Vidyasagar University
Syllabus of M.Sc. Course in Biotechnology

Distribution of Marks:-

I. M.Sc. Part-I

SEMESTER – I - Theoretical -200 marks
- Practical -100 marks

Paper-**I** -Chemistry of Biomolecules

Paper- **II** - Cell Biology and Genetics.

Paper-**III** -Microbiology and Virology

Paper **IV** -Molecular Biology.

Paper-**V** (Practical) -Cell Biology and Genetics

Paper-**VI** (Practical) -Microbiology.

SEMESTER – II - Theoretical -200 marks
- Practical -100 marks

Paper-**VII** -Biochemistry.

Paper-**VIII** - Immunology. — Paper - IX

Paper- **IX** -Recombinant DNA Technology and methods in Biotechnology. — Paper VIII X

Paper- **X** -Biostatistics and Computer application — Paper VII

Paper-**XI** (Practical) -Biochemistry.

Paper – **XII** (Practical) - Molecular Biology and Immunology.

II. M.Sc. Part-II

SEMESTER – III - Theoretical -200 marks
- Practical -100 marks

Paper-**XIII** -Plant Biotechnology.

Paper -**XIV** -Animal Biotechnology.

Paper-**XV** -Microbial Biotechnology

Paper-**XVI** - Bioinformatics.

Paper-**XVII** (Practical) - Cell And Tissue Culture.

Paper-**XVIII** (Practical) - Bioinformatics.

SEMESTER – IV - Theoretical -100 Marks
- Practical -50 Marks
- Project -100 marks.
-Seminar -20 marks.
- Comprehensive Viva – 30 marks.

Paper-**XIX** - One Of The Following Specialization.
A)Biotechnology In Agriculture And Forestry.
A) Food Biotechnology And Bioreactor Technology
B) Pharmaceutical And Medical Biotechnology
C) Environmental Biotechnology.

Paper-**XX** - Practical to Special paper.

Paper- **XXI** -Project ,Seminar, and Comprehensive Viva.

**Syllabi of semester IV will be modified later as decided by PG. BOS, Biotechnology, V.U.

DISTRIBUTION OF MARKS

Each theoretical and practical paper carries 40 marks each.10 marks will be allotted for internal assessment.

Questions for each theoretical paper:

Q.no.1. – 05 questions out of 8 (X2) = 10 marks.
Q.no.2. – 02questions out of 4(X5) = 10marks
Q.no.3. – 02 questions out of 4 (X10) = 20 marks

Total- 40 marks.

SEMESTER – I

Paper-I

(40 marks)
(40 lectures)

CHEMISTRY OF BIOMOLECULES

1. An overview on biomolecules –Carbohydrate, Protein, Lipid and Nucleic acid (5L)
2. Forces involved in protein structure, Sequencing of proteins, Separation and detection of proteins, chemical synthesis of proteins. (4L)
3. An overview of enzyme classification, Overview of enzyme-reaction kinetics, Multienzyme complexes, Allosteric enzymes, Ribozymes. (6L)
4. Application of Thermodynamics in Biological system. (3L)
5. *Isotopes and radioactivity*: Radioactivity, decay laws, production of radioisotopes, detection and measurement of dose, autoradiography, G.M. Counter, scintillation counter, radiation safety, use of radioisotopes in biological system. (12L)
6. *Spectroscopy*: Principles of light absorption, ultraviolet, visible and infrared absorption spectrophotometer and their working principles. Raman spectroscopy, NMR, ESR and Mass spectroscopy and their biological application, circular dichroism (CD) and optical rotatory dispersion (ORD), fluorescence and phosphorescence. (10L)

Paper-II

(40marks)
(40 lectures)

CELL BIOLOGY AND GENETICS

1. *Cell types*: Structure of prokaryotic and eukaryotic cells, ultra structure of animal and plant cell. Autocrine, paracrine and endocrine cells. Muscle cells and nerve cells. (3L)
2. *Biological membranes*: structure and properties, membrane constituents- phospholipids, glycolipid, cholesterol, membrane proteins. Transport of nutrients- ions and macromolecules across membrane – passive; diffusion, osmosis, ionophores, reverse osmosis and active transport, permease, Na Pump, Ca Pump, Co-transport, symport, antiport, endocytosis and exocytosis. Junction

between cells- desmosomes, plasmodesmata. Plant cell wall. (8L)

