File Ref.No.97375/GA - IV - J3/2019/Admn

UNIVERSITY OF CALICUT

Abstract

General & Academic - CBCSS PG Regulations 2019 - Scheme and Syllabus of M.Sc General Biotechnology programme w.e.f 2020 Admission onwards -Incorporating Outcome Based Education - Implemented - Subject to ratification by the Academic Council - Orders Issued.

G & A - IV - J

U.O.No. 5761/2021/Admn Dated, Calicut University.P.O, 30.05.2021

Read:-1) U.O.No. 9182/2019/Admn, Dated 11.07.2019.
2)The email, Dated 25.05.2021 from the Chairperson, Board of Studies, in Biotechnology.
3) Remarks of the Dean, Faculty of Science, Dated 29.05.2021.
4) Orders of the Vice Chancellor in the file of even no, Dated 29.05.2021.

ORDER

1. The Scheme and Syllabus of M.Sc General Biotechnology Programme under CBCSS PG Regulations 2019 in the affiliated Colleges of the University, w.e.f 2019 admission onwards has been implemented, vide paper read (1) above.
2. The Chairman, Board of Studies in Biotechnology, vide paper read (2) above, has forwarded the Scheme and Syllabus of M.Sc General Biotechnology Programme , incorporating Outcome Based Education(OBE) in the existing syllabus in accordance with CBCSS PG Regulations 2019, w.e.f 2020 admission after circulating among the members of the Board of Studies , as per Chapter 3(34) of Calicut University First Statute, 1976.
3. The Scheme and Syllabus of M.Sc General Biotechnology Programme , incorporating Outcome Based Education(OBE), has been approved by the Dean, Faculty of Science, vide paper read (3) above and by the Vice Chancellor, subject to ratification by the Academic Council, vide paper read (4) above.
4. The Scheme and Syllabus of M.Sc General Biotechnology programme (CBCSS) incorporating Outcome Based Education (OBE) in the existing syllabus, in tune with CBCSS PG Regulations 2019, is therefore implemented with effect from 2020 Admission onwards under affiliated colleges of the University, subject to ratification by the Academic Council.
5. Orders are issued accordingly.
6. U.O.No.9182/2019/Admn, Dated 11.07.2019 is stands modified to this extend. (Modified syllabus appended)

Ajitha P.P

Joint Registrar

To

The Principals of all Affiliated Colleges
Copy to: PS to VC/PA to PVC/ PA to Registrar/PA to CE/JCE I/JCE V/DoA/EX and EG Sections/GA I F/CHMK Library/Information Centres/SF/DF/FC

Forwarded / By Order

Section Officer

M. SC. GENERAL BIOTECHNOLOGY CURRICULUM

(Syllabus for Affiliated Colleges)

To be followed with the OBE from the academic year

2020 admission onwards

UNIVERSITY OF CALICUT

SEMESTER- WISE COURSE TITLES, DURATION OF THEORY AND LABORATORY EXERCISES FOR EACH COURSE AND CREDITS

Semester – 1

COURSE CODE	COURSE TITLE	CREDITS
GBT 1C 01	Cell Biology	5
GBT 1C 02	Biomolecules	4
GBT 1C 03	Microbiology	4
GBT 1L 01	Laboratory – I (Cell Biology, Biomolecules and Microbiology)	5
GBT 1A 01	Classical / Benchmark papers – Presentation and critical analysis (AEC – Ability Enhancement Course)	4
	TOTAL	**18+4**

Semester – II

COURSE CODE	COURSE TITLE	CREDITS
GBT 2C 01	Metabolism and Basic Enzymology	4
GBT 2C 02	Molecular Biology	5
GBT 2C 03	Environmental Biotechnology	4
GBT 2C 04	Biostatistics & Bioinformatics	4
GBT 2L 01	Laboratory – II (Metabolism & Enzymology, Molecular Biology and Environmental Biotechnology)	5
GBT 2A 01	Application of statistical software such as SPSS – capabilities, data entry, choosing statistical tests, interpretation and analysis of data output. (PCC – Professional Competency Course)	4
	TOTAL	**22+4**

Semester – III

COURSE CODE	COURSE TITLE	CREDITS
GBT 3C 01	Genetic Engineering	4
GBT 3C 02	Bioprocess Technology	4
GBT 3C 03	Plant Biotechnology	4
GBT 3C 04	Immunology	4
GBT 3E 01	Stem Cell Biology Part A (Option I)	4
GBT 3E 02	Virology Part A (Option II)	
GBT 3L 01	Laboratory – III (Genetic Engineering, Bioprocess Technology, Plant Biotechnology and immunology)	4
	Total	**24**

*The students should select any one of the the elective paper-stem cell biology part A or Virology partA

Semester – IV

COURSE CODE	COURSE TITLE	CREDITS
GBT 4P 01	Project Work (Dissertation format – Introduction with aims and objectives, Literature review, Materials and methods, Results and Discussion, Conclusions and Future prospective)	5
GBT 4V 01	Comprehensive Viva-Voce	3
GBT 4E 03	Stem Cell Biology Part B	4
GBT 4E 04	Virology Part B	
GBT 4E 05	Industrial Food Biotechnology	4
GBT 4E 06	Nanobiotechnology	
	Total	**16**

* The students should select any two of the four electives given in IVth semester. Students who have opted for stem cell biology part A in third semester should select Stem cell part B and those who have selected viorology part A in third semester should select virology part B in fourth semester. in addition they have to select one more elective paper ,either industrial food biotechnology or Nano biotechnology.

Total credits : 22 +26+ 24+16 = 88

Total credits excluding AEC and PCC courses = 80

SEMESTER-I

GBT 1C 01 - CELL BIOLOGY

1. Cells –diversity of cell size, shape and number, diversity in internal organization – cell theories. Sub cellular organisms Viruses, Prions. Microscopy – types and techniques.
2. Prokaryotic cells and eukaryotic cells- structure and organization. Cellular organelles, plasma membrane, cell wall, mitochondria, chloroplast, endoplasmic reticulum, chromosomes, nucleus, nucleolus and ribosome biogenesis and structural features, Golgi apparatus, lysosomes, microbodies, peroxisomes, cytoskeleton. Cell motility- cilia and flagella–organization and functions.
3. Cell growth and cell division- cancer, oncogenes and tumour suppressors, molecular events and model systems. Regulation of cell cycle- cell cycle checkpoints. Apoptosis – intrinsic and extrinsic pathways.
4. Biosynthesis of proteins in prokaryotes and eukaryotes. Co- and post translational modifications. Protein folding.
5. Transport of molecules across cell compartments. Transport across ER and Golgi vesicular trafficking. Protein delivery into peroxisomes, mitochondria and chloroplasts.
6. Cellular responses to environmental signals in plants and animals, principles and mechanisms of signal transduction, cell to cell interaction - extracellular matrix, interaction of cells with other cells, tight junctions, adherence, gap junctions, plasmodesmata.
7. Cellular energy transactions- role of mitochondria and chloroplast- oxidative metabolism in mitochondria, translocation of protons machinery of ATP formation.

References:

1. Molecular biology of cell – Alberts B et al
2. Molecular cell biology – Lodish et al
3. Cell and Molecular Biology: Concepts and Experiments - Gerald Karp and Nancy L Pruitt

4. Reproduction in eukaryotic cells – D M Prescott
5. Developmental biology – S F Gilbert, Sinauer Associates
6. Cell in development and inheritance – E B Wilson
7. The coiled spring – Ethan Bier
8. Fertilisation – F T Longo, Champan and Hall
9. Molecular biology of steroid and nuclear hormone receptors – L P Freedman

GBT 1C 02 - BIOMOLECULES

1. Chemical foundations of biology – Introduction to biomolecules, Molecular logic of Life, Energy transformations and Chemical reactions. weak bonds, covalent bonds, weak interactions in aqueous system, ionization of water, weak acids& bases, pH, pKa, Henderson-Hassel Balch equation, titration curves, buffers, buffer systems. Diffusion and osmosis.

