5 year M.Sc., Integrated Course Syllabus

Dept. of Biotechnology & Bioinformatics

(Effective from the academic year 2015-16)

Yogi Vemana University

Vemanapuram, Kadapa, AP 516 003

Semester	Number of Papers	Marks in the Semester End Examinations for each Paper	Internal Tests for Each Paper	Total Marks for all the Paper
I	Theory: 4	75	25	100x4=400
	Physical Science-I	70	30	100x1=100
	Practicals:3	100	---	100x3=300
II	Theory: 4	75	25	100x4=400
	Physical Science-II	70	30	100x1=100
	Practicals:3	100	---	100x3=300
III	Theory: 4	75	25	100x4=400
	Physical Science-III	70	30	100x1=100
	Practicals:3	100	---	100x3=300
IV	Theory:5	75	25	100x5=500
	Practicals:3	80	---	80x3=240
	Seminar	----	60	60
V	Theory:5	75	25	100x5=500
	Practicals:3	80	---	80x3=240
	Seminar	----	60	60
VI	Theory:5	75	25	100x5=500
	Practicals:3	80	---	80x3=240
	Seminar	---	60	60
VII	Theory:5	75	25	100x5=500
	Practicals:3	80	---	80x3=240
	Seminar	---	60	60
VIII	Theory:5	75	25	100x5=500
	Practicals:3	80	---	80x3=240
	Seminar	---	60	60
	Non-core-1	75	25	100
IX	Theory:5	75	25	100x5=500
	Practicals:1	80	---	80x1=80
	Project Design	---	80	80
	Seminar	---	40	40
	Non- core-2	75	25	100
X	Research Methodology	100	---	100
	Project (Individual)	150	100	
	Viva Voce	50	---	300
Total				**7700**

5 years Integrated M. Sc., Biotechnology and Bioinformatics
DRAFT SYLLABUS FOR APPROVAL
w.e.f. Academic Year 2015-16

Semester - I

S. No.	Paper No.	Title of the Paper	Teaching Hours per week	Marks
1	16011	English	4	100
2	16012	Introduction to biology	4	100
3	16013	Mathematics-I	5	100
4	16014	Physical Sciences-I	4	100
5	16015	Cell biology	4	100
6	16011P	Biology Lab	3	100
7	16012P	Physics Lab-I	3	100
8	16013P	Chemistry Lab-I	3	100
Total			30	800

Semester - II

S. No.	Paper No.	Title of the Paper	Teaching Hours per week	Marks
1	26011	Communication Skill (English)-I	4	100
2	26012	Computer Science-I	4	100
3	26013	Mathematics-II	5	100
4	26014	Physical Sciences-II	4	100
5	26015	Biodiversity and ecological principles	4	100
6	26011P	Computer Lab-I	3	100
7	26012P	Physics Lab-II	3	100
8	26013P	Chemistry-II	3	100
Total			30	800

Semester - III

S. No.	Paper No.	Title of the Paper	Teaching Hours per week	Marks
1	36011	Communication Skill (English)-II	4	100
2	36012	Computer Science-II	4	100
3	36013	Mathematics and Statistics	5	100
4	36014	Physical Sciences-III	4	100
5	36015	Principles of microbiology	4	100
6	36011P	Statistics Lab	3	100
7	36012P	Physics Lab-III	3	100
8	36013P	Chemistry Lab-III	3	100
Total			30	800

Semester - IV

S. No.	Paper No.	Title of the Paper	Teaching Hours per week	Marks
1	46011	Second Language	4	100
2	46012	Environmental Studies	4	100
3	46013	Entrepreneurship & Principles of Management	4	100
4	46014	Introduction to Bioinformatics	4	100
5	46015	Biomolecules	4	100
6	46011P	Computer Science Lab-II	3	80
7	46012P	Lab: Microbiology & Introduction to Bioinformatics	3	80
8	46013P	Lab: Biomolecules	3	80
9	46011S	Seminar	3	60
Total			32	800

Semester - V

S. No.	Paper No.	Title of the Paper	Teaching Hours per week	Marks
1	56011	Biochemical and biophysical tools	4	100
2	56012	Molecular biology	4	100
3	56013	Enzymology and Bioenergetics	4	100
4	56014	Bio-computing	4	100
5	56015	Genetics	4	100
6	56011P	Lab: Biochemical and biophysical tools	3	80
7	56012P	Lab: Biocomputing and Genetics	3	80
8	56013P	Lab: Enzymology and Molecular biology	3	80
9	56011S	Seminar Presentation	3	60
Total			32	800

Semester - VI

S. No.	Paper No.	Title of the Paper	Teaching Hours per week	Marks
1	66011	Immunology	4	100
2	66012	Genetic engineering	4	100
3	66013	Intermediary metabolism	4	100
4	66014	Computational Molecular biology	4	100
5	66015	Plant biotechnology	4	100
6	66011P	Lab: Immunology	3	80
7	66012P	Lab: Computational Molecular biology	3	80
8	66013P	Lab: Plant biotechnology	3	80
9	66011S	Seminar Presentation	3	60
Total			32	800

Semester - VII

S. No.	Paper No.	Title of the Paper	Teaching Hours per week	Marks
1	76011	Genomics	4	100
2	76012	Microbial biotechnology	4	100
3	76013	Animal biotechnology	4	100
4	76014	Molecular modeling	4	100
5	76015	Elective 1: Plant system physiology/ Bacteriology and Virology	4	100
6	76011P	Lab- Genetic Engineering & Genomics	3	80
7	76012P	Lab- Molecular modeling	3	80
8	76013P	Lab- Animal biotechnology	3	80
9	76011S	Seminar Presentation	3	60
Total			32	800

Semester - VIII

S. No.	Paper No.	Title of the Paper	Teaching Hours per week	Marks
1	86011	Environmental Biotechnology	4	100
2	86012	Stem cell biology & Regenerative medicine	4	100
3	86013	Proteomics and Protein Engineering	4	100
4	86014	Drug design and targeting	4	100
5	86015	Elective 2: Animal System Physiology/ Agricultural biotechnology	4	100
		Non-core-1	4	100
6	86011P	Lab: Proteomics	3	80
7	86012P	Lab: Microbial and Environmental biotechnology	3	80
8	86013P	Lab: Drug design	3	80
9	86011S	Seminar Presentation	3	60
Total			36	900

Semester - IX

S. No.	Paper No.	Title of the Paper	Teaching Hours per week	Marks
1	96011	Cell signaling and Cancer Biology	4	100
2	96012	Metabolomics	4	100
3	96013	Elective 3: Nanotechnology/ Medical biotechnology	4	100
4	96014	Elective 4: Bioethics, Biosafety, and IPR/Advanced bioinformatics	4	100
5	96015	Elective 5: Developmental biology/ Oxidative Stress, Antioxidant Defence in health & Disease.	4	100
		Non-core-2	4	100
6	96011P	Lab: Cancer biology/metabolomics/ Bioinformatics	3	80
7	96011T	Project design	6	80
8	96011S	Seminar	3	40
Total			36	800

Semester - X

S. No.	Paper No.	Title of the Paper	Teaching Hours per week	Marks
1	06011	Research Methodology	4	100
2	06011T	Project/ Dissertation	32	300
Total			36	400

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Semester I

Paper 16012: Introduction to Biology

Unit I: Evolution and classification

Emergence of evolutionary thoughts – Lamarck, Darwin theory of evolution, spontaneity of mutations. Origin of life - Origin of basic biological molecules; concept of Oparin and Haldane; experiment of Miller; evolution of prokaryotes; evolution of eukaryotic cells. Classification of living organisms; viruses, prokaryotes, Eukaryotes, fungi, plants, and animals.