3. *Cell motility*: Cilia and flagella of eukaryotes and prokaryotes, cyto- skeleton – Microtubules, microfilaments and intermediate filaments. (4L)
4. *Cell division and control*: Cell cycle and mitosis, Meiosis and its genetic Significance. (4L)
5. *Genetic Control of development*: Mitochondrial and chloroplast gene - maternal inheritance; Zygotic genes (eg. gap genes, segmental polarity genes and homeotic genes) in pattern formation, anterio-posterior embryogenesis; gene expression in animals (Drosophila) and plants (Arabidopsis). (6L)
6. Chromosomal Genetics:- molecular organization of chromosomes, karyotype constructions in normal and in genetic disorders, ISH, FISH. (3L)
7. Human Genetics:- Pedigree analysis, inheritance of sex linked and autosomal traits, chromosome aberrations, Biochemical genetics, polygenic inheritance, mapping of human genome, genetic counseling. (6L)
8. Population Genetics:- Genetic variation, random mating, genetic frequency and Hardy-Weinberg law, natural selection, genetic drift, inbreeding, genetic equilibrium, DNA polymorphism. (6L)

Paper-III (40marks)
(40 lectures)

MICROBIOLOGY *AND VIROLOGY*

1. *Structure of Prokaryotic organisms*: Ultra structure and chemistry of capsule, pili and flagella. Cell wall of Archaebacteria. Gram positive and Gram negative bacteria, tactic movements – chemo taxis. (3L)
2. *Classification*: classification and importance of micro organisms, short description of thermopiles, holophiles, acidophiles, Mycoplasma, Actinomycetes, Rickettsias, chlamydias. (4L)
3. *Bacterial growth and nutrition*: Growth requirements, growth factors, mathematical expression of growth, synchronous growth, continuous culture. (4L)

4. Plant–microbe interactions: Mycorrizae, Cyanobacteria, nitrification, denitrification, biological nitrogen fixation. (4L)
5. Microbial metabolism: EMP pathway, ED pathway, Krebs cycle, Fermentation, acetogenesis and methanogenesis. (4L)
6. Virus: Morphology, ultrastructure and genetic system of Bacteriophages (lambda, T4, T7, M13), plant viruses, (TMV, Potato virus X and Y, CaMV, CMV, TYMV), Animal viruses (vaccinia, adeno, hepatitis-B, Influenza, HIV), lytic cycle, lysogeny, Viral Replication, Retroviral replication and integration. (8L)
7. Antibiotics and antimicrobial agents, Sulfa drugs, Mode of action of important antibiotics, Mechanism of resistance to antibiotics. (5L)
8. Molecular Genetics: - Modes of gene exchange in Bacteria-transformation, conjugation and transduction. Transposable elements in Prokaryotes. Site specific recombination in lambda phage. (8L)

Paper-IV (40 marks)
(40 lectures)

MOLECULAR BIOLOGY

1. Biosynthesis of DNA – DNA replication, helicases, nucleases, DNA binding and unwinding proteins, topoisomerases, Messelson-Stahl, Bonhoeffer – Grier and Crains experiment. Mechanism of DNA replications in Prokaryotes & Eukaryotes. DNA ligase, replication intermediate – D-loop, theta form. Rolling circle replication. (7L)
2. DNA repair – Photo reactivation, excision, mismatch, recombination, SOS, double strand break repair. (3L)
3. Mutation:- Types of mutation, molecular basis of mutation, normal and induced mutation. (3L)
4. Transcription – RNA polymerases in prokaryotes – its molecular composition, different sigma factors – related to stress, viral infection etc. Mechanism of transcription, Post transcriptional control, Eukaryotic Promoters, enhancers, transcription factors, RNA

Polymerases. RNA Processing enzymes, RNA editing, splicing - different modes of m-RNA, t-RNA splicing. (7L)