2. Thermodynamics – Principles, enthalpy, entropy, free energy concept, standard free energy, thermodynamics governing biochemical systems.

3. Sugars – Classification, structure, function and chemical reaction, methods for compositional analysis of polysaccharides. Biosynthesis of Starch and Glycogen-UDP sugars.

4. Amino acids – Basic ideas about physiological functions of amino acids,Classification, structure, stereochemistry, physical & chemical properties. Biosynthesis Proteins – Classification, structural hierarchy, Ramachandran map, separation and purification, criteria of homogeneity, end group analysis,

5. Lipids–Classification, structure, functions, physical and chemical properties, Sphingolipids eicosanoids, separation & analysis of lipids. Bio-synthesis.

6. Nucleic acids – Nucleotide structure & function, nucleic acid structure & function. Bio-synthesis; Phosphoribosyl diphosphate - significance. Regulation of Biosynthesis.

7. Vitamins & Hormones – Classification, structure & physiological functions, Phytohormones.

8. Heterocyclic compounds – Secondary metabolites in living system, pigments, andIsoprenoids – mevalonate pathway.

9. Separation techniques – Chromatographic techniques, Electrophoresis and centrifugation techniques and spectrophotometer.

10. Analytical techniques – Analytical techniques in biochemistry & biophysics for small molecules and macro molecules for quantitation. X-ray crystallography & NMRspectroscopy of proteins Mass spectrometry of proteins-MALDI, ESI, MALDI-TOF.

References

1.Biochemical Calculations, Irwin H. Segel, John Wiley and sons Inc.

2. General Chemistry, Linus Pauling, W.H.Freeman & Company.
3. Organic Chemistry, DJ Cram and GS Hammond, McGraw Hill.
4. Biochemistry, D Voet and JG Voet, J Wiley and Sons.
5. Principles of Biochemistry, Lehninger. A.L., Nelson, D.L. and Cox, M.M, CBS Publishers and Distrubutors.
6. Biochemistry, Jeremy M.Berg, John L. Tymoczko and Lubert Stryer, W. H. Freeman & Company.
7. Physical Biochemistry, D Freifelder, W. H. Freeman & Company.
8. Laboratory Techniques in Biochemistry and Molecular Biology, Work and Work.
9. Understanding Chemistry, CNR Rao, Universities Press, Hyderabad.
10. A Biologist's Guide to Principles and Techniques of Practical Biochemistry. K. WilsonKH Goulding, ELBS Edition.
11. Tools of Biochemistry , T.G. Cooper.

GBT 1C 03 – MICROBIOLOGY

1. History of Microbiology, Discovery of microbial world, role of microbes in transformation of organic matter and in causation of disease. Microscopy – Light, Phase contrast, Fluorescent, Transmission electron microscope, Scanning electron microscope and scanning tunneling microscope, Confocal microscope, Atomic force microscope. Sterilization methods – Physical, Chemical and Biological
2. Pure Culture Concepts – Culture Media preparation; selective differential and enrichment media, Pure Culture Concepts, Microbial growth – different phases, measurement – Bacterial Growth Curve. Microbial Nutrition – Growth factors, Nutritional Classification of bacteria, uptake of nutrients
3. Diversity of Microbial World, Principles of Classification of microbes, approaches in bacterial taxonomy, Biology of Mycoplasmas, Microbial Staining- Grams, Differential, Motility determination

4. Introduction to Mycology – General characters of Fungi, Cultivation of Fungi, Cultural characters, Microscopic Morphology, Importance of Fungi in industry and Food production. Fungi as pathogen to man, animals and plants

5. Introduction to Virology Bacteriophages.– Discovery and structure, Baltimore Classification, Replication – Lytic and Lysogenic Cycles, Cultivation of Viruses. Detection and Enumeration of Viruses – Viral assay.

6. Microbial Metabolism – Glycolysis, Krebs Cycle, Glyoxylate Cycle, Entner Duodroff pathway, HMP shunt, ATP Synthesis, Aerobic and Anerobic respiration, Photo Synthesis, Fermentation, Methanogenesis,

7. Microflora of Soil – Rhizosphere, Biogeochemical cycles (Phosphorus, Oxygen, Nitrogen, Sulphur, Carbon), Plant Microbe interaction (symbiotic and asymbiotic). Biopesticides and Bioinsecticides. Microbiology of Air and Water- Dust, Droplets and droplet nuclei, Bacteriological examination of drinking water, waste water treatment and management (aerobic and anaerobic process.)

8. Microbes and Man - Saprophytes, Commensals, Pathogen. Sources of infection – Reservoirs, Carriers and Vectors. Congenital infections, Mode and source of infections, pathogenesis and prophyllactic methods of following diseases – Cholera, Tuberculosis, Diphtheriae, Syphilis, Influenzae, Poliomyelitis, Malaria, Amoebiasis, Dermatomycosis.

9. Antimicrobial Agents, Antibiotics, chemotherapeutic agents, major classes and mechanism of action, minimal inhibitory concentration (MIC), Microbial Drug resistance.

References

1. Pelczar, M.J.Chan, ECS & Krieg - Text Book of Microbiology.

2. Fundamentals of Microbiology – Alcamo E.

3. Prescott, L.M., Harley J.P & D.A.Klein – Microbiology

4. Benson, H.J. – A Laboratory Mannual in General Microbiology.

5. Cappuccino, J.G. – Laboratory Mannual in Microbiology.

GBT 1L 01 – LABORATARY 1- CELL BIOLOGY, BIOMOLECULES AND MICROBIOLOGY

Cell Biology (Practicals)

1. Microscopy: Bright field, phase contrast and fluorescence microscopy
2. Microtomy
3. Mitosis and meiosis
4. Histochemical techniques
5. Observation of Barr body
6. Subcellular fractionation
7. Squash preparation- polytene chromosome
8. Karyotyping

Biomolecules (Practicals)

1. Titration of amino acids – Determination of pK and pI values.
2. Reactions of amino acids, sugars and lipids.
3. UV, visible & fluorescence spectroscopy, absorption spectra.
4. Quantitation of Sugars & Proteins.
5. Analysis of oils – iodine number, saponification number.
6. Chromatography (Gel permeation, Ion exchange, TLC)
7. Electrophoresis (PAGE, SDS-PAGE, Agarose)

Microbiology (Practicals)

Equipments – Hot air oven, Autoclave, Seitz and membrane filter, Microscopy.

1.
2. Media Preparation – Nutrient broth and Nutrient Agar, Mac conkey Agar, Blood Agar, Potato Dextrose Agar, Yeast Extract Mannitol Agar.
3. Staining Techniques – Simple and Gram Staining, Spore and Capsule Staining, Fungal Staining, Acid Fast Staining.
4. Motility Determination – Hanging drop method.
5. Isolation of Pure Colonies of Bacteria – Streak, Spread and Pour Plate Methods.
6. Biochemical Tests – Indole Test, Methyl Red test, Voges Prauskaur test, Citrate Utilisation test, Triple Sugar Iron test
7. Cultivation Microscopic Examination of fungi *Penicillium, Aspergillus*
8. Bacteriological Analysis of Water – Presumptive, Confirmed and Completed tests (MPN).
9. Determination of Anti-Microbial Activity by Disc Diffusion method (Kirby Bauer Method), Determination of MIC by Tube Dilution Method.

SEMESTER-II

GBT 2C 01 METABOLISM AND BASIC ENZYMOLOGY

1. Introduction to Metabolism – Overview of metabolic pathways (carbohydrates, amino acids, lipids, nucleic acids), key reactions of metabolic pathways, regulation of metabolic pathways, evolution of metabolic pathways-RNA world.

2. Bioenergetics – Standard free energy concept, energy of activation, standard free energy, relationship between Standard free energy & equilibrium constant, energy coupled reactions in Metabolism, , high energy & low energy phosphate compounds, Biological oxidation- reduction reactions.

3. Carbohydrate Metabolism – Glycolytic pathway, Citric acid cycle, glycogenolysis, gluconeogenesis, pentose phosphate pathway.