Unit II: Cell and organism biology

Cell structures - Prokaryotic cell, Eukaryotic cell – plant, animal cell structures and differences. Tissues (epithelial tissue, connective tissue, muscle tissue) and systems (digestive system, circulatory system, lymphatic system, respiratory system, sensory systems, homeostasis). Plant structure and functions.

Unit III: Metabolism and reproduction

Energy and metabolism, modes of nutrition, autotrophs, heterotrophs, respiration, fermentation, photosynthesis. Reproduction – Asexual reproduction, sexual reproduction, breeding systems in plants and commercial applications, overview on development of an embryo to adult in humans.

Unit IV: Inheritance biology

Inheritence, DNA, the genetic material, mendelian principles, law of dominance, law of segregation, independent assortment, derivation of Mendelian inheritance, mutations, cytoplasmic inheritance..

References:

1. Biological science – low price ed
2. Biology - Davidson
3. “Evolution” by D. J. Futuyma.
4. “Ecology-Principles and Applications” by Chapman and Reiss Cambridge
5. “Developmental biology” by Scott Gilbert
6. “Animal Physiology”, Hill R, Wise G A & Anderson M Sinauer.
7. “Plant Physiology” Taiz & Zeiger Sinauer.
8. “Molecular biology of the Cell” by Albert et.al
9. Biodiversity
10. Verma PS, Agarwal V.K. Cell Biology, Genetics, Evolution and Ecology. S.chand & Co.

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Semester I

Paper 16015: Cell Biology

UNIT I:
Cell Theory and the Cell: Discovery of cell and the cell theory, exceptions to the cell theory. Cell structure – bacteria, plant and animal cell. Structural differences between prokaryote and eukaryotic cells and plant and animal cells.

UNIT II:
Membrane structure and function – Structure of model membrane, lipid bilayer and membrane protein diffusion, osmosis, ion channels, active transport, ion pumps, mechanism of sorting and regulation of intracellular transport, electrical properties of membranes.

UNIT III:
Structural organization and function of intracellular organelles: Cell wall, nucleus, mitochondria, Golgi bodies, lysosomes, endoplasmic reticulum, peroxisomes, plastids, vacuoles, chloroplast, structure & function of cytoskeleton and its role in motility.

UNIT IV:
Organization of chromosomes: Structure of chromatin and chromosomes, organization of chromosomes in eukaryotes and prokaryotes, unique and repetitive DNA, heterochromatin, euchromatin, tranposons. **Cell division and Cell cycle:** Mitosis and meiosis, their regulation, steps in cell cycle, and control of cell cycle.

References:

1. De Robertis and De Robertis. Cell and Molecular Biology, Lipncott Williama and Wilkins.
2. P.K.Gupta. Cell and Molecular Biology. Narosa Publisher.
3. Verma PS, Agarwal V.K. Cell Biology, Genetics, Evolution and Ecology. S.chand & Co.
4. Bruce Alberts. Essential cell biology an introduction to Molecular Biology of the Cell. Garland
5. Cooper – Introduction to The Cell.

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Semester II

Paper 26015: Biodiversity and Ecological principles

Unit I:
Biodiversity: Introduction, definition, levels of biodiversity, magnitude and distribution of biodiversity, methods for biodiversity monitoring, megadiversity zones and hot spots.

Unit II:
Natural history of Indian subcontinent: Biodiversity at global, National and local levels. Major habitat types of the subcontinent, geographic origins and migrations of species; common Indian mammals, birds; seasonality and phenology of the subcontinent. Organisms of health and agricultural importance: Common parasites and pathogens of humans, domestic animals and crops.

Unit III:
Biodiversity conservation: Threats to biodiversity: habitat loss, poaching of wildlife, man-wildlife conflicts. Endangered and endemic species of India. IUCN threat categories, Red data book. Strategies for biodiversity conservation: Principles of biodiversity conservation, in-situ and ex-situ conservation strategies. Biodiversity act.

Unit IV:
Ecology: Environment, concept of habitat and niche, ecological succession, concept of climax. Ecosystem – structure and function, energy flow, structure and functions of some Indian ecosystems: terrestrial (forest, grassland) and aquatic (fresh water, marine, estuarine). Biogeography.

References:

1. Raven P.H.et al. (2006) Biology 7th edition Tata Mc Graw Hill Publishers, New Delhi.
2. Mauseth, James.D (2003) Botany: An introduction to plant biology. 3rd edition Jones and Bartlett Publishers.

YOGI VEMANA UNIVERSITY
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Semester III

Paper 36015: Principles of Microbiology

Unit I:
Historical introduction - Discovering the Microbial world and developments in Microbiology, origin and evaluation of microbes, Scope of Microbiology and Importance of microorganisms to human welfare. Principles of physical, chemical, and mechanical sterilization methods, antimicrobial compounds.

Unit II:
Classification – Basics of microorganisms classification (Hackle and Whittakar Kingdom concepts, Bergey's manual), General and distinctive characteristics of the major groups of Microorganisms – Bacteria, mycoplasma, actinomycetes, fungi and protozoa. Ultra structure of bacteria. Cell wall structure and staining techniques, Microscopy – light and electron microscopy

Unit III:
Isolation and characterization of common microorganisms – bacteria, cyanobacteria, fungi. Direct and indirect methods of maintenance and of cultures. Preservation of microbial cultures (glycerol stocks, oil overlay, drying and freeze- drying). **Viruses:** Nature, properties and classification of Viruses. Viruses of Plants, animals and microorganisms. Morphology, size, ultra structure and life cycles of some representative viruses - TMV, T4, Lambda, HIV and SV40, Prions, Viroids.

Unit IV:
Nutritional requirements – mode of nutrition – Phototrophy, chemotrophy, symbiotic and parasite microorganisms. Saprophytes; symbiotic and parasitic modes of nutrition. Types of media – basal, defined complex, enrichment, selective, differential, maintenance and transport media. Cell growth and kinetics of bacterial growth, Normal and biphasic growth curve, batch and continuous cultures,

References:

1. Microbiology: concepts and Applications. Michael J. Pelczar, Jr., E.C.S., Chan, Noel R. Krieg, 1993. Mc. Graw Hill, Inc.
2. Fundamentals of Microbiology. 4th ed. 1994. I.E. Alcamo. Scientific Publication.
3. Microbiology, 1990. 4th Ed.B.D. Davis, R. Dulbeco, H.N. Eisen and H.S. Ginsberg and J.B. Lippincott Company.
4. Fundamental Principles of Bacteriology. 1994. A.J. Sake. Tata McGraw Hill.
5. Microbiological Applications: A Laboratory Manual in General Microbiology. 5th ed. 1990. H.J. Benson. Panama Publications. PP 459.
6. Microbiology Prescott et al., Wm. C. Brown Publications

YOGI VEMANA UNIVERSITY
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Semester IV

Paper 46014: Introduction to Bioinformatics

Unit I:
Basics of Internet: Internet, Applications, World Wide Web. Elementary commands and protocols used in Bioinformatics.

Unit II:
Introduction to Bioinformatics: Definition, history and development of Bioinformatics, Aim and Scope of bioinformatics, Branches of bioinformatics, Applications of Bioinformatics.