5. Translation: Prokaryotic and eukaryotic translation – Mechanism of initiation, elongation and termination. Amino acid activation, inhibitors, post translational modification of Proteins. (5L)
6. Regulation of gene expression: The operon hypothesis, Lac operon, trp operon,. Brief account of eukaryotic gene regulation. (5L)
7. Biosignaling - Over view of extra cellular signaling, G- Protein linked receptor and activity of G-Proteins, role of c-AMP in the regulation of cellular metabolism, Receptor tyrosine kinase, Ca^{++}, IP3, DAG as second messengers, regulation of cell surface receptors. (5L)
8. Molecular biology of cancer – Characteristics of tumor cells, viral and cellular oncogenes, structure, function and mechanism of actions of p53 and RB tumor suppressor protein. The multicausal, multistep nature of carcinogenesis. (5L)

PRACTICAL PAPERS

PAPER V-(BTM 103)

Group – A – CELL BIOLOGY AND GENETICS

1. Vital staining of mitochondria
2. Localisation of Barrbodies
3. Mitosis – onion root tips
4. Meiosis – Grasshopper testis, flower buds
5. Cell fractionation – chloroplast and mitochondrial isolation
6. Study of chromosome aberration on mitosis in Allium lepa / Allium sativum.
7. Polytene chromosome – salivery gland of Drosophila / chironomus
8. Blood smear – differential staining and identification of different types of cell.
9. Determination of Nucleolus frequency in Allium sp by hematoxyline staining.

PRACTICAL PAPERS
PAPER VI-(BTM 103)
Group – B –MICROBIOLOGY

1. Staining technique **i)** simple staining **ii)** differential staining **iii)** endospore staining **iv)** capsule staining
2. Pure culture method – Enumerate the number of bacteria from air and soil.
3. Preparation of bacterial growth curve
4. Assay of antibiotics by agar cup method and dilution method
5. Biochemical tests **i)** Indole tests **ii)** Methyl red test **iii)** Voges Proskaur tests **iv)** Starch hydrolysis tests **v)** Tests for catalase, lipase, protcase, amylase and oxidase **vi)** Gelatin hydrosis test
6. Isolation of Rhizobium from legume root nodule
7. Water microbiology – Testing for quality of water (coliform test), H_2S strip test.

SEMESTER – II

PAPER VII (40 Marks)
BIOCHEMISTRY (40 Lectures)

1. BIOENERGETIC - Energy coupling, concept of energy, principles of thermodynamics, standard free energy and equilibrium constant, differences between ΔG and $\Delta G_o'$ and their relationship with spontaneous biological reactions . ATP as universal currency of free energy in biological systems. [8L]

2. Carbohydrate metabolism: Glycolysis, krebs cycle, electron transport chain, oxidative Phosphorylation. Substrate level Phosphorylation and photo phosphorylation. Gluconeogenesis, pentose phosphate pathway. Rate controlling steps and regulation. [8L]

3. Lipid metabolism –Regulation of Biosynthesis, oxidation saturated and unsaturated, fatty acids. [5L]

4. Amino acids metabolism –Biosynthesis and oxidative degradation of amino acids (e.g. - serine, Methionine, lysine, phenylalanine, leucine, isoleucine) . [5L]

5. Nucleic acids metabolism – Biosynthesis of purines and pyrimidines (de novo and salvage pathways). Degradation of Purines and Pyrimidines. [5L]

6. Regulation of cellular metabolism – Integration of carbohydrate, lipid, protein and nucleic acid metabolism. Major control sites of metabolic pathways. [6L]
7. Vitamins and their Co-enzyme function. [3L]

PAPER VIII (40 Marks)
BIOSTATISTICS AND COMPUTER APPLICATION (40 Lectures)

1. STATISTICAL METHODS – collection tabulation and graphical representation of data, frequency distribution, relative and cumulative frequencies, histogram, frequency polygons. [3L]
2. Measures of central tendency – Arithmetic mean, median, mode, range, standard deviation and co-efficient of variation. [4L]
3. Concept of correlation and regression method of least squares. [4L]
4. Probability and Probability distribution –Additive and multiplicative laws of probability, Discrete, continuous, binomial, Poisson and normal distribution. [8L]
5. Population & Sample – Random sample, sampling distribution of simple means, standard error. [3L]
6. Hypothesis testing – Basic concepts, definitions, tests based on normal, student t test, Chi square test for goodness of fit. [6L]
7. Basic computers- Components of a digital computer. DOS – internal and external commands, windows- basic concepts. Concept of algorithm and flow chart. Introduction to C programming language. Basic concept of Internet. [12L]