4. Electron transport systems – Electron transport systems in mitochondria & chloroplast, alternate pathways, glyoxylate pathway, cyanide insensitive respiration.

5. Amino acid metabolism – Biosynthesis and degradation of amino acids, Urea cycle, overview of nitrogen metabolism, biosynthesis of proteins.

6. Lipid metabolism – Biosynthesis and Oxidation of fatty acids, phospholipids & glycolipid metabolism, biosynthesis of cholesterol.

7. Nucleic acid metabolism – Biosynthesis and degradation of purine, and pyrimidine nucleotides, General account of nucleic acid biosynthesis.

8. Enzymes – Classification and nomenclature of enzymes, Mechanism of enzyme action, Lock and key and induced fit hypothesis, factors influencing Enzyme activity, Isolation and purification of enzymes, Expression of enzyme activity, unit of activity, measurement of activity, Specific activity. Kinetics of enzyme, Km value determination – methods. Enzyme inhibition- types and the method for the determinations of inhibitor constants. Transition state analogs, Abzymes.

9. Mechanism of Enzyme Catalysis, Role of coenzymes and metals. Regulation of enzyme activity.. Allosterism, positive and negative modulations, zymogens, covalent modifications . Multienzyme complexes, compartmentation of enzymes, Isozymes, Immobilized enzymes, Enzyme engineering. Applications of Enzymatic analysis in medicine and industry.

References

Lehninger, A.L., Nelson, D.L. and Cox, M.M. Principles of Biochemistry. CBS Publishers and Distributors.

Voet, D. and J.G. Voet. Biochemistry, John Wiley & Sons, Inc.

Murray, R.K., D.K. Granner, P.A. Mayes and Rodwell V.W. Harper's

Biochemistry: Appleton & Lange.

Gumport, R.I., Jonas, A. Mintel, R. and Rhodes C. Students companion for Stryer's Biochemistry. Freeman and Company.

Stumpf, P.K. and Conn, E.E. The Biochemistry of Plants. A comprehensive treatise (Series) Academic Press.

Gowenlock, A.H., McMurray, J.R. and McLauchlan, D.M. Practical Clinical Biochemistry. CBS Publishers & Distributors.

GBT 2C 02 MOLECULAR BIOLOGY

1. Molecular Basis of Life –Nucleic Acids and Polypeptides, Structure of DNA – Geneticmaterial, Chargaff's Rule, X-ray Crystallographic studies, Denaturation and Renaturation, super-coiling, Different forms of DNA, Circular DNA.

2. DNA Replication – General features; semi-conservative, Mechanism of Replication – Elongation and Termination, rolling circle and theta model, Enzymology of Replication – primase, DNA Polymerase, Gyrase, Topoisomerase, Helicase; Replication fork, Telomerase activity; Replication in cancer Cells.

3. DNA recombination and Repair – Mechanism, Proof-reading, Types of DNA damage, Types of DNA Repair; Mismatch, Base-excision, Nucleotide-excision, recombinational and direct repair, SOS repair, DNA recombination models and mechanisms – Holliday model (Homologous), D-loop, double-strand break, site-specific recombination and DNA transpositions, Transposable Elements in Prokaryotes and Eukaryotes, classification of Transposons, Mutations - Types and various mutagens.

4.Molecular Genetics - Molecular Mechanisms of Transformation,Transduction and Conjugation.

5. Gene Structure – Salient Features of Genes, Fine Structure of Prokaryotic and Eukaryotic Genes; Transcription – Mechanism in Prokaryotes, Types of Transcripts, EukaryoticTranscription, Post Transcriptional Modification of mRNA, mRNA Maturation, mRNA surveillance, Promoters and promoter elements.

6. RNA Splicing – Chemistry of Splicing, Spliceosome Machinery, Splicing Pathways, Modifications in RNA - 5'-cap Formation, 3' end Processing and Polyadenylation, RNA Processing, rRNA and tRNA processing, RNA Editing, Ribozymes.

7. Gene Regulation – Prokaryotic Gene Regulatory Mechanism; Operon Concept: Lac, trp, gal and ara operons. Gene Regulation in Eukaryotes, DNA methylations, Regulation of mRNA stability, Transcription Factors, Enhancers and Silencers.

8. Genetic Code – Salient Features, Deciphering the Code, Multiple Recognition of Codons and Wobble Hypothesis – Initiation and Termination Codon. tRNAs and their charging by amino-acyl transferases – chemical and kinetic proof-reading.

9. Proteins Synthesis Mechanism in Prokaryotes and Eukaryotes – Translation initiation, elongation and termination. Post Translational Modifications.

10. Biology of Cancer – Oncogenes and Tumour Suppressor Genes, Viral and Cellular Oncogenes, Tumour Suppressor Genes of Humans

References

1. Molecular Biology of the Genes – J.D.Watson, N.H.Hopkins
2. Moleculary Cell Biology, J.Darnell, H.Lodish
3. Genes XII – latest edition
4. Genomes, T.S.Brown
5. Molecular Cloning: a Laboratory Manual, J.Sambrook.

GBT 2C 03 - ENVIRONMENTAL BIOTECHNOLOGY

1. Environment - Basic concepts andissues.

2. Environment Pollution – Sources, types of pollution, Methods of Measurement of pollution. Air Pollution, sources and controlmeasures.

Water Pollution – Water as a scarce natural resource, Need for Water management, Measurement of Water Pollution, sourcing of water pollution, control measures of water pollution.

3. Microbiology of waste watertreatment

Waste water collection, physical, chemical and biological waste water treatment methods. Aerobic waste water treatment, Activated sludge process, Oxidation Ponds, Oxidation ditches, trickling filters, towers, rotating discs.

Anaerobic processes – Anaerobic digestion, anaerobic distillery, tannery, antibiotic industries.

4. Solid waste Management – sources, types of solid wastes, Strategies for Management (composting, wormiculture, and methane production), treatment of hazardous wastes, and Biomedicalwastes.

Biosensors - Types and applications in environmental pollution detection and monitoring.Biological indicators

5. Bioremediation of contaminated solid and wasteland-Insitu, Exsitu Bioremediation, phytoremediation

Biofertilizers – Symbiotic and asymbiotic nitrogen fixers, Benefits and limitations of Biofertilizers.

6. Microbiology of degradation of xenobiotics in environment, bioaccumulation, biodegradation of xenobiotics, Role of degradative plasmids, degradation of hydrocarbons- substituted hydrocarbons, fate of polychlorinated biphenyls, and fate of surfactants, detergents, and fate of oil spillage, bioleaching, andbiosorption.

7. Pesticides and its adverse effect on Environment. Biopesticides in integrated pest management – Preventive IPM Strategies, types ofBiopesticides.

8. Bioplastics - PHA, PHB,BIOPOL-A.

9. Biofuels - Production of Alcohols, Methane, Hydrogen from Biomass,energy crops, the future applications

Green composite – starch based. Concept of green patent.

10. Global Environmental Problems - Ozone depletion, UV-B Radiation Flux increase, effect of UVB on biological system, Greenhouseeffect, Implications of global warming, Effects and measures to control Acidrain.

References

1. Wastewater Engineering – Treatment, Disposal and Reuse. Metcalf andEddy.
2. Comprehensive Biotechnology Vol.4,M.Moo-Young.
3. Environmental Chemistry,A.K.De,
4. Introduction to Biodeterioration, D.Allsopp andK.J.Seal.
5. Comprehensive Biotechnology. Second edition, Elsevier, 2011, Murray Mor. Young (Editor in chief). ISBN-978-0-08-088504-9
6. Environmental Science and Biotechnology: A.G.Murugesan, C.Rajakumari; MJP Publishers
7. Environmental Biotechnology; Alan Scragg; Oxford University Press.
8. Environmental Biotechnology; M.H.Fulekar; Oxford & IBH Publishing Co. Pvt. Ltd.