Unit III:
Biological data bases: Definition, types of data bases, primary data bases - nucleic acid, proteins, Secondary data bases - PROSITE, PRINTS, BLOCKS, P-FAM. Specialized data bases – SCOP, CATH, KEGG, EXPASY, NRDB, OWL, Data retrieval.

Unit IV:
Sequence Alignment: Definition, local and global alignments, pair-wise, multiple sequence alignment. Phylogenetic analysis - definition, softwares used in phylogeny.

References:

1. Essential bioinformatics by C.S.V. Murthy
2. Basic concepts are bioinformatics by P. Goutham
3. Introduction to Bioinformatics by T.K. Attwood and D.J. Parry Smith.

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Semester IV

Paper 46015: Biomolecules

Unit I:
Chemical foundation of biology – pH, pK, acids, bases, chemical bonding, properties of water. **Carbohydrates** – Classification, structure and properties of carbohydrates, mono (glucose, galactose, fructose) di (lactose, maltose, sucrose), polysaccharides (starch, glycogen, cellulose). Mucopolysaccharides. **Lipids** –Classification. Structure and biological functions of fatty acids, triacylglycerols, phospholipids, steroids. Physico-chemical properties and analysis of fats and oils. Structure and functions of prostaglandins, leukotrienes, thromboxanes.

Unit II
Amino acids – Classification, structures and physicochemical properties. Peptides – Peptide bonds, naturally occurring peptides. **Proteins** – Classification, properties, functions, Isolation and purification of protein, criteria of homogeneity. Primary structure of proteins and its sequence determination.

Unit III
Secondary (alpha, beta, random coils, Ramachandran plot), tertiary and quaternary structural features of proteins, Forces responsible for protein stability. Structural organization of globular (myoglobin, hemoglobin), fibrous proteins (collagen, keratins, silk fibroin). Denaturation and renaturation of proteins, chaotropic agents. Structure and functions of glycoproteins and lipoproteins.

Unit IV
Nucleic Acids – Structure of purines, pyrimidine, nucleosides, and nucleotides. Structure, properties and functions of nucleic acids (DNA, RNA). Different forms of DNA and RNA. t-RNA and Micro RNA. Denaturation and renaturation of nucleic acids, cot curves. The law of DNA constancy and C value paradox. **Vitamins** – classification structures and functions.

References:
1. Principles of Biochemistry. A.L. Lehninger, Nelson and Cox. (C.B.S., India).
3. Principles of Biochemistry General Aspects. 1983 by Smith *et al*., (McGraw Hill).
4. Biochemistry (2nd edition) by Donald Voet and Judith Voet.
5. Biochemistry (4th edition) by L. Stryer (Free man).
6. Textbook of Biochemistry with Clinical Correlation by Thomas M. Devlin.
7. Biochemistry by Zubay.
8. Nucleic acid Biochemistry and Molecular Biology by Main Waring *et al*., (Blackwell).

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Semester IV

Practical 46012P: Microbiology & Introduction to Bioinformatics

1. Rules and regulations of Microbiology Laboratory
2. Sterilization
3. Preparations of Media
4. Simple staining
5. Gram staining
6. Motility test for Microorganisms from soil by Hanging –Drop method
7. Preparations of slant and stab cultures
8. Isolation and Maintainance of microorganisms
9. Enumeration of microorganisms from soil
10. Enumeration of microorganisms from water
11. Enumeration of microorganisms from air
12. Slides:
13. NCBI
14. Data bases – GenBank, DDBJ, EMBL
15. Data retrieval
16. BLAST
17. FASTA
18. CLUSTAL W
19. PHYLIP

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Semester IV

Paper 46013P: Biomolecules

1. General reactions of amino acids and sugars to identify the unknown solutions
2. Preparation of buffers
3. Isolation and estimation of glycogen from liver
4. Isolation and estimation of Cholesterol from brain
5. Preparation of lecithin
6. Estimation of proteins by Biuret, modified Lowry, UV methods and Bradford method.
7. Estimation of amino acids by ninhydrin method.
8. Estimation of glucose by glucose oxidase/Nelson-Somagyi method
9. Titration curve of an amino acid and calculation of pK and pI values.

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Semester V

Paper 56011: Biochemical and Biophysical tools

Unit – I: PH Determination . Measurement of PH, biochemical buffers, oxygen electrode and biosensors. Cell disruption methods: French press, sonication, freeze-thaw techniques, enzymatic method, use of liquid nitrogen in cell disruption. Centrifugation. Basic principles of sedimentation, types of centrifuges and rotors. Preparative ultracentrifugation - differential centrifugation, density-gradient. Analytical ultracentrifugation and applications.

Unit – II: Separation methods - General principles and definitions. Methods based on polarity. Partition chromatography (Paper chromatography), adsorption chromatography (thin-layer chromatography), gas-liquid chromatography, reverse phase liquid chromatography. Methods based on size - Principle of Gel filtration, methodology and applications. Methods based on affinity - Principle of Affinity chromatography, methodology and applications. High-performance liquid chromatography - Principle, instrumentation, practical procedure and applications. HPTLC, Ion-exchange chromatography - Principle, ion exchangers, methodology, applications. Amino acid analyzer.

Unit – III: Electrophoresis. General principles and definitions. PAGE . Native-PAGE, SDS-PAGE, Isoelectricfocussing, 2D electrophoresis, capillary electrophoresis. Agarose gel electrophoresis - Preparation, separation and determination of molecular size of DNA, Pulse-field gel electrophoresis - Principle, methodology and applications.

Unit – IV: Biophysical methods: Principles, laws of light absorption, Instrumentation and applications of UV-Vis spectrophotometer, fluorescence spectroscopy, ESR, NMR, Mass spectroscopy, Radioisotope Techniques - Types of isotopes, radioactive decay. Detection and measurement of radioactivity - GM counter, scintillation counter, autoradiography. Incorporation of radioisotopes in biological tissues and cells, CD and ORD. Principles and applications of X-Ray diffraction.

References:

1. Biochemical methods - Pingoud
2. Biochemical research technique. Ed. John M. Wriggles worth
3. Analytical biochemistry by David J. Holmes and Hazel peck
4. Biophysical chemistry Upadyay and Nath
5. Practical experimental Biochemistry – Rodney Boyer.
6. Practical biochemistry: Principles & Techniques. Wilson & Walker,

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Semester V

Paper 56012: Molecular Biology

Unit I:
DNA replication, repair and recombination: Evidence of DNA as genetic material, Evidence of semi conservative mode of replication, Unit of replication, enzymes involved, Replication origin and replication fork, fidelity of the replication, Replication mechanism in E.coli, extrachromosomal replicons, Replication apparatus and mechanism of DNA replication in eukaryotes, DNA damage and repair mechanisms. Recombination – Homologous, site-specific and transposition.

Unit II:
Transcription: RNA synthesis and processing: RNA synthesis in prokaryotes - Transcription factors and machinery, formation of Initiation complex, transcription activators and repressors, RNA polymerases, capping, elongation and termination, RNA synthesis in eukaryotic cell – RNA polymerases, RNA synthesis, RNA processing, RNA editing, splicing, polyadenylation, structure and function of different types of RNA, RNA transport.

Unit III:
Translation: Protein synthesis and processing: Ribosome, formation of initiation complex, initiation factors and their regulation, elongation and elongation factors, termination, genetic code, aminoacylation of tRNA, tRNA-identity, aminoacyl tRNA synthetase, translational proof reading, Mechanism of protein biosynthesis in E.coli, translational inhibitors, post- translational modification of proteins.