PAPER IX
IMMUNOLOGY

(40 Marks)
(40 Lectures)

1. IMMUNE SYSTEM- Structure and functions of cells and organs involved in immune system- T-cells, B-cells, macrophages, Mast cells , Innate immunity, acquired immunity. [4L]
2. General concepts of: i) Antigens ii) Immunogens iii) Haptens iv) Adjuvants. [2L]
3. Immunoglobulins- Structure, classes, complement systems- structure, components, activations, pathways and regulations. The molecular genetics of antibody diversity. [8L]
4. Major histocompatibility complex (MHC) – Structure and functions of MHC and the HLA system. HLA and tissue transplantation. [5L]
5. Immune Response – B-lymphocytes-maturation, activation and differentiation; T- lymphocytes-maturation, activation and differentiation. [8L]
6. Antigen antibody reactions- Molecular basis of antigen-antibody reaction. In vitro methods- Agglutination. Precipitation. Diagnostic methods- Immuno diffusion, immuno electrophoresis. ELISA, RIA and Western Blot. [5L]
7. Antibody production – Hybridoma Technology- Application of cell culture for production of lymphokines, cytokines. Chimeric antibody, Humanized antibody, Reshaped antibody. [4L]
8. Vaccines – Different types of vaccines. Active and Passive immunization. Production of toxoids, production of Recombinant vaccines. [4L]

PAPER – X
RECOMBINANT DNA TECHNOLOGY

(40 Marks)
(40 Lectures)

1. Gene cloning _- General concept, restriction endonuleases, enzymatic tools for gene cloning, linkers and adaptors. [4L]

2. Vectors Used in Gene cloning.
   - i. Plasmids (pBR 322, pACYC 1854, pUC Vectors, pBin 121)
   - ii. Yeast plasmid vectors (Integrative plasmid, episomal plasmid, replicative plasmid)
   - iii. Ti plasmid, binary vector, Co-integrate vector.
   - iv. Cosmids, phagemids
   - v. Bacteriophage vector – λ phage cloning vectors M13 phage
   - vi. YAC, BAC, HAC, PAC

vii. Shuttle vectors
viii. Expression vectors [8L]

3. c-DNA and genomic cloning – Genomic libraries, c-DNA libraries, identification and analysis of cloned DNA. Approaches for identification of genes (colony and plaque hybridization, Immunological detection, Southern blot analysis) Radioactive labelling, Non-radioactive labelling. [7L]
4. In vitro mutagenesis– Site directed mutagenesis, deletion mutagenesis, PCR based mutagenesis. [3L]

5. Gene transfer methods- Marker genes (reporter genes, selectable markers) Gene transfer in plants (Agrobacterium mediated gene transfer, physical gene transfer methods, chemical gene transfer methods) Gene transfer in animals (transfection methods, ES cell transfer, Targeted gene transfer) [10L]

6. Antisense & ribozyme technology – Molecular mechanism of antisense molecules, Si-RNA. Biochemistry of ribozymes-hammerhead, hairpin and other ribozymes, Strategies for designing ribozymes. Application of antisense and ribozyme technologies. [8L]

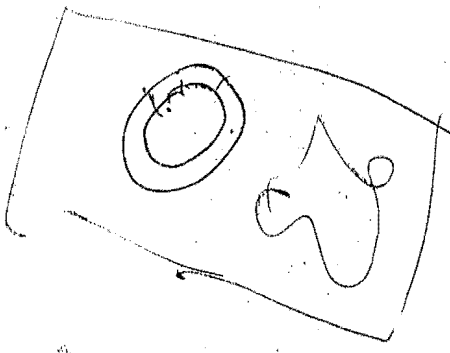
PRACTICAL PAPERS

PAPER- XI
BIOCHEMISTRY

1) Quantitative estimation of

i) Total sugar/ Glycogen
ii) Reducing sugar
iii) Amino acids
iv) Total protein
v) Total lipid
vi) Cholesterol
vii) Ascorbic acid
viii) RNA

2) Separation of amino acids sugar and phospholipids by TLC/Column Chromatography
3) Analysis of oils- iodine number, saponification value and acid number
4) Preparation of buffer- a) phosphate buffer (b) citrate buffer (c) Tris HCl
5) Extraction and spectrophotometric of following enzyme activities -
   a) α Amylase
   b) Protease
   c) Dehydrogenase
   d) Alkaline Phosphatase