GBT 2C 04 - BIOSTATISTICS AND BIOINFORMATICS

1. Population, Sample, variable, parameter, primary and secondary data, screening and representation of data. Frequency distribution, tabulation, bar diagram, histograms, per diagram, and cumulative frequency curves. Mean median, mode, quartiles and percentiles, measures of dispersion : range, variance, standard deviation , coefficient of variation, symmetry : measures of skewness and kurtosis

2. Simple linear regression and correlations.

3. Understand and interpret results from Analysis of Variance (ANOVA), a technique used to compare means amongst more than two independent populations flow charts and programming techniques in statistics with R Programming

4. Introduction to programming in BASIC : Understanding the computer – problem solving and flowcharts- Basics of Basic – constants AND variables – Expressions in Basic – Printer controls- Jumping, Branching & looping – subscripted variables. Introduction to programming in C : Overview of C – constants, variables and data types- operators and expression – Managing input and output operations- Decision making and branching – Decision making and looping – Arrays user defined functions

5. Introduction to data structures – Arrays – stacks – Queues – List operations on Arrays

– stacks- Queues – List. Database Management System :- Characteristics of DBMS-advantages of DBMS over file processing – Actors on the scene-database models-structure of DBMS.

6. Introduction to MSEXCEL- use of worksheet to enter data, edit data, copy data, move data. Use of in-built statistical functions for computations of Mean, S.D., correlation, regression coefficients etc. Use of bar diagram, histogram, scatter plots, etc. graphical tools in EXCEL for presentation of data. Introduction to MS-WORD word processor-editing, copying moving formation, table insertion, drawing flow charts etc.

7. Computer- oriented statistical Technique : Frequency table of single discrete variable, bubble sort, computation of mean, variance and standard deviation, the test correlation coefficient.

8. Introduction to Internet and use of the same for communication, searching of database, literature, references etc.

9. Introduction to Bioinformatics, Databank search, Data management and interpretation, BLAST, Sequence alignment

10. Protein Modeling, Protein structure Analysis, Docking, Ligplot interactions, Genes, Primer designing, Phylogenetic Analysis.

References

1. Applied Bioinformatics – an introduction – (springer) Selzer P.M and others

2. Bioinformatics Basics – (CRC) – Rashidi, Hooman H , Lukas K Buchler

3. Structural Bioinformatics – (CRC) – Burkowski

4. Bioinformation a practical guide to the analysis of genes and proteins Bexevanis Andress D - ed

5. Practical Bioinformatics (springer) - Bujnicki, Janusz M.- ed

6. Biostatistics refoundation for analysis in health sciences (John wiley) Wayne W Daniel

7. Fundamentals of Biostatistics a practical approach (Kanishka) – Narenkumar Dutta

8. Statistical methods in Biology (Cambridge University Press) – Bailey,

Norman T. J

9. Principles of Biostatistics (Wadsworth,USA) – Pagano Marcello.

10. Biostatistics for the biological and health sciences (Pearnon) Triola, Mare M , Triola, Mario F

GBT 2L 01 -LABORATARY II- METABOLISM & BASIC ENZYMOLOGY, MOLECULAR BIOLOGY AND ENVIRONMENTAL BIOTECHNOLOGY

Metabolism and Basic Enzymology (Practicals)

I. *Extraction and purification of Enzymes. (Choose suitable enzymes)*

1. Extraction from plant tissues/Animal in suitable media and its activity measurement
2. Fractional precipitation using ammonium sulphate/ organic solvents.
3. Dialysis and desalting by gel filtration.
4. Purification by Ion exchange, adsorption chromatography and molecular sieving.
5. PAGE for the enzymes.

II. *Enzyme assay and quantitative measurement of activation by methods such as colorimetry and spectrophotometry.*

1. Velocity measurements and calculation of specific activity.

2. Determination of optimum pH, enzyme concentration, temperature and time for enzyme activity.

3. Substrate saturation and determination of Michaelis – Menton constant

4. Determination of temperature coefficient. Determination of energy of activation.

5. Effect of inhibitors: Competitive and non-competitive inhibition. Determination of inhibitor constant.

Environmental Biotechnology (Practicals)

1) Detection of coli forms for determination of the purity of potable water.
2) Determination of dissolved oxygen concentration of water sample.
3) Determination of biological oxygen demand (BOD) of a sewage sample.
4) Determination of Chemical Oxygen demand (COD) of a sewage sample.
5) Isolation of xenobiont degrading bacteria by selective enrichment technique.
6) Survey of degradative plasmids in microbes growing in polluted environment.
7) Effect of sulphur dioxide on crop plants.
8) Estimation of nitrate in drinking water.
9) Study on biogenic methane production.

Molecular Biology

1. Preparation of Buffers – Phosphate, Acetate, Tris HCl and Borate.
2. Quantitation of Nucleic Acids.
3. DNA and RNA Agarose Gel Electrophoresis, SDS – PAGE.
4. Restriction Digestion and Ligation Experiments.
5. Isolation of Total RNA.

6. Isolation of Plasmid DNA.

7. Isolation of Genomic DNA from bacteria, plant and animal tissues.

SEMESTER-III

GBT 3C 01 - GENETIC ENGINEERING

1. Basic principles of genetic engineering. Scope of genetic engineering. Basic tools: restriction and modifying enzymes, Gene cloning vectors:Plasmids, Bacteriophages, Phagemids, Cosmids, Artificial chromosomes. Introduction of recombinant DNA into prokaryotic and eukaryotic systems. cDNA and genomic libraries.

   Recombinant screening and selection – markers, nucleic acid hybridizations: colony, plaque, dot blot, southern and northern.

2. DNA sequencing techniques, Sanger- Coulson method, Maxam Gilbert method, Automated DNA sequencing PCR and its applications. PCR steps, Primer design Studying PCR products, Types of PCR Study of gene regulation, DNA transfection,

Northern analysis, S1 mapping, Primer extension, RNase protection and Reporter assays

3. Expression vectors Expression in prokaryotic and eukaryotic systems. Antibody based screening for recombinant proteins. Expression of heterologous genes: Bacterial, Yeast, Insects Baculovirus system. Mammalian cells(Human viral vectors shuttle vector). Production of protein drugs for clinical trial

4. Processing of Recombinant proteins, Intra cellular periplasmic and extra cellular expression of protein. Purification and refolding. Characterization of recombinant proteins. Stabilization of proteins. Phage display system

5. Molecular mapping of genome. Genetic and physical maps, Chromosome microdissection and microcloning, Molecular markers in genome analysis(AFLP, RAPD, and AFLP analysis, molecular markers linked to disease resistant genes), Application in forensic, Disease prognosis, Genetic counseling, Pedigree analysis, Taxonomy and biodiversity

6. Transgenic and gene Knockout technologies, Gene therapy, Vectors and gene delivery, Gene replacement/augmentation, Gene correction, Gene editing, Gene regulation and silencing DNA Micro array technology

7. Genetic engineering guidelines, cloning and patenting of life forms Biosafety Introduction, GMOs, General Concerns, Hazards of environmental engineering, Bio-safety Guidelines and regulations Operation of Biosafety guidelines and regulations

References

1. Molecular cloning : A laboratory manual- Sambrook
2. DNA cloning: A practical approach- D.M Glover and B,D, Hames
3. Molecular and cellular methods in biology and medicine- Kaufman
4. Methods in enzymology- Vol 152: A guide to molecular cloning techniques- S.L. Berger and A.R. Kimar

5. Methods in enzymology: VOl 185: gene expression technology- D.V. Goeddel
6. DNA science: A first course in recombinant technology: D. A. Mickloss and G. A. Frier
7. Molecular biotechnology- S.B. Primrose
8. Molecular biotechnology- Glick and Pasternak

GBT 3C 02 - BIOPROCESS TECHNOLOGY

1. Introduction to Bioprocess engineering. The chronological development of the fermentation industryMicrobial biomass, Microbial metabolites, Recombinant products, Transformation process

2. Bioreactors: A typical bioreactor. Configuration of a bioreactor. Body construction. Aeration and agitation. Achievement and maintenance of aseptic conditions. Sterilization of fermenter, air supply exhaust gas from fermenter. Inoculation, Different ports and Probes. Valves and steam traps

3. Isolation, preservation and maintenance of microorganisms Selection of natural variants important characteristics. Screening methods Strain improvement Random mutagenesis and Site directed mutagenesis Isolation of induced mutants synthesizing improved levels of primary metabolites and secondary metabolites

4. Kinetic of microbial growth and death Batch culture Continuous culture Multistage systems Feedback systems Comparison of batch and continuous culture in industrial processes. Fedbatch culture Variable volume Fixed volume and Cyclic fed batch culture. Specific growth rate. Monod equation

5. Media for fermentation Typical media composition. Medium formulation. Carbon, Nitrogen, Minerals and Energy sources. The addition of precursors and

metabolic regulators to media Medium optimization. Oxygen requirements. Antifoams. Air and media sterilization- Media and Air sterilization. Batch, continuous and Filter sterilization.