Unit IV:
Gene regulation: Principles of gene regulation, Operon concept, structure, function and expression of lac, trp, ara in E.coli and gal operon in yeast. Induction of transcriptional activity by environmental and biological factors in regulation of eukaryotic gene expression (hsp), light (Rubisco), signal molecules. Molecular control of transcription - DNA sequence and protein involved in the control of transcription in eukaryotes. Role of chromatin in regulating gene expression and gene silencing.

References:

1 Molecular Biology of the Gene (4th Edn) JD Watson, NH Hopkins, JW Roberts,
2 Molecular Cell Biology (2nd Edn) J. Darnell, H.Lodish and D. Baltimore, Scientific American Books, Inc. USA 1994
3. Genetics – Conceptual approach, Benjimin Pierce
5. Molecular Biology, TA Brown (Ed) Bios Scientific Publishers Ltd.,Oxford, 1991

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Semester VI

Paper 56013: Enzymology and Bioenergetics

Unit I: Enzyme Definition, general properties, IUB nomenclature and classification of enzymes. Nature of enzymes, active site, coenzymes, cofactors, assay of enzyme, units of enzyme activity. Kinetics of enzyme catalyzed reaction - Michaelis-Menten equation Determination of Vmax, Km, Kcat, and their significance. Factors affecting on enzyme activity. Mechanism of enzyme catalysis.

Unit II: Enzyme inhibition – Reversible and irreversible. Competitive, non-competitive and feed-back enzyme inhibition, enzyme poisoning. Enzyme regulation – Allosteric modification, covalent modification, zymogens activation. Isoenzymes (LDH), Multienzyme complexes, Multifunctional enzymes, Modern concepts of evolution of catalysis – ribozymes, Abzymes

Unit III: Bioenergetics: Concept of free energy, thermodynamic principles in biology. Free energy changes in biological transformations in living systems. High energy compounds, Biological Oxidation-Reduction Reactions, Components and organization of mitochondrial electron transport system (experimental approach). Classes of electron-transferring enzymes, inhibitors of electron transport. Oxidative phosphorylation and ATP synthesis. Uncouplers, Regulation of Oxidative Phosphorylation,

Unit IV:
Photosynthesis: Light harvesting complexes; mechanisms of electron transport; Mechanism of photosynthesis. Plant mitochondrial electron transport and ATP synthesis, alternate oxidase.
Secondary metabolites of bacteria, fungi and plants – Types, structures, properties and functions.

References:

1. Lehninger's Biochemistry2008 Nelson and Cox CBS India.
2. Harpers Illustrated Biochemistry 28th Edition. Longman
3. T B Biochemistry Clinical relations – Thomas Devlin 2005
4. Outlines of Biochemistry By Cohn and Stumf
5. Biochemistry by Zubay.
6. Principles of Biochemistry General Aspects. 1983 by Smith *et al*., (McGraw Hill).
7. Biochemistry (2nd edition) by Donald Voet and Judith Voet.
8. Biochemistry (4th edition) by L. Stryer (Free man).

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Semester V

Paper 56014: Biocomputing

UNIT – I: Introduction to Unix: Listing files and directories, Making Directories, Changing to a different Directory ,More about home directories and path names, Copying Files Moving Files, Removing Files and directories, Displaying, Searching the contents of a file on the screen Redirecting the input, Output ,File system security (access rights), Changing access rights, Processes and Jobs .

UNIT – II: Basics of HTML: The web browsers in use, the use of hypertext, how to design a web page using web documents, what Hyper text Markup language is and is not, the HTML Elements, format of HTML text, Rules for the HTML language.
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UNIT – III: Object oriented Programming Fundamentals: Java Features, Object oriented programming concepts: Abstraction, Encapsulation, and Polymorphism.
Java Fundamentals, Objects, References, Constructors, Nested and inner classes, abstract classes. Inheritance, threading and their types. Applet programming & packages

UNIT – IV: Bio PERL: Introduction to PERL, Starting a PERL script & data types, scalaras, arrays & hashes using bio PERL. Accessing sequence data from local and remote data banks & accessories remote data base.

Reference Books:
UNIX: Concepts and applications by sunitha dass.
HTML: Web enablead commercial applicatons Development using HTML,DHMFL,PERL CGI by Bagross ivan
JAVA:1.Balaguruswamy:Programming with java,(TMH)
2.Thamus Wu:An introduction To Object Oriented programming with java
3.Dietel & Dietel:java2 How to Program

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Semester V

Paper 56015: Genetics

Unit I:
Mendelian principles: Dominance, segregation, independent assortment, deviation from Mendelian inheritance. **Concept of gene:** Allele, multiple alleles, pseudoallele, complementation tests. **Extensions of Mendelian principles:** Codominance, incomplete dominance, gene interactions, pleiotropy, genomic imprinting, penetrance and expressivity, phenocopy, linkage and crossing over, sex linkage, sex limited and sex influenced characters.

Unit II:
Gene mapping methods: Linkage maps, tetrad analysis, mapping with molecular markers, mapping by using somatic cell hybrids, development of mapping population in plants. **Extra chromosomal inheritance:** Inheritance of mitochondrial and chloroplast genes, maternal inheritance.

Unit III:
Microbial genetics: Methods of genetic transfers – transformation, conjugation, transduction and sexduction, mapping genes by interrupted mating, fine structure analysis of genes. **Human genetics:** Pedigree analysis, lod score for linkage testing, karyotypes, genetic disorders. **Quantitative genetics:** Polygenic inheritance, heritability and its measurements, QTL mapping.

Unit IV:
Population Genetics - Gene pool and gene frequencies: Hardy-Weinvberg principle. **Mutation:** Types, causes and detection, mutant types – lethal, conditional, biochemical, loss of function, gain of function, germinal verses somatic mutants, insertional mutagenesis. **Structural and numerical alterations of chromosomes:** Deletion, duplication, inversion, translocation, ploidy and their genetic implications. **Recombination:** Homologous and non-homologous recombination, including transposition, site-specific recombination.

Reference books:

1. Genetics ; From Genes to Genomes by Hartwell I.H. etal (2000) McGraw Hill
2. Human Molecular Genetics by Sudbery P (1998). Addison – Wesley Longman Harbor.
3. Gene VIII & IX by Benjamin Lewin, Odford University press, Oxford.
4. Genetics and Analysis of Quantitative traits by Lynch. M and B. Walsh (1997). Senauer Associates, Sunderland.
5. Evolutionary Genetics by Maynard Smith J (1989), Oxford University press.
6. Genes in Population by Spiess. E (1989) 2nd Edition. Wiley-Liss, New York.