PAPER XII
MOLECULAR BIOLOGY & IMMUNOLOGY*

MOLECULAR BIOLOGY

1) Isolation of plasmid DNA from *E. coli* by adopting two methods – (A) Alkaline SDS method B) Boiling lysis, Agarose Gel electrophoresis
2) Isolation of genomic DNA from bacteria
3) Isolation of genomic DNA from plant cell/animal cell
4) Transformation by $CaC1_2$ and PEG method
5) Selection of cloned micro-organism by blue/white colony
6) Restriction enzyme digestion of DNA and calculation of molecular weight of the digested DNA
7) DNA amplification by PCR method
8) Southern blotting

IMMUNOLOGY

1) Serum separation from whole blood
2) Precipitation of immunoglobulins (Igs) from serum by ammonium sulphate precipitation followed by dialysis of ammonium sulphate precipitated Immunoglobulins.
3) Electrophoresis of the immunoglobulin preparation
4) Separation of Lymphocytes from blood
5) Single radial immuno diffusion and determination of Ig concentration

6) Blood group testing
7) Immunoprecipitation test
8) Western Blotting.

Vidyasagar University

M.Sc. III rd Semester Course
(Biotechnology)

Paper – XIII (BTM 301) — 40 marks, 40 lectures

PLANT BIOTECHNOLOGY

1. ***Cell and tissue culture:*** Tissue culture media, totipotency of plant cells, isolation and Maintenance of Callus and suspension cultures; organogenesis and somatic embryogenesis; shoot tip culture, clonal propagation, somaclonal variations and applications of regenerated plant, production of Virus free plants; Embryo rescue; Protoplast isolation, culture & fusion; Production of haploids, hairy root culture. (8L)
2. ***Germplasm conservation:*** Cryopreservation, DNA banks and germplasm conservation. (2L)
3. ***Plant transformation technology:*** Transformation of plant systems using various methods - *Agrobacterium* mediated gene transfer; Binary vector, co-integrate vector; Direct gene transfer (Electroporation, Particle gun & other methods); use of 35S and other Promoters, Reporter genes, Multiple gene transfer, methods of nuclear and organelle transformation. (10L)
4. ***Application of Biotechnology in Plant improvement:*** Improvement of photosynthetic efficiency of plants; Concepts of transgenic plants - Developing virus resistant plants, Fungal resistant transgenics, resistant to bacterial pathogens; Resistance to insects (endotoxin gene of *Bacillus* thuringensis), Protease inhibitors and Baculo-viruses; Herbicide resistance; improvement of quality of seed storage Proteins; Manipulation of starch biosynthesis; Genetic engineering of plant oils; post-harvest biotechnology - genetic engineering for extended shelf-life of fruits, genetic manipulation of flower Pigmentation; Development of male sterility; Development of stress – tolerant plants – regulation of gene expression under stress condition; Gene silencing and antisense technology. (14L)

5. ***Plants as producers of speciality chemicals:*** Molecular farming- benefits and risks, ethical issues related to G.M. crop; Plantibodies, edible vaccines, edible interferons, Production of secondary metabolites. (6L)

Paper – XIV
(BTM 302)

ANIMAL BIOTECHNOLOGY

40 marks
40 lectures

1) ***Primary culture and established cell line***: Culture media required for animal cell culture. Isolation of animal tissue. Disaggregation of tissues (physical and enzymatic methods). Establishment of primary cell lines and continuous cell lines. Characterization of cultured cells. Valuable products from cell culture- tPA, blood factor VIII, Erythropoietin (EPO) etc. (8L)

2) ***Manipulation of cultured cells and tissues***: Scaling up of animal cell culture. Cell synchronization. Cell transformation, tissue engineering - 3-D culture, artificial skin and artificial cartilage. (6L)

3) ***In vitro fertilization (IVF)***: Sexing of sperms and embryos, spermatogenesis and oogenesis, infertilities in human male and female. Ovary stimulation. Oocyte recovery and uptake. Sperm preparation. IVF and embryo transfer, assisted reproductive technology (ART). IVF in cattle, embryo splitting. (6L)