6. Types of fermentation processes Types of reactors. Analysis of batch fed batch and continuous bioreactions. Stability of microbial reactors. Analysis of mixed microbial populations. Bioreactors like pulsed, fluidized, photobioreactors, Plug flow.

7. Measurement and control of bioprocess parameters Methods of measuring Process Variables. Online Analysis of other chemical factors. Control systems.

Computer applications in fermentation technology. Mass/Oxygen transfer resistance. Aeration and agitation. Yield and energy consideration. Reynolds number and power number.

8. Downstream processing. Removal of microbial mass and solid matter. Foam separation Filtration, Precipitation, Centrifugation. Cell disruptions methods. Liquid- liquid extraction. Chromatography Membrane process. Drying and crystallization.

9. Industrial production of chemicals. Alcohol (ethanol) Acids(citric, acetic and gluconic) Solvents(glycerol, acetone and butanol) Antibiotics(penicillin, streptomycin and tetracycline) Amino acids(lysine, glutamic acid) Single cell protein Whole cell immobilization and their industrial applications

References

1. Biochemical engineering, Alba.S, Humphrey,A.Eand Millis
2. Biochemical reactors,Atkinson,B,
3. Principles of fermentation technology, Stanbury,P.F and Whitaker
4. Bioprocess technology, fundamentals and applications, KTH, Stockholm
5. Process engineering in biotechnology, Jackson, A.T., Prentice Hall, Engelwood
6. Bioreaction engineering principles, Nelson,J and Villdsen, J. Plenum Press

GBT 3C 03 - PLANT BIOTECHNOLOGY

1. Plant tissue culture introduction and techniques- lab organization, media preparation and types, aseptic manipulation, contamination, disease indexing anderadication,vitrification. Cell biology of plant cell culture and development-Major cell types in culture, separation of cell types, growth of cells in suspension, role of growth regulators in growth and differentiation in culture, hormone habituation.

2. Micro propagation - Principle, stages, applications.Micro propagation in commercial perspectives - advantages, economics, robotics and automation. Regeneration *in vitro*- Pathways and factors controlling regeneration. Organogenesis. Somatic embryogenesis-Induction, development and maturation, somatic embryo vs zygotic embryo, synseed production andapplications

4. Somatic hybridization-Protoplast isolation, purification, viability test, culture-conditions and media, culture methods, microcalli, regeneration, fusion methods-mechanical, chemical,selection and isolation of heterokaryons, genetic consequences, cybridization.

5. Haploid production-anther and microspore culture, pathways of androgenesis, media, factors controlling androgenesis, applications in plant breeding. Triploid production- Techniques, media, explants, organogenesis, factors affecting callus and shoot bud formation, applications in plantbreeding.Tree biotechnology – modification of wood quality.

6. Embryo culture-Types of embryo, media, role of suspensor, precocious germination, morphogenesis of undifferentiated embryo, embryo rescue, applications in plant breeding. Culture of ovule and ovary, factors affecting seed-set after *in vitro* pollination,applications.

7. Somaclonal and Gametoclonal variation-Molecular basis of variation, variants, Selection. Application in plant breeding. Mutation breeding in tissue culture-Spontaneous, induced, chimeras, adventitious bud technique. Germplasm conservation-Modes of conservation, *in vitro* methods of conservation,viability testing, applications.

8. Secondary metabolite production by plant tissue culture - Factors affecting production.Bioreactors Biotransformation, Immobilized plant cells, Hairy root cultures. Applications – Production of antibodies, viral antigens and peptide hormones in plants, biodegradable plastics in plants.

9. Plant transformation-Ti&Ri plasmids as vectors, basis of tumor formation Mechanism of DNA transfer, role of *vir*genes, binary and co-integrate vectors, viral vectors, use of 35s, inducible, tissue specific promoters, nuclear transformation, multiple gene transfer, direct gene transfer methods-macro- and micro- injection, particle gun method,electroporation, transformation ofmonocots.GM plants with animal gene – plantibodies and plant vaccines.

10. Applications of plant transformation - Herbicide resistance: phosphinothricin, glyphosphate, sulfonyl urea, atrazine; Insect resistance: Bt genes, non Bt like protease and amylase inhibitor genes,Virus resistance: coat protein mediated, nucleocapsid gene; Disease resistance: chitinase, 1-3 β-glucanase, RIP, antifungal proteins, thionins, PR proteins, Nematode resistance; Abiotic stress, Post-harvest losses, Long shelf lifeoffruits and flowers, use of ACC synthase, polygalacturonase, ACC oxidase, male sterility, carbohydrate composition and storage, ADP glucose pyrophosphate.

References

1. Bhojwani S.S and RazdanM.K. PalntTissueCulture,Elsevier,Amsterdam.
2. DeberghP.C. and Zimmerman R.H.(Eds.) 1991.Micropropagationtechnology and application,Kluwer,Dordrecht.
3. Dixon R.A. & Gonzales R.A.(Eds.) Plant cell culture-A practical approach,IRI Press,Oxford.
4. Gamborg O.L and Phillips G.C. Plant cell,tissue and organ culture.Narosa publishing house,NewDelhi, 1995.
5. Radenbaugh K.(ed.). Synseeds : application of synthetic seeds to crop improvement,CRC Press, Boca Raton, FL.

6. Chawla H.S., "Introduction to Plant Biotechnology", 3rd Edition, Science Publishers, 2009.

GBT 3C 04 - IMMUNOLOGY

1. Introduction to Immune system. Types of immunity- Innate, Acquired, Passive and Active. Factors affecting Immune System.

2. Hematopoeisis and differentiation - Hematopoietic growth factors. Genetic regulation of hematopoiesis. Cells of Immune system –lymphocytes, null cells, mononuclear cells, granulocytes, dendritic cells. Organs of Immune System – primary lymphoid and secondary lymphoid organs, lymphatic system.

3. Antigens – properties- types. Immunogenicity and antigenicity. Factors affecting immunogenecity. Antigenic epitopes, adjuvants, haptens, superantigens. Antibodiesbasicstructure, Immunoglobulin domains, antigenic determinant on immunoglobulin-isotype, allotype, idiotype, B- cell receptors (BCR) -Immunoglobulin classes and sub classes. Generation of Antibody diversity- Immunoglobulin genes.

4. Antigen – antibody interactions – Affinity and avidity, cross- reactivity, precipitation,agglutination and agglutination inhibition reactions, Hemagglutination, Bacterial agglutination and particle agglutination and its applications.

5. MHC- structure, organization and inheritance, Cellular distribution of MHC- Antigen presentation pathways- immune response, disease susceptibility, T-cell andB-cell receptors. Antigen processing and presentation. Effector responses- Humoral and Cell-

mediated response. NK cell mediated cytotoxicity, Antibody dependent cellmediated cytotoxicity, macrophage mediated cytotoxicity. Regulation of immuneresponse. Activation of B and T lymphocytes.

6. Cytokines- Properties and therapeutic use- cytokine secretion by TH1 and TH2 cells - Cytokine related diseases : Bacterial septic- shock, chaga‟s

disease ,lymphoid and myeloid cancers. Complement system- Pathways- Role in

immune regulation.

7. Hypersensitivity – types. Diagnosis and treatment approaches Autoimmunity and

Autoimmune diseases – Organ specific :thyroid and Systemic: SLE Diagnosis and

treatment approaches

8.Immunity to infectious agents – viral, bacterial, protozoan and helminthesinfections.Immune aversion mechanisms.