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Semester V

Practical 56011P: Biochemical and Biophysical tools

1. Preparation of buffers and measurement of pH
2. Separation and identification of amino acids by paper chromatography.
3. Separation and identification of sugars by TLC.
4. Separation and identification of lipids by TLC.
5. Separation of amino acids by Ion-exchange chromatography.
6. Separation of proteins by Gel filtration
7. Absorption spectra of amino acids, Proteins and nucleic acids
8. Verification of Beer's law.
9. Dialysis.
10. HPLC demonstration
11. Isolation of mitochondria by subcellular fractionation.
12. SDS PAGE
13. Agarose gel electrophoresis

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Semester V

Practical 56012P: Biocomputing and Genetics

1. Operation of Unix commands
2. Solving biological problems using Bioperl
3. HTML usage in web design
4. Genetics problems from theory
5. Estimation of gene frequencies and testing equilibria at loci with two alleles – multiple and sex linked genes
6. Testing Hardy-Weinberg equilibrium for two linked loci
7. Calculation of inbreeding coefficient from pedigree data
8. Effects of mutation and selection on gene frequency
9. Problems on genetic drift and effective population size.
10. Genetics problems

YOGI VEMANA UNIVERSITY
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Semester V

Practical 56013P: Enzymology and Molecular biology

1. Assay of trypsin
2. Assay of alpha-amylase from saliva
3. Assay of LDH from serum
4. Assay of acid and alkaline phosphatase
5. A preparation of urease crystals from horsegram seeds and assay
6. Purification of an enzyme and effect of time pH, temperature, substrate concentration, enzyme concentration, inhibition on enzyme activity.
7. Molecular weight determination of enzyme by SDS - PAGE
8. Mitochondrial respiration by oxygraph (O_2 electrode)
9. Warburg Manometer
10. Isolation of genomic DNA from bacteria, plant and sheep liver
11. Determination of purity of the isolated DNA by UV spectrophometry
12. Quantification of DNA
    . Spectroscopic method (UV absorption method)
    . Colorimetric method (Diplhenylamine reagent)
13. Thermal denaturation of DNA and demonstration of hyperchromic effect.
14. Determination of melting temperature (Tm) and estimation of GC content.
15. Isolation of RNA and estimation of RNA.
16. Isolation of plasmids from *E.coli* and separation of CCC, Open circular and linear forms of plasmids
17. Agarose gel electrophoresis – Separation and molecular size determination of DNA
18. Isolation and separation of proteins by SDS- PAGE

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Semester VI

Paper 66011: Immunology

UNIT – I

History and scope of immunology, structure, composition and function of cells and organs involved in immune system. Immune response (humoral and cell mediate) Types of immunity, innate immunity, acquired immunity; immunohematology, blood groups, blood transfusion and Rh – incompatibility, phagocytes, inflammation, and extra cellular killing. **Antigens – Antibodies:** Antigens – structure and properties – types (Iso and allo) haptens, adjuvants, antigenic specificity. Membrane receptors for antigens; Immunoglobulins, structure – heterogeneity – types and sub types properties (physico chemical and biological); theories of antibody – production, polyclonal, monoclonal and recombinant antibodies and their applications.

UNIT – II

Antigen and Antibody interactions: Invitro methods – Flocculation, Precipitation, Immuno diffusion, Agglutination Phagocytosis Opsonization, Neutralization, Complement fixation. Immuno electrophoresis, Immunoflorescence. RIE, CIE, RIA, ELISA. Complement system; complement components, complement activation, regulation of complement system, biological consequences and pathways of complement activation, and complement deficiencies.

UNIT – III

Structure and functions of MHC and the HLA system; gene regulation and r – genes; HLA and tissue transplantation – tissue typing, methods for organ and tissue transplantations in humans; graft versus host reaction and rejection. Auto immunity, autoimmune diseases and their treatment, tumor immunology–tumor specific antigens, immune response to tumor, immunodiagnosis of tumors, immunodeficiency of tumor, immunoprophylaxis, Immunotherapy of tumors, alphafeto-protein, carcino embryonic antigen, genetic control of immune response.

UNIT – IV

Hypersensitivity reactions: Antibody–mediated–type I. Anaphylaxis; type II Antibody dependent cell cytotoxiciy; Type III Immune complex mediated reactions; type IV cell mediated hypersensitivity reactions (the respective diseases, immunological methods of their diagnosis, lymphokines and cytokinines, their Assay methods. **Immunization:** Active and passive immunization**;** objectives of immunization, immunotherapy, cytokines inter–leukins, immunotherapy, types of vaccines: whole organism vaccines, recombinant vector vaccines, DNA vaccines, synthetic peptide vaccines, recombinant vector vaccines, DNA vaccines, subunit vaccines, immunization procedures, adverse reactions to vaccines.

Ref: Kuby immunology

YOGI VEMANA UNIVERSITY
5 years Integrated *M. Sc.*, Biotechnology and Bioinformatics
Semester VI

Paper 66012: Genetic engineering

Unit I:
Introduction and outlines of gene cloning**,** isolation and purification of RNA & DNA. Different enzymes used in rDNA technology, Restriction and modification enzymes – Classification, nomenclature and importance, Restriction mapping. RFLP, Polymerase chain reaction – Principle, variations of PCRs (RT PCR, QPCR, inverse PCR, nested PCR) and their applications. RAPD, AFLP, DNA fingerprinting. DNA sequencing – Maxum-Gilbert, Sanger and automated.

Unit II:
Host cells and Vectors - Characteristics of a vector. Vectors used for cloning in *E.coli* (plasmid vectors – pBR, pUC, Bluescript vectors, bacteriophages, cosmids, phasemids), Super vectors - BACs, YACs, shuttle vectors, higher plants (Ti plasmid, caulimovirus) and animal cells (constructs of SV 40 and retroviruses). Baculovirus vectors. Expression vectors.

Unit III:
Cloning strategies: Preparation of genomic and cDNA libraries. Generation of DNA molecules, Cloning from mRNA, Cloning from genomic DNA, Joining of DNA fragments to vector molecules - cohesive termini ligation and blunt end ligation - linkers, adaptors and homopolymer tails, delivery of recombinant molecules into host cells – transformation, transfection; Agrobacterium mediated transformation, electroporation, particle bombardment method. Screening and identification of positives clones-antibiotic, nucleic acid and protein based approaches.

Unit IV:
Expression of cloned genes, IPTG, x-gal, lac, taq promoters. Factors influencing the expression of recombinant proteins. Expression of fusion protein tags (his tags), purification tags, inducible expression systems – inclusion bodies and solubilization of proteins. Production of recombinant insulin, growth hormone. Genetically engineered organisms.

References:
1. An Introduction to genetic engineering - Nicoll
3. Molecular Cloning: A Laboratory manual, J. Sambrook, E.Ffrisch and T.Maniatis, Old Spring Harbor Laboratory Press New York, 2000
4. Introduction to Practical Molecular Biology, P.D. Dabre, John Wiley & Sons Ltd,
5. Genetic engineering - TA Brown (Ed)
6. From Genes to Genome – Dale
7. Principles of gene manipulation – Primrose et al.

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5 years Integrated *M. Sc.*, Biotechnology and Bioinformatics
Semester VI

Paper 66013: Intermediary metabolism

Unit-I
Introduction to intermediary metabolism, Glycolysis and its regulation. Fermentation. HMP shunt pathway and its significance. Glucuronic acid pathway and ascorbic acid pathway. TCA cycle - reactions of the TCA cycle and regulation. Anaploretic reaction. Shuttle systems, glyoxylate cycle. Gluconeogenesis and regulation. Glycogen metabolism and regulation. Disorders of carbohydrate metabolism- glycogen, Lactose, Galactose and fructose.

Unit -II
Lipid digestion, absorption and transport. Oxidation of fatty acids - oxidation of unsaturated, odd-chain fatty acids, peroxisomal oxidation. Regulation of fatty acid oxidation. Degradation of triacyl glycerol and phospholipids. Ketone bodies - Formation and utilization. Fatty acid synthase complex, biosynthesis and regulation of fatty acid synthesis. Biosynthesis of TAG and its regulation. Sphingolipid storage diseases. Biosynthesis of cholesterol and its regulation, Biosynthesis of prostaglandins.

Unit - III
General metabolic reactions of amino acids. Urea cycle and its regulation. Metabolic breakdown of individual amino acids. Ketogenic and glucogenic amino acids; Biosynthesis and regulation of aspartate family amino acids, branched chain amino acids, Metabolic defects of amino acid metabolism. Amino acids as biosynthetic precursors - formation of creatine, serotonin, melatonin, histamine, anserine, carnosine. GABA, melanin, catecholamine.