4) ***Stem cells***: Types, characteristics, tissue healing, therapy, application in Research and Industry. (4L)

5) Gene targeting: Targeted gene transfer. Knockout mice. (4L)

6) ***Transfection and transgenesis***: Different types. Transgenic fish and mammals (Mice, Sheep etc.). Animal cloning. Animal as a bioreactor and molecular farming. (8L)

7) **Biosafety issues and Bioethics** in animal genetic engineering. (4L)

Paper – XV
(BTM 303)

MICROBIAL BIOTECHNOLOGY

40 marks
40 lectures

1. ***Industrial microorganisms***: Yeast, Bacillus, Aspergilus, Penicillium etc., microbial fermentation, microbial growth and microbial culture, genetic improvements of microbial cells – strain improvement. The component parts of a fermentation process. (8L)

2. ***Industrial Production:***
   - i) alcoholic beverages (Wine, Beer, Rum, Whiskey)
   - ii) organic solvents (Acetone Butanol, Glycerol)
   - iii) organic acids (Citric acid, acetic acid)
   - iv) amino acids (Lysine, Glutamic acid)
   - v) vitamin B_{12}.
   - vi) antibiotics (Penicillin, Streptomycin)
   - vii) toxin (β-exotoxin)
   - viii) enzymes including purification and immobilization
   - ix) probiotics (10L)

3. ***Single cell Protein (SCP):*** Microorganisms used, substrates for production of SCP, method of production of SCP, advantages and disadvantages. (2L)

4. ***Biofertilizers:*** Mass cultivation of *Rhizobium* spp, *Azotobacter*, *Azospirillum*, Blue green algae, Azolla, phosphate solubilizing microorganisms. Benefits from biofertilizers. Vermicomposting. (2L)

5. ***Bioprocess engineering:*** Introduction to bioprocess engineering, design and operation of conventional fermenters, bioreactors, measurement and control of bioprocess parameters. Downstream processing – introduction, removal of microbial cells and solid matter, effluent treatment, DOC, COD, BOD, disposal of effluents: bioleaching. (8L)

6. ***Bioremediation:*** Bioremediation in paper & pulp industry; Bioremediation of heavy metats, Bioremediation of contaminated Soils & wasteland, Bioremediation of Xenobiotics. (4L)

7. ***Application of enzymes:*** Industrial uses, analytical uses, therapeutic uses, manipulative uses; General idea about biosensor and biochips. (4L)

8. Marketing and management in biotechnology including IPR. (2L)

Paper – XVI
(BTM 304)

BIOINFORMATICS

40 marks
40 lectures

1. ***Introduction to Bioinformatics:*** (2L)
2. ***Biological databases:*** Accession codes and identifiers, nucleotide sequence databases, Protein sequence databases, Molecular structure databases, Mutation databases, Gene expression databases, Microbial genomic databases, other databases. (8L)
3. ***Sequence Comparison:*** Dot plots, sequence comparison using dynamic programming, searching sequence databases. (2L)
4. ***Pattern recognition in DNA and Protein sequences:*** Sequence analysis – sequence reading, sequence alignment – Global local sequence alignment, Pair-wise sequence alignment, Multiple sequence alignment, phylogenetic analysis, coding region identification. Web-based structure tools, Protein analysis, secondary structure prediction, Post translational modification sites. (12L)
5. ***Genomics:*** Genome sequencing Projects, human genome project, comparative genomics - Gene Prediction, Gene Counting and SNPs. (8L)
6. ***Proteomics:*** Potentiality of Proteomics, Types of Proteomics, Basic technology for Proteomics, Application of Proteomics technology. (8L)

Paper XVII

(Practical paper)

Cell & Tissue Culture

- Preparation of media.
- Preparation of primary culture
- Production of polyclonal antisera
- Grafting in rose plant
- Surface sterilization of field grown tissues
- Micropropagation technique
- Anther and pollen culture
- Callus induction
- Study of xylogenesis
- Initiation of suspension cultures
- Role of hormones in plant morphogenesis
- Regeneration of roots and shoot from callus cultures
- Hardening of tissue culture plants
- Leaf disc experiment using Agrobacterium mediated transformation

Paper XVIII

(Practical paper)

Bioinformatics

- An overview of computational analysis of biological sequences
- Transcript Analysis
- Biological databases
- Introduction to PERL scripting
- Genomics and Computational Molecular Biology Genomics
- Sequence analysis, Analysis Tools for Sequence Data Bank
- Pairwise sequence alignment
- Multiple sequence alignment
- BLAST database, BLAST and genome annotation
- Patterns & Motifs
- Database Concepts
- Visualization of bimolecular structures

Paper XIX

(Special paper)

Pharmaceutical and Medical Biotechnology

Pharmaceutical Biotechnology.