9. Transplantation immunology – Tissue and organ transplantation. Immunology of

rejection-mechanism, Immunosuppressive agents, Tumor Immunology – Oncogenes

and cancer induction. Tumor antigens and immune response. Cancer immunotherapy

10.Vaccines: Active and passive immunization. Whole organism vaccines, Recombinant vector vaccines, DNA vaccines, Synthetic peptide vaccines, Multivalent vaccines - Hybridoma technology - Monoclonal antibodies and therapeutic applications

References

1.Godkar, P.B (1998): A Text Book of Medical LaboratoyTechnology.Bhalani

Bhalani Publishing House Mumbai.

2.JanisKuby (2000) .Immunology.7th ed. W.H. Freeman& Co. New York.

3.Chakraborty ,A.K.(2006).Immunology and Immunotechnology.Oxford University Press.

4.Peter Parham (2004): The immune system (Second edition, Garlands, New York).

4. Eli Benjamini, Richard Coico, Geoffrey Sunshine (2000)Immunology – A short course Wiley,– New York ; Chichester :

5. William Paul (2012)Fundamentals of Immunology –Wolters Kluwer, Luppincott, Williams & Wilkins

6. David Male,Jonathan Brostoff, David Roth& Ivan Roitt(2012)-Immunology- Saunders

GBT 3E 01 Stem Cell Biology **(***PART-A)*

Unit. I - Introduction to stem cells, classification, Sources, programming and reprogramming, tissue specific stem cells Embryonic hematopoietic and neural stem cells, Classification and Sources

Unit II - Embryonic Stem Cells Blastoyst and inner cell mass cells; Organogenesis; Mammalian Nuclear Transfer Technology; Stem cell differentiation; Stem cells cryopreservation

GBT 3E 02 Virology Part A

Unit I General properties of viruses- Structure and Morphology, Cultivation. Methods used for viral quantification and enumeration. Electron-microscopic studies Viral classification DNA and RNA viruses, Laboratory requirements for cultivation. Lawn culture, Embryonated egg inoculation, Animal inoculation, Permissive and non-permissive hosts or cells. Tissue - Types of cell-lines used for the study Detection of virus growth in cell culture

UnitIIViral Tropism, Factors responsible for viral tropism. Replication of DNA viruses and RNA viruses, effects of viruses on the host cells – cyto-pathic effect. Immune aversion mechanism of viruses, Emerging viral diseases. Virus Host interaction- Acute infection, chronic/persistent infection latent infection and slowly progressive virus infection Viral inclusion bodies - methods of staining and demonstration.

GBT 3L 01-LABORATARY III- GENETIC ENGINEERING, BIOPROCESS TECHNOLOGY, PLANT BIOTECHNOLOGY AND IMMUNOLOGY

Genetic Engineering (Practicals)

1. Preparation of competent cells
2. Calcium Chloride mediated transformation of *E. coli*
3. Shot- gun cloning in plasmid or phagemid vectors
4. Southern blotting
5. Northern blotting

6. PCR
7. Repoter gene assay(Gus/CAT/b-GAL)

Bioprocess Technology (Practicals)

1 Isolation of industrially important microorganisms for microbial processes
2. Comparative studies of ethanol production using different substrates
3. Microbial production of citric acid using *Aspergillus niger*
4. Microbial production of antibiotics(penicillin)
5. Production and estimation of Protease
6. Use of alginate for cell immobilization

Plant Biotechnology (Practicals)

1. Preparation and sterilization of glasswares, explant.
2. Preparation stock solution for and media.
3. Large scale isolation of mesophyll cells from leaves.
4. Initiation and maintenance of callus.
5. Organogenesis from callus

6. Somatic embryogenesis from root cultures.
7. Induction of haploids from anther and pollen cultures
8. Cultures.Isolation and culture of protoplasts from leaf/callus by
9. Quantitation of tissue culture procedures: Determination of fresh and dry weights, cell culture density, PCV and MI

Immunology (Practicals)

1. Blood film preparation and identification of cells, ABO Blood grouping.
2. Lymphoid organs and their microscopic organization.
3. Immunization and collection of Serum.
4. Antibody titration.
5. Double immunodiffusion, Radial Immunodiffusion and immunoelectrophoresis.
6. Western Blotting.
7. ELISA.
8. Separation of mononuclear cells by Ficoll – Hypaque and its cell culture by mitogen induction.
9. Widal and VDRL tests

SEMESTER-IV

Elective Course

GBT 4E 03 Stem Cell Biology **(***PART-B)*

Unit III = Application of stem Cells Overview of embryonic and adult stem cells for therapy Neurodegenerative diseases; Parkinson's Alzheimer, Spinal Code Injuries and other Brain Syndromes; Tissue systems failures; Diabetes; Cardiomyopathy; Kidney failure; Liver Failure; Cancer; Hemophilia.

Unit IV - Human Embryonic Stem Cells and society. Human stem cells research: Ethical considerations; Stem cell religion consideration; Stem cell based therapies: Pre clinical regulatory consideration and Patient advocacy.

Unit V - Various model organisms. Stem cell isolation &characterization techniques

References

1. Ann A Kiessling, Human Embryonic Stem Cells: An Introduction to the Science and Therapeutic Potential, jones and Bartett, 2003.
2. Peter J. Quesenberry, Stem Cell Biology and Gene therapy, 1st Edition, Willy-Less, 1998.
3. Robert Lanja, Essential of stem cell Biology, 2nd Edition, Academic Press, 2006.
4. A.D. Ho., R. Hoffiman, Stem Cell Transplantation Biology Processes Therapy, Willy-VCH, 2006.
5. C.S. Potten, Stem Cells, Elsevier, 2006.

GBT 4E 04 Virology Part B

Unit III Animal viruses Poxviruses, Papilloma Viruses, Human Herpes Viruses, Adenoviruses, Picornaviruses, Rotaviruses, Retroviruses, Flaviviruses, Coronaviruses Human Swine fever virus Cancer causing RNA and DNA Viruses. Viral arthritis. Control of animal viral diseases, Antiviral agents, Combination therapy, Nucleic acid based therapies

Unit IV

Bacteriophages Lambda phage, T phages, Filamentous phages M 13 phages.Lytic and lysogenic cycles of Lambda phage. M13 replication Types of plant viruses, Economic losses due to important viruses;DNA viruses, RNA viruses, satellite viruses, viroids, virusoids; Disease symptoms, local and systemic movement of viruses, plasmodesmata and virus movement.

Unit V

Virus detection and diagnosis; Infectivity assays- Sap transmission, insect vetor transmission, agroinfection (using Agrobacterium); Ultracentrifugation, electron microscopy, serological methods, immunelectrophoresis in gels, direct double-antibody sandwich method, Dot ELISA, Immunosorbent electron microscopy (ISEM), Nucleic acid based viral detection.

Texts/ References

Ed. C.L. Mandahar, Molecular biology of Plant viruses, Kluwer academic publishers, Dordrect, 1999.

Roger Hull (Ed), Mathews Plant Virology, 4th Edition, Academic Press, San Diego, 2002.

D.G.A. Walkey (Ed), Applied Plant Virology, 2nd Edition, Chapman & Hall, London, 1991.

Text Book of Microbiology :Ananthanarayanan& JayaramPanikker

Medical Virology : Fenner and White

Principles and Practice of Infectious diseases – Madell, Bennett, Dolin Vol- 1 & 2

Medical Microbiology : David Greenwood, Slack, Peutherer

Essentials of Diagnostic Virology: G. Storch

Notes on Medical Virology ByMorag.C. Timbury

Diagnostic methods in Clinical Virology : N.R. Grist

Fundamentals of Molecular Virology By Nicholas H. Acheson

GBT 4E 05 Industrial & Food Biotechnology

Unit I Industrial and Food Biotechnology; Indroduction; History; Importance; Applications of Bioprocess and Biotechnology in food processing; Significant advances; Risk factors; Safety regulations.