Unit IV
Biosynthesis and degradation of porphyrin (Heme). Biosynthesis, degradation and regulation of purine and pyrimidine nucleotides, Salvage pathway. Disorders of purine and pyrimidine metabolism.

References:
1. Principles of Biochemistry. A.L.Lehninger(CBS Publishers).
2. Biochemistry. Lubert Stryer (5th Edition).
3. Principles of Biochemistry. General aspects . Smith et al., (8th edition).
4. Harper.s Review of Biochemistry. Martin et al., (Lange).
5. Text Book of Biocehmistry with clinical correlation. Thomas M.Devlin (John Wiley).
6. Text Book of Biochemistry. West et al., 1966 (MacMillian).
7. Biochemistry 2nd ed. C.K.Mathews and K.E.Van Holde (1995).
8. Biochemistry 2nd ed Donald Voet and J.G.Voet (1994)(John Wiley).

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Semester VI

Paper 66014: Computational Molecular Biology

UNIT– I: The central dogma in molecular biology-the killer application, Parallel universes, top-down verses bottom-up, information flow from data to knowledge. Data management in bioinformatics – strategies & their limitations.

UNIT – II: Data lifecycle-creation, acquisition, modification, archiving. Biological data integration- specifications, technical approaches, development process, nature of biological data, data sources in life science, approaches to integrate data bases & scientific algorithms, ontology.

UNIT–III: Data Mining Techniques - knowledge discovery process. Data mining methods, technology overview, infrastructure, pattern recognition, machine learning technologies, Text mining - Text summarization, tools. Bioinformatics problems related to data-mining e.g Secondary protein structure prediction, protein – protein interactions.

UNIT – IV: Intermolecular interactions & biological pathways: Introduction, pathway and molecular interaction databases - primarily molecular interaction databases (e,g BIND, DIP). Primarily metabolic pathway databases – KEGG, ECOCYC. Prediction algorithms for pathways and interactions – methods to predict protein-protein interactions.

Reference Books:

Bioinformatics-A Practical guide to the analysis og genes & proteins by Andres D. Baxevnes B.F. Francis Ouellette
Advanced Data Mining Technologies in Bioinformatics – Hui- Huang Hsu.
Bioinformatics Managing scientific data by Zoe Lacroix, Terence Critchlow.
Bioinformatics computing by Bryan Bergeron,M.D.

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Semester VI

Paper 66015: Plant Biotechnology

Unit I: Introduction to cell and tissue culture. Tissue culture media. Initiation and maintenance of callus and suspension culture. Organogenesis, somatic embryogenesis. Shoot-tip culture: rapid clonal propagation and production of virus-free plants. Embyo culture and embryo rescue. Anther, pollen, ovary, ovule, nucellus culture, Endosperm culture for production of haploid plants and homozygous lines. Protoplast isolation, culture and fusion, selection of hybrid cells and regeneration of hybrid plants, symmetric and asymmetric hybrids, cybrids. Cryopreservation.

Unit II : Plant Transformation Technology, Vector mediated or Indirect gene transfer (Agrobacterium-mechanism of T-DNA transfer and its integration into plant genome,basis of tumor formation ,role of virulence gene, use of Ti and Ri plasmids as vectors), Direct Gene transfer-microinjection, electroporation, particle gun, Choloroplast transformation and applications Gene silencing. Nitrogen fixation and biofertilizers (nitrogen fixation genes, transfer of *nif* genes to microorganisms).

Unit III: Application of Plant Transformation for Productivity and Performance-Herbicide Resistance, Male sterility, Virus resistance, Pest Resistance, Fungal resistance. Genetic Engineering of plant for extended shelf life of fruits, manipulation of starch biosynthesis. Terminator technology, plantibodies.

Unit IV: Introduction to molecular markers, different types-PCR based and Non PCR based, role of molecular marker in plant breeding, types of maps-physical and genetic map, applications of molecular markers in plant biotechnology. phytodiagnostics based on immunological and molecular techniques, biopesticides, transgenic plants as biofactories-biodegradable plastics, therapeutic proteins

References:

1. Molecular approaches to crop improvement. 1991. Dennnis and Liwelly eds. PP. 164.
2. Plant cell and Tissue culture. A Laboratory Manual. 1994. Reinert. J. and Yeoman,
3. Plant biotechnology, 1994. Prakash and Pierik. Oxford & IBH Publishing Co.
4. Gene transfer to plants. 1995. Potrykus-I and Spangenberg, G. Des. Springer Scan.
5. Methods in Plant Molecular Biology and biotechnology, 1993.
6. Genetic engineering with plant viruses. 1992. T. Michale. A. Wilson and J.W. Davies.
8. Microalgal Biotechnology. 1988. Borocotizka M.A. and Borocoitzka L.J. Cambridge University Press.

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Semester VI

Practical 66011P: Immunology

1. Staining of blood smear and identification of different lukocytes.
2. Determination of A,B, O and Rh blood groups in humans
3. Identification of primary and secondary lymphoid organs.
4. Recognition of T-cell by rosette formation.
5. Injection of antigen into experimental animals by different routes.
6. Preparation of antigen
7. Electrophoretic study of normal and immune serum - immunodiffusion
8. Isolation and separation of immunoglobulins by gel electrophoresis.
9. Labeling of purified immunoglobulins with enzymes/dyes.
10. Western blotting
11. Different serological tests
    a. Agglutination - Brucella system
    b. Precipitation test - Ring interface and agar gel double diffusion tests.
    c. Immunoelectrophoresis - Counter current and Rocket.
    d. Hemagglutination and Hemagglulination inhibition tests.
    e. Labeled antibody tests - ELISA, Dot ELISA, FAT and Western blotting.
    f. Viral infectivity neutralization test.
12. Cell - mediated immunity tests
    a. Leukocyte migration inhibition test
    b. Opsonic index.

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Semester VI

Practical 66012P: Computational Molecular biology

1. Primary molecular interaction databases
2. Protein- protein interactions analysis.
3. Protein structure prediction.
4. Metabolic pathway databases.
5. Structure analysis.

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Semester VII

Practical 66013P: Plant Biotechnology

1. Preparation of tissue culture media
2. Surface sterilization
3. Organ culture
4. Callus propagation, organogenesis, transfer of plants to soil.
5. Protoplast isolation and culture
6. Anther culture, production of haploids.
7. Cytological examination of regenerated plants
8. *Agrobacterium* culture, selection of transformants, reporter gene (GUS) assays.
9. Developing RFLP and RAPD maps

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5 years Integrated *M. Sc.*, Biotechnology and Bioinformatics
Semester VII

Paper 76011: Genomics

Unit I: Introduction to genomics, genomics and its databases, genome, genome sizes, organization and structure of genomes of viruses, prokaryotes and eukaryotes, organization of organelle genomes. Genome projects – Aims of project, model organisms, Human genome project and its applications. Computational genomics – concepts.

Unit II: Structural Genomics - Concept, genome mapping, genome sequencing, sequence assembly, genome annotation, whole genome sequencing by shotgun approach and sequencing; Analysis of sequence data – ORF, exon/intron boundaries, promoters, expression signals, etc. Gene ontology, phylogenetics. Centres of Genomics -JCSG Center, BSGC Center, MCSG Center, NYSG Center, TBSG Center. Comparative genomics – introduction, comparative genomics of prokaryotes, eukaryotes and organelles.