1. Introduction to pharmaceutical and medicinal biotechnology: 3 Lectures

2. Production and downstream Processing of Biotech Products: Production (Expression systems cultivation systems, cultivation media), downstream processing, over expression and purification of recombinant therapeutic proteins. 10 Lectures

3. Formulation of Biotech products, including Biopharmaceutical considerations: Microbiological considerations, experements in vitro, Parental formulations of Biotech products, shelf life of Protein Based Pharmaceuticals, Delivery of Proteins- Routes of Administration and Absorption Enhancement, Approaches of rate controlled delivery. 10 lectures

4. Pharmacokinetics and Pharmacodynamics of Peptide and Protein drugs: Elimination of Protein therapeutics, distribution of Protein therapeutics, Pharmacodynamics of Protein therapeutics, Heterogeneity, Chemical modifications of Protein therapeutics. 10 lectures

5. Hematopoietic growth factors: Hematopoiesis, Physiological role of G-CSF, GM-CSF, EPO and SCF, Physiological role of thromboproteins, Clinical aspects of hematopoietic growth factors, toxicities. 5 lectures

6. Interferon & interleukins: Overview of interleukins, Commercially available interleukins, interferons-α, β and γ. 5 lectures

7. Insulin: Chemical description, Pharmacology & formulation, Clinical aspects, Chemical & Physical stability of insulin formulations. 5 lectures

Paper – XX

Medical Biotechnology

8. Growth hormones: hGH structure, Pharmacology of growth hormones manufacture, formulation & stability, clinical uses. 5 lectures

9. Vaccines: Conventional vaccines, Modern vaccine technologies, Genetically, improved subunit vaccines, Anti-idiotype antibody vaccine, DNA vaccines, Production & formulations, Regulatory & Clinical aspects of vaccines. 7 Lectures

10. **Monoclonal antibody based Pharmaceuticals :** Antibody biology, Development of MAB as therapeutics, Humanized antibodies Molecular Structure, Pharmacology & Clinical uses of antibody based Pharmaceuticals. 5Lectures

11. Recombinant Coagulation factors: Pharmacology, Clinical uses. 5 Lectures

12. Dispensing Biotechnology products: handling, Professional education & proper information, storage, handling, Preparation, administration, Patient assessment and education. 5 Lectures

13. Personalised medicine; Neurodegenarative disorders. 5 Lectures

14. Legal and public aspects including IPR 5 Lectures

GROUP-B
Paper-XX

Aquaculture Biotechnology

FM-40.

1. Introduction:
Scope and definition, Cultural and socioeconomic basis, Biological and technological basis, short history of development of aquaculture practice, present status and national planning. **5 Lectures**

2. Aquaculture Practice :
Selection of species for culture considering its biological characteristics, economic and market demand: Characteristics, systematic position and biology of some economically important aquatic species- (i) Arthropods including prawns and shrimps. (ii) Fishes including carps, fin fishes, trout's, eels and cold water fish species. (iii) others like oysters and mussels. **8 Lectures**

3. Aquaculture engineering :
Principle and criteria for site selection for aqua farm construction (Fish and prawn), Designing hatchery, pond construction, construction of feed mill.
7 Lectures

4. Aquaculture Biotechnology:
(i) Preparation, culture and utilization of live food organisms (Brine shrimps), See weed culture; (ii) Hatchery operation – larval development, rearing, feeding, water quality management for prawn and fin fish hatchery; (iii) Brood stock management and post larval rearing- collection, transportation, spawning and health monitoring of brooders, packing, transportation, stocking, feeding, health and water quality monitoring for post larval stages; (iv) Applied nutrition-Aqua feed formulation, preparation and digestibility with special reference to prawns; (v) Transgenesis- Principles, procedure, application in details, genetic selection.
10 Lectures

