shared by the TCA cycle and the Urea cycle?
   a. α-Ketoglutarate b. Succinyl coA
   c. Oxaloacetate d. Fumarat
5. The blood cholesterol level in normal subjects is
   a. 300- 350 mg/dL b. < 200 mg/L
   c.150- 220 mg/dL d. > 200 mg/dL
6. Ketone bodies are produced in the
   a. Kidney b. Brain
   c. Heart d. Liver
7. The translocation of calcium across a membrane
   a. is a passive mediated transport
   b. is an example of symport system
   c. involves the phosphorylation of serine residue by ATP.
   d. may be regulated by binding of calcium calmodulin complex to the transporter.
8. Membrane channels
   a. Have a large aqueous area in the protein structure so are not very selective.
   b. commonly contain amphipatheic alpha helices
   c. are opened or closed only as a result of a change in the transmembrane potential
   d. are the same as gap junction.

9. Gout is the disease of
   a. Purine metabolism b. Pyrimidine metabolism
   c. Lipid metabolism d. Protein metabolism
10. Pyrimidine analog that is substrate for the enzyme orate phosphoribosyl transferase
   a. 5-Fluorouracil b. 6-Thioguanine
   c. 5-Iodo-21- deoxy uridine d. 6-Azauridine

Section – B

Answer all the questions choosing either A or B (5 X 4 =20 marks)

Answer not exceeding two pages

11. a) Explain the Cori cycle.
   (or)
   b) Discuss how galactose enters the glycolytic pathway.
12. a) Trace the pathway for the synthesis of heme from glycine.
   (or)
   b) Explain the urea cycle. Give a short note on disorders of urea cycle.
13. a) Write about β – oxidation of Fatty acid.
   (or)
   b) Differentiate α – oxidation and ώ – oxidation of fatty acids.
14. a) Write about Z scheme of photosynthesis.
   (or)
   b) Discuss about the role of Na-K in membrane transport.
15. a) Give an account on pyramidine biosynthetic pathway.
   (or)
   b) Discuss about ketogenesis and ketolysis.

Section – C

Answer any THREE questions (3 X 10 =30 marks)

Answer not exceeding four pages

16. What is Embden Meyerhof pathway?
17. Why is the citric acid cycle considered to be an amphibolic pathway?
18. Discuss about biosynthesis of fatty acid along with regulation.
19. Explain about structure of mitochondria and give details about oxidative phosphorylation.
20. Give an account on purine biosynthetic pathway and its regulation.

16. Teaching methodology

A teaching method comprises the principles and methods used by teachers to enable student learning. These strategies are determined partly on subject matter to be taught and partly by the nature of the learner. For a particular teaching method to be appropriate and efficient it has to be in relation with the characteristic of the learner and the type of learning it is supposed to bring about. Suggestions are there to design and selection of teaching methods must take into account not only the nature of the subject matter but also how students learn.

In today's school the trend is that it encourages a lot of creativity. It is a known fact that human advancement comes through reasoning. This reasoning and original thought enhances creativity.

1. Lecture Method.
2. The Discussion Method.
3. The Demonstration Lesson.
4. Brainstorming.
5. Peer team teaching method

17. Text Books

1. Principles of Biochemistry, Author: AlbertL. Lehninger, Pub: CBS
2. Biochemistry, Author: Lubert Stryer, Pub: Freeman International Edition
3. Veer Bala Rastogi, Cell biology, Genetics
4. Mol. Biology, P.S.Verma & V.K. Agrawal,
5. Mol. Biology of cell , Albert et al, The Cell Coope.

18.Reference Books

Reference books are given below in each paper.

19. Retotalling and revaluation provision

Revaluation means to re evaluate the paper of a particular subject completely. Under this, Student has to surrender his/her original marks of particular paper and accept the final marks when declared by the University as a result of Revaluation. Application form available at Examination Section and University Website. Fee Structure Rs. 500/ per subject for Revaluation Rs. 250/ per subject for Retotalling.

Condition- Application for Revaluation is to be made within 15 days from the date of publication of result on University website. Application form is to be completely filled and signed by the student (concerned) only. Select the paper carefully in which you wish to seek revaluation. No second application for additional papers shall be accepted. The fees once paid shall not be refunded.The application is to be made by the student in his/her own handwriting and under his/her own signature and not by anyone else on his/her behalf.

Rules for Revaluation - Revaluation shall be available only for the paper of end term examination. Revaluation for the paper of end term examination shall be sent to two external evaluators for evaluation. The average of the marks awarded by two external evaluators shall be taken as final marks and the original marks obtained by the student shall have no value.

20. Transitory provision 3+3

PG syllabus revision once in 2 years and afterwards 2 years under transitory provision.

21. Subjects and paper related websites.

Science Books Online lists , free science e-books, textbooks, lecture notes, monographs, and other science related documents. All texts are available for free reading online, downloading in various formats.