Unit III: Functional genomics – concepts and applications. Analysis of gene function - gene knockouts, complementation, gene function through protein interactions. Forward genetics, reverse genetics – knock-ins, knock-outs, RNAi technology Mutagenesis as functional genomics tool – T- DNA T- DNA Insertional mutagenesis, transposan (*Ac*/*Ds* and *En*/*Spm*), Genome wide mutation screening - TILLING (Targeted Induced Local Lesion IN Genome) - principle and mechanism. DeALING (Detecting Adducts Local Lesions IN Genome) – principle and experimental approach to identify deletions.

Unit IV: Functional genomics and epigenomics – Activation tagging. GAL4 mediated over expression. Gene expression analysis - traditional sequence based approaches, microarray based approaches. SAGE, SADE and microbead – based expression profiling, Epigenomics – mechanism and applications. *In silico* genomics.

References:

1. Principles of Gene Manipulation and Genomics. 3rd Edition By S B Primerose and R. M. Twyman.
2. A Primer of genome science. 2nd Edition by G Gibson, and S V Muse
3. Essential bioinformatics by Jin Xiong, Cambridge University press.
4. From Genes to Genome by Dale and Schanz.
5. Functional genomics by Hunt and Livesey.
6. Genomics by Arther Lesk.

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Semester VII

Paper 76012: Microbial biotechnology

Unit I: Introduction to Fermentation process
Fermentation – Definition. The component parts of a fermentation process, chronological development of fermentation industry. Fermentors/Bioreactors – types and features. Isolation, preservation and strain improvement of industrially important microorganisms. Media design and sterilization for industrial fermentation. Principles of microbial growth and culture system, scale up, and downstream processing.

Unit II: Immobilized Enzymes
Introduction, definition, applications. Commercial production of enzymes. Methods of immobilization of cells and enzymes. Stabilization of enzymes and cells. Production of amylases, glucose isomerase and proteases. Biosensor – definition, types and applications.

Unit III: Production of products.
A brief outline of process for the production of some commercially important organic acids – citric acid , lactic acid , acetic acid; aminoacids - Glutamic acid , Lysine, aspartic acid; antibiotics – pencillins, aminoglycosides, tetracyclines; Vitamins – Vit $B_{12,}$ Beverages- alcohol, wine and beer. Production of hepatitis B vaccine.

Unit IV: Microbial transformations – types of biotransformation reactions, Steroids and antibiotics transformation. **Introduction to food technology** - Elementary idea of canning and packing. Sterilization and pasteurization of food products. Technology of typical food/food products (bread, cheese, idli, yoghurt). Food preservation. Commercial production of SCP. Production of biogas from biomass.

References:

1. Industrial Microbiology - J.E. Casida
2. Industrial Microbiology – A.H.Patel
3. Microbial biotechnology Glazer and Nikaido 1995
4. Principles o fermentation technology, Stanbury, Whittaker and Hall 1997
5. Prescott and Dunns Industrial microbiology. Reed (Ed)
6. Biotechnology 3 rd edition by john E.Smith . Cambridge low price editions.

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Semester VII

Paper 76013: Animal Biotechnology

Unit I: History and development of animal tissue culture. Application of animal cell culture. Equipment and materials required. Principles of sterile techniques. Sources of tissues, types of tissues. Balanced salt solution. Cell culture media - components of the medium, physical, chemical and metabolic functions of media. Role of serum and supplements, serum-free media, features and specifications of MEM, DMEM, RPMI and Ham's medium. Role of antibiotics in media. Measurement of cell number. Measurement of cell viability and cytotoxicity. Measuring parameters of growth – Growth curves, PDT, Plating efficiency and factors influencing growth.

Unit II: Primary culture – Mechanical and enzymatic desegregation, establishment of primary culture. Subculture - passage number, split ratio, seeding efficiency, criteria for subculture. Cell lines - definite and continuous cell lines, characterization, authentication, maintenance and preservation of cell lines. Contamination - bacterial, viral, fungal and mycoplasma, contamination detection and control. Cell transformation – normal vs. transformed cells, growth characteristics of transformed cells. Viral and chemical-mediated methods of cell immortalization.
Scale-up of animal cell culture – Factors to be considered. Scale-up of suspension cultures - Batch reactor, continuous culture, perfusion systems. Scale-up of monolayer cultures – roller bottles, Nunc cell factory, microcarrier cultures. Organotypic culture, Histotypic culture. Concepts of tissue engineering.

Unit III: *In vitro* fertilization - Concept of superovulation, collection, maintenance, and maturation of oocytes, fertilization of oocytes, Maintenance and assessment of embryos, embryo transfer - Artificial insemination, preparation of foster mother, surgical and non-surgical methods of embryo transfer, donor and recipient aftercare. Animal cloning - concept of nuclear transfer, nuclear reprogramming and creation of Dolly. Stem cells - embryonic and adult stem cells, plasticity and concept of regenerative medicine. Tansgenic animals. Application of transgenic animals. Biopharming, disease models, functional knockouts. Genetherapy - *ex vivo* and *in vivo* gene therapy methods, applications.

Unit IV: Vaccine production. Principles and species suitable for aquaculture. Genetic status of culture stocks. Chromosome manipulations - Production of all male and sterile populations, Pearl culture - pearl producing mollusks, rearing of oysters, nucleation for pearl formation and harvesting of pearls. Probiotics and their significance in aquaculture. Molecular tools for the identification of diseases in aquatic species.

References:

1. Culture of Animal Cells, (3rd Edn) R Ian Fredhney. Wiley-Liss
2. Animal Cell Culture – Practical Approach, Ed. John RW. Masters, Oxford
3. Animal Biotechnology - Ramasamy

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Semester VIII

Paper 76014: Molecular Modeling

Unit I:
Introduction to molecular modeling, Geomatric parameters in proteins, nucleic acids and small molecular systems. Stereochemistry – 3D structures from X-ray-CPK space filling models, Computer models and Calculations, Physical and computer models.

Unit II:
Computer aided molecular design, energy minimization, molecular mechanics, Conformational studies. Molecular dyanamics - concept of molecular dynamics, periodic boundary conditions, salvation, long range electro statistics, numerical integrations, termination criteria, equilibration and production phase, trajectors of RMSD, conformational flexibility and RMSF, High temperature dynamics, Brownian dynamics, Modeling – protein folding, and Docking

Unit III:
Prediction and Visualization of shapes and properties of bio and simple molecules, modeling reaction pathways and animating transition states, Application to conformations and vibrations, Applications of modeling in development of chemical sensors and probes, Study of molecular properties, 2D diagrams, 3D arrangement of atoms in the study of stereochemistry.

Unit IV:
Solving and Building of structures, SHELX program, drawing using Ortep, Rasmol, Chime and crystal office. Software packages in molecular modeling, detailed discussions on GROMACS. Molecular simulation - basic principle and methods

References:

1. Principles of Gene Manipulation and Genomics Third Edition By Richard M.Twyman, Sandy Blackadder Primrose Blackwell Scientific Publications.
2. Introduction to Proteomics - Dunn
3. Computational Modeling of Genetic and Biochemical Networks by James M.Bower and Hamid Bolouri, MIT press.

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Semester VII

Elective 1: Paper 76015: Plant System Physiology

Unit I. Photosynthesis and Respiration & photorespiration: Light harvesting complexes; mechanisms of electron transport; photoprotective mechanisms; CO_2 fixation- C_3, C_4 and CAM pathways. Citric acid cycle; plant mitochondrial electron transport and ATP synthesis; alternate oxidase; photorespiratory pathway.