Unit II Bioprocessing - Industrial use of microorganism; Microbes exploited commercially - Saccharromyces, Lactobacillus; Penicillium, Acetobactor, Bifidobacterium, Lactococcus, Streptococcus. Fermentation-process, media and systems; Upstream and down stream processing; Product development; Dairy fermentationand fermented products.

Unit III Microbial enzymes in food processing; Industrial production of enzymes – proteases amylase, invertase, pectinase and cellulases; High Fructose Corn Syrup (HFCS). Food and beverage fermentation-alcholic and non alcoholic beverages; Food additives and supplements

– probiotics, health care products, Neutraceuticals, vitamins and antibiotics, Fuels and industrial chemicals-Alkanes, industrial ethanol.

Unit IV Modification of microbes/enzymes – Strain improvement, enzymes/cofactors recombinant enzymes, Applications in product development/improvement.

Unit V Cells and enzymes immobilization. Product enhancement – Classic examples; Biosensors and Bioprocess monitoring; Basic components and the utility and applications. Texts/References

1. Gautam, N.C., Food Biotechnology in Comprehensive Biotechnology, Vol.6., Shree Publishers,
2. Gutierrez – Lopez, G.F. et. Al., Food Science and Foos Biotechnology. CRC Publishers, Washington, 2003
3. Maheshwari, D.K. et. Al., Biotyechnological applications of microorganisms, IK. International, New Delhi, 2006
4. Stanbury, P.F. et. al., Principles of Fermentation Technology, 2nd Edition, Elsevier, UK, 1995.

5. Waites, M.J. et. al., Industrial Biotechnology: An Introduction, Blackwell publishing, UK, 2007.
6. Food Microbiology, William C. Fraizer & Deniss C Westhoff, Tata MaGraw-Hill, 2008.
7. Industrial Microbiology Casida L. E., Wiley, 2007

GBT 4E 06- Nanobiotechnology

Unit I - Introduction to Nano-Biotechnology; Nanotechnology definition and concepts; Cellular Nanostructures; Nanoprocess; Biomolecular motors; Criteria for suitability of nanostructures for biological applications

Unit II - Molecular nanotechnology; Nanopowders and nanomaterials: Sol-gels and their use, Use of natural nanoparticles, Nanobiometrics, Lipids as nano-bricks, Proteins as nanomolecules, DNA in nanotechnology, Present and future of nanotechnlogy applications in Molecular biology and Medicine

Unit. III - Basic characterization techniques; Electron microscopy; Atomic force microscopy; Photon correlation sepectroscopy, Thin films; Colloidal nanostructures; Nanovesicles; Nanospheres; Nanocapsules

Unit IV - Nanostructures for drug delivery, concepts, targeting, routes of delivery and advantages

Unit V - Nanostructures for diagnostics and biosensors; Nanopartcles for diagnostics and imaging; Nanodevices for sensor development.

References

1. Multilayer Thin Films, Editors(s): Gero Decher, Joseph B. Schlenoff, Multilayer

   Thin Films, Wiley-VCH Verlag, GmbH & Co. KGaA ISBN: 3527304401
2. Bionanotechnology: Lessons from Nature Author: David S. Goodsell Publisher:

   Wiley-Liss ISBN: 047141719X.
3. Biomedical Nanotechnology Editor: Neelina H. Malsch Publisher: CRC Press

   ISBN: 0-8247-2579-4
4. Gero Decher, Joseph B. Schlenoff, Multilayer Thin Films, Wiley-VCD Verlag, GmbH & Co.KGaA, 2003.
5. David S. Goodsell, Bionanotechnology: Lessons from Nature, 1st Edition, Wiley-Liss, 2004.
6. Neelina H. Malsch, Biomedical Nanotechnology, 1st Edition, CRC Press, 2005.

GENERAL PATTERN OF QUESTION PAPER FOR CORE AND ELECTIVE COURSES IN GENERAL BIOTECHNOLOGY

ENVIRONMENTAL BIOTECHNOLOGY

Time: Two and half hours **Max. Weight : 30 weightage**

Section- A

Answer any four questions. Each question carries a weightage of 2 - **(4 x 2 = 8)**

1. Differentiate between BOD and COD

2. What are Biosensors and its application

3. Give an account on biological indicator species

4. What are oxidation lagoons

5. Concept of green patent

6. Write the important features of UASB

7. Comment on Ozone depletion

Section B

Answer any four questions. Each question carries a weightage of 3 - **(4 x 3 = 12)**

8. Explain the hazardous effects of xenobiotics

9.Biofuels.

10.Discuss the role of microorganisms in the degradation of pesticides.

11.Bioplastics.

12.Write notes on Vermicomposting

13.Biochemistry of Lignin biodegradation

14. Working of Trickling filter.

Section C

Answer any two questions. Each question carries a weightage of 5 - **(2 x 5 = 10)**

15. Describe the tertiary treatment strategies for waste water.

16. Explain degradation of xenobiotics using microbes

17. Describe various strategies for management of solid waste

18. Discuss sources and controlmeasures for air pollution

Programme Outcome for the MSc. General Biotechnology

Students will attain following capabilities after successful completion of M.Sc. General Biotechnology programme. To be followed with the OBE from the academic year 2020 admission onwards

PO1	**Acquire knowledge relevant to Biotechnology from Modern Biology courses.**
PO2	**Identify the Biotechnological components required to satisfy the Human needs**
PO3	**Apply Biotechnology for the large-scale exploration in healthcare, agriculture, environment and industry.**
PO4	**Able to access social, environmental, public safety and health implications of Biotechnology practices.**
PO5	**Appreciate difference between technologies adopted by Biotechnology over the other technologies**
PO6	**Perceive research and development or biotechnology based industrial venture as a carrier option.**

Semester 1- Cell Biology (GBT 1C 01) Learning Outcomes

Students who successfully complete this course in master's programme will be able to;

- Understand the structures and grounds of basic cell components of prokaryotes and eukaryotes including macromolecules, membranes, and organelles.
- Helps to understand cellular components underlying cell growth and division.
- Also helps them to perceive, how cell to cell interaction takes place.
- Students will understand how these cellular components are used to generate and utilize energy in cells
- Students will apply their knowledge of cell biology to selected examples of changes or losses in cell function. These can include responses to environmental or physiological changes, or alterations of cell function brought about by mutation.
- Also helps to understand the how proteins are getting synthesised and utilised by the body cells.
- Also provides research based specialization in biological and medically oriented studies. Modern pharmaceutical, biomedical, and biotechnological industry often base their research on biochemical, molecular, cell biological and physiological techniques. There is an increasing need for knowledge of cell biology and physiology within biomedical research.

The key concepts of the course will improve the ability of the students to apply the knowledge acquired in different tools involved in Cell Biology and to promote their individual research in the field of Biotechnology.

Semester 1- Biomolecules (GBT 1C 02) Learning Outcomes

For Msc Biotechnology, Biochemistry paper is included in the first and second semesters.

Learning Outcome (Semester I)

By studying the biochemistry paper the students will be able to

- Demonstrate the techniques in biochemistry and to apply them in scientific research.
- Describe the basic concepts of thermodynamics.
- Explain the structure and functions of major biological macro and micro molecules.
- Quantify the biological macro and micro molecules in different samples.
- Describe the biochemical pathways that sustain life.

Semester 1- Microbiology (GBT 1C 03) Learning Outcomes

Objective

After successful completion of this programme, the students will be able to understand

- Basic types of Microscopes and staining techniques and various culture media. Understand the basic microbial growth mechanism, Know the various Physical and Chemical growth requirements of bacteria and their classification based on nutritional requirements.
- Physiology and metabolism of microorganisms including viruses.
- Soil microflora and kinds of interactions and importance of biogeochemical cycles.
- Importance and types of biofertilizers, biopesticides

Course Outcome

Microbiology technician, Research Assistant, Lab Manager/Supervisor, Technical assistant in Pharma industries

Semester 2- Metabolism and Basic Enzymology (GBT 2C 01) Learning Outcomes

Upon completion of the Biochemistry paper students will be able to:

- Outline the major metabolic pathways in human and plants.
- Explain the regulation of biochemical processes.
- Describe the basic properties and role of enzymes that sustain life.
- Demonstrate the techniques in biochemistry and to apply them in scientific research.