5. Macro and Micro algae **5 Lectures**

6. Aquaculture management:
(i) Technological aspects- Managing diseases, control of weeds and predators, post harvest technologies with special reference to preservation and processing of aqua products; (ii) Economic and marketing aspects – Economic and financing of aquaculture including economic viability, financial and economic feasibility of investment, marketing of aquaculture products including organization of marketing and market strategies for industrial aquaculture. **5 Lectures**

Dept. BIOTECHNOLOGY, 4th Semester

(Special paper)

Agriculture and Aquaculture Biotechnology

GROUP-A

Paper XIX

Agriculture Biotechnology.

FM-40

1. Introduction to Agriculture Biotechnology **2 Lectures**

2. Clonal germplasm:

- Micro propagation: Clonal plant propagation *in vitro*.
- In vitro production of pathogen and contaminant free plants **5 Lectures**

3. Crop improvement:

a. Asexual cell genetics
b. Genetic Engineering of crop plants including Rice, Jute, Wheat.
c. Engineering for industrial Traits. **10 Lectures**

4. Production of secondary metabolites:

a. Production of secondary metabolites.
b. Large scale plant tissue culture.
c. Production of foreign compounds in Transgenic Plants. **5 Lectures**

5. Biotechnology of plant pest control:

a. Biocontrol of bacteria and phytopathogenic fungi.
b. Transgenic plants for the control of insect pests including Terminator technology (cotton).
c. Biotechnology of weed control. **5 Lectures**

6. Biofertilization, fermentation and bioremediation:

a. Biofertilizers (Types, Production, improvement).
b. Lignin-degrading fungi: mechanism and utilization.
c. Bioremediation: pesticides and other agricultural chemicals. **5 Lectures**

7. Forest Biotechnology. **5 Lectures**

8. Legal and public aspect:

a. Agricultural biotechnology and the law: patents, plant patents, plant variety certificates and the rise of Intellectual Property Rights in biological subjects. **3 Lectures**

Syllabus to practical of Biotechnology in **aquaculture** Paper xxi 25 marks

1. Induced breeding of carps using pituitary gland extract and GnRH (Ovaprim)
2. Breeding of gold fish in aquaria
3. Hatching in glass jar hatchery , Designing Eco-hatchery
4. Collection, temporary slide preparation and identification of fish food organisms (Cyclops, Daphnia, Artemia)
5. Designing artificial fish habitat using conventional and non- conventional materials
6. Hydroponics and its application in weed culture
7. Preparation of fish chromosomes
8. Culture of Brine shrimp/ *Chironomous tubifex* larvae or Preparation of basic supplementary aqua feed.
9. Histochemistry and histology of gonads and pituitary gland
10. Isolation of genomic DNA of a fish

Vidyasagar University
M.Sc Biotechnology
Modification for syllabus

Paper – I

1. Atom and chemical bonds:- Atomic structure, ionization potential, Electron affinity, Electronegativity, periodic table. Chemical and physical forces involved in chemical bond formation between two atoms and molecules, Mechanism of bond formation based on electronia orbitals, sigma bonds, pie bonds, covalent, ionic, co-ordinate bonds, metallic bonds, hydrophobic and vaderwall's interaction and their properties.
2. Introduction to organic chemistry: General nature of organic reactions and mechanisms, Aromatic compounds, aliphatic compounds.

5. Overview of enzyme reaction kinetics, mechanisms and related problems.

Paper – III

7. Pathogenicity of microorganisms: Normal flora of human body, overview of bacterial and viral pathogenesis, Endotoxin, Exotoxin, mode of action of cholera, diptheria, tetanus, and botulinum toxin, Epidemiological terminology, General mode of transmission of pathogenic disease, Bioterrorism overview.

Paper – IX

5. Hypersensitive reactions.
6. Autoimmune diseases.

VIDYASAGAR UNIVERSITY

Syllabus of M. Sc. Course in Biotechnology

Semester – IV

Paper – XXI

(Practical Paper)

Agriculture Biotechnology

1. Micropropagation technique with shoot tip culture.
2. Callus induction.
3. Callus subculture.
4. Study of xylogenesis.
5. Preparation of artificial seed.
6. Study of vesicles and arbuscles mycorrhizae.