Semester 2- Molecular Biology (GBT 2C 02)Learning Outcomes

- Molecular Biology gives an in-depth knowledge of the biological process through the investigation of the underlying molecular mechanisms.
- Gain insight into the experiments which determined DNA as genetic material.
- Explain the fundamental structure, properties, and processes in which nucleic acids play a part.
- Discuss the molecular mechanisms by which DNA controls development, growth or morphological characteristics of organisms.
- Gain knowledge into the mechanism of how variations are generated from one generation to another.

- Discuss the mechanism of how the information from DNA is converted into effector molecules proteins and the role of post-translational modifications in normal functioning of an organism.
- Understand the mechanism of how cancer progresses and gain insight into various methods of detection and treatment.
- Understand and apply the principles and techniques of molecular biology which prepares students for further education and employment in teaching, basic research, or the health professions.
- They can critically and quantitatively analyze scientific data, either their own original data or the published data of others.
- They can define a specific hypothesis and design an experiment to test it, also work collaboratively in a team to produce a joint intellectual product.
- With the knowledge of Molecular biology, the student can obtain a position in both the public and private sector as a consultant in biochemical, pharmaceutical, biomedical and biotechnological industry.

Semester 2- Environmental Biotechnology (GBT 2C 03) Learning Outcomes

Students who successfully complete this Subject will be able to:

- Understand the various global and regional environmental concerns due to human and natural activities, and its impact on various forms of biodiversity and human habitat.
- Investigate case studies of different types of environmental pollution and their impacts.
- Able to incorporate the knowledge from chemistry, biochemistry, molecular biology and/or microbiology, to understand and address environmental issues, alongside exploring environmental resources for new technologies.
- Create awareness of emerging concerns such as climate change, waste management or reductions in fossil fuels, and new technologies for addressing these.
- Conduct independent research work in a laboratory and produce hypothesis.
- Select, adapt and conduct molecular and cell-based experiments to confirm the hypothesis.
- Demonstrate advanced skills in performing literature searches and presenting a critical appraisal.

Semester 2- Biostatistics & Bioinformatics (GBT 2C 04)Learning Outcomes

On Completion of the course the students will be able:

- The objective of the course is to acquire knowledge and awareness of the basic principles and concepts of biology, computer science and mathematics.
- Know about the existing software effectively to extract information from large databases and to use this information in computer modeling.
- Will attain problem-solving skills, including the ability to develop new algorithms and analysis methods
- An understanding of the intersection of life and information sciences, the core of shared concepts, language and skills the ability to speak the language of structure-function relationships, information theory, gene expression, and database queries

Semester 3- Genetic Engineering (GBT 3C 01) Learning Outcomes

On Completion of the course the students will be able:

- The objective of the course is to familiarize the students with the basic concepts in genetic engineering; to acquaint the students to versatile tools and techniques employed in genetic engineering and recombinant DNA technology; and to appraise them about applications genetic engineering.
- To acquire knowledge in Gene regulation studies.
- To know about the production of protein drugs for clinical trial.
- Knowledge about molecular mapping of genome
- Gain the information about the ethical issues and Biosafety of Genetically modified organisms

The key concepts of the course will improve the ability of the students to apply the knowledge acquired in different tools involved in recombinant DNA technology and to promote their individual research in the field of Genetic Engineering.

Semester 3- Bioprocess Technology (GBT 3C 02)Learning Outcomes

- Students will acquire knowledge of Bioprocess Engineering underlying principles of main bioprocess unit operations like fermentation, downstream processing including the types and use parts of a fermenter.
- Also have knowledge about recombinant protein expression and production from various cell systems has advanced knowledge about factorial experimental set up.

- They will understand how industrially useful microorganisms are getting isolated and preserved and the processes of using it for synthesis of industrially important products like Antibiotics, organic acids, enzymes, Single cell proteins, vitamins.

- They will have a strong knowledge about the techniques of development of a new industrially important microorganism.

- They will able to apply knowledge of biological science and engineering to bio-catalysed reaction systems to understand mechanism and kinetics of enzyme/microbial catalysed reactions

- Also understand how to select suitable bioreactor for desired application and also to select suitable separation system for downstream processing.

- They will also understand the concept of enzymes, its purification and its industrial relevance.

The key concepts of the course will improve the ability of the students to acquire knowledge in industrial bioprocessing and to promote their research in the field of Bioprocess Technology.

Semester 3- Plant Biotechnology (GBT 3C 03)Learning Outcomes

On Completion of the course the students will be able:

- The goal of this course is to introduce biotechnological methods in plant system.
- Understanding of biotechnological processes and also has applicative value in pharmaceutical and food industry.
- This course explores the use of biotechnology to both generate genetic variation in plants and to understand how factors at the cellular level contribute to the expression of genotypic and phenotypic variation.
- There is a highlighting on the molecular mechanisms directing plant gene expression under diverse environmental and developmental stimuli.
- A problem-based learning approach is employed to demonstrate the use of various technologies.

The key concepts of the course will enhance their ability to apply the knowledge acquired in different problem-solving sessions and their own research planning project.

Semester 3- Immunology(GBT 3C 04)Learning Outcomes

Upon completion of the course the student will have the following learning outcome

- Demonstrate how the immune system works building on their previous knowledge from biochemistry, genetics, cell biology and microbiology.

- Know the cellular ontogeny and organs involvement in immunity.
- Explain the principles of self-tolerance and autoimmunity.
- Able to provide an overview of the interaction between the immune system and pathogens.
- Understand the molecular basis of complex, cellular processes involved in inflammation and immunity, in health and disease.
- Effectively communicate the understanding of basic mechanisms and therapeutic implications.
- Develop critical thinking and use of primary research publications to understand the scientific processes which lead them to draw hypothesis and scientific discovery.
- Conduct independent research work in a laboratory and produce hypothesis.
- Select, adapt and conduct molecular and cell-based experiments to confirm the hypothesis.
- Demonstrate advanced skills in presenting research outcomes along with a critical appraisal.

Also they can engage themselves in discussions about concepts in immunology and research. Communicate their findings using oral presentations and involve in a question & answer session on the content and also publish their research articles on recent advances in immunology.

Semester 3- Stem Cell Biology Part A (GBT 3E 01) Learning Outcomes

Students who successfully complete this Subject will be able to:

- Define key molecular and cellular principles of pluripotent stem cell biology (i.e. embryonic stem cells and induced pluripotent stem cells).
- Develop a molecular understanding of nuclear reprogramming and cloning.
- Compare between different types of stem cells, their function, characterization and isolation techniques.
- Define key molecular and cellular principles of the biology of several adult stem cell types including hematopoietic, skin, intestine and neural stem cells as well as cancer stem cells.
- Develop a firm conceptual understanding of key stem cell fate choices including self-renewal and differentiation/commitment as well as stem cell plasticity.

Semester 4- Stem Cell Biology Part B (GBT 4E 03) Learning Outcomes

Students who successfully complete this Subject will be able to:

- List key components of stem cell niches and their role in regulating stem cell development.
- Recall selected bioengineering tools for use in stem cell therapy for recovery from neurodegenerative diseases and tissue system failures such as diabetes, cardiomyopathy and kidney failure.
- Demonstrate advanced skills in performing literature searches for model organisms and presenting a critical appraisal.

Semester 4- Industrial & Food Biotechnology (GBT 4E 05) Learning Outcomes

By the end of the course, the student must be able to:

• Describe the basic principles of fermentation

• Describe basic safety aspects of fermentation

• They will understand about different fermentation system

• Understand enzyme action and main classes of enzymes

• They will understand about industrially useful microorganisms

• Understand the importance of probiotics

• Understand about dairy fermentation and fermented products

• understand about strain improvement and also about recombinant enzymes

•describe cell and enzyme immobilization

• understand product enhancement, biosensors and bioprocess monitoring