Unit II. Plant hormones and Secondary metabolites : Biosynthesis, storage, breakdown and transport; physiological effects and mechanisms of action. Biosynthesis of terpenes, phenols and nitrogenous compounds and their roles.

Unit III. Sensory photobiology: Structure, function and mechanisms of action of phytochromes, cryptochromes and phototropins; stomatal movement; photoperiodism and biological clocks.

Unit IV. Stress physiology: Responses of plants to biotic (pathogen and insects) and abiotic (water, temperature and salt) stresses; mechanisms of resistance to biotic stress and tolerance to abiotic stress

References:

1. Plant Physiology- Salisbury & Ross
2. Plant Growth & Development: Hormones and Environment- Srivastava
3. Plant Physiology-Taiz and Zeiger

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Semester VII

Elective 1: Paper 76015: Bacteriology & Virology

UNIT I: Morphological types- cell walls of archaebacteria, Gram positive Gram negative bacteria and L-forms; antigenic properties; capsule types, composition and function., Cell membrane- structure, composition and properties. Structure and function of flagella, cilia, pili, gas vesicles, chromosomes, carboxysomes, magnetosomes, phycobilisomes, nucleoids, spores and cell division. Reserve food materials polyhydroxybuterate, polyphosphate granules, oil droplets, cyanophycin granules and sulfur inclusions.

UNIT II: Salient features and classification of bacteria as per the second edition of ergey's Manual of Systematic Bacteriology .Characteristics, classification and economic importance of major bacterial groups: *Enterobacteriae*, *Rickettsiae*, *Mycoplasma*, *Mycobacteria*, oxygenic and anoxigenic photosynthetic bacteria and actinomycetes (as per First edition of Bergey's manual).

UNIT III: Brief outline on discovery nature and properties of viruses, Chemical composition of viruses, morphology, architecture, principles of symmetry with reference to T4, TMV, Adeno Polio, Influenza, Rhabdo, Reo and HIV. Nucleic acid diversity, sub viral particles, satellite viruses, viroids, virusoids. DI particles and prions. Taxonomy of viruses: classification and nomenclature of viruses, as per ICTV. General methods of detection, Isolation, cultivation, characterization and assay / qualification of plant, animal and bacterial viruses.

UNIT IV: Life Cycles of bacterial viruses; one step growth curve, lytic and lysogenic cycles with reference to T4, λ and φ X 174. Importance of Phages.Replication strategies of viruses (TMV, CaMV.) and animal viruses (Adeno, Influenza, Herpes, SV 40, Hepatitis, and Retro viruses).Transmission management on plant and animal viral diseases (interferon, antiviral drugs, and vaccines).

Reference:

1. Atlas, RM., (1998) Microbiology, Fundamentals and Applications (IIed) Macmillan Publishing Company.
2. A. Balows, A.G. Thuper, M. Dworkes, W. Harder, (1991) The Prokaryotes, K. Schleifer, Springer Verleag, Publ.
3. A. J. Salle A Fundamental principles of Bacteriology Publ.
4. Alan J. Cann (1997). Principles of Molecular virology.(2nd edition).Academic press, California.
5. Bergey's Manual 2nd Ed. "Systemic Bacteriology" 2001-2005

YOGI VEMANA UNIVERSITY
5 years Integrated *M. Sc.*, Biotechnology and Bioinformatics
Semester VII

Practical 76011P: Genetic engineering and Genomics

1. Bacterial culture and antibiotic selection media.
2. Preparation of competent cells.
3. Isolation of lambda phage DNA
4. Agarose gel electrophoresis and restriction mapping of DNA
5. Construction of restriction map of plasmid DNA
6. Cloning in plasmid/phagemid vectors –Selection of positive clones using blue/white colours.
7. Preparation of single stranded DNA template
8. DNA sequencing
9. Gene expression in *E.coli* and analysis of gene product
10. PCR
11. Reporter gene assay (Gus/CAT/b-GAL)
12. Demonstration of blotting methods – Sourthern, northern.
13. Bioinformatics for genome sequence
14. Finding genes in prokaryotic and eukaryotic genomes ORF, contents, signals
15. Searching DNA databases with FASTA and BLAST
16. Multiple sequence alignment

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Semester VII

Practical 76012P: Molecular Modeling

1. Solving and Building of structures
2. Protein structure modeling
3. Structural prediction through homology modeling, Stereo chemical quality. Drug design. Structure Drawing, Docking.

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5 years Integrated *M. Sc.*, Biotechnology and Bioinformatics

Semester VIII

Practical 76013P: Animal Biotechnology

1. Preparation of tissue culture medium and membrane filtration
2. Preparation of single cell suspension from spleen and thymus
3. Cell counting and cell viabililty
4. Macrophage monolayer from PEC, and measurement of phagocytic activity
5. Trypsinizaation of monolayer and subculturing
6. Cryopreservation and thawing
7. Measurement of doubling time
8. Role of serum in cell culture
9. Preparation of metaphage chromosomes from cultured cells.
10. Isolation of DNA and demonstration of apoptosis by DNA laddering
11. MTT assay for cell viability and growth
12. Cell fusion with PEG

YOGI VEMANA UNIVERSITY
5 years Integrated *M. Sc.*, Biotechnology and Bioinformatics
Semester VIII

Paper 86011: Environmental Biotechnology

Unit I: Environmental pollution and biotechnological methods for management**.** Water pollution and sewage. Microbiology of waste water treatment – aerobic and anaerobic processes, activiated sludge, oxidation ditches, trickling filters, towers, rotating discs, rotating drums, oxidation ponds. Aerobic and Anaerobic microbes. Purification of water by water weeds and membrane filters, reclaim of treated waste water.

Unit II
Pesticides and other pollutants degradation by microorganisms and genetically engineered microbes. Degradation of oil spills and plastics by microorganisms for production of useful products. Recovery of minerals by microbes. Bioindicators of hazardous pollutants, Aquifer (underground water) indicators and mineral indicators. Use of biosources for detecting environmental pollutants and environmental resources.

Unit III
Bioremediation of contaminated soils and water land, Biopesticides in integrated pest management, Biofertilizers (Rhizobial, free living N_2 fixers and Phosphate solubilizing bacteria) and their importance significance and practice. Production of biopesticides and biofertilizers for large scale production. Genetically engineered bacteria in bioremediation of organic pesticides, insecticides, oil spills. Phytoremediation

Unit IV
Microbial leaching – Introduction, organisms for leaching, chemistry of leaching and commercial processes. Genetically engineered microbes in environmental health. Genetically engineered plants and microbes in agriculture and productivity,

Referenes:

1. Microbial Ecology – fundamentals and applications. Atlas and Bartha
2. Environmental Microbiology . Grant and Long
3. Microbial aspects of Pollution. Skyes and Skinner.
4. Microbial Biotechnology – Glazer and Nikaido 1995
5. Biotechnology – A Text Book of Industrial Microbiology – Crueger and Crueger.
6. Concepts in Biotechnology – Balasubramanian, Bryce, Dharmalingam, Green and Jayaraman

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Semester VIII

Paper 86012: Stem cell biology and Regenerative medicine

Unit I Basics of stem cell biology Overview, different types of stem cells, stem cell differentiation, Self-renewal of Stem Cells, Study the factors that generate stem cells and to maintain stem cells in undifferentiated Trafficking of stem cells Asymmetric Cell Division and Cellular Aging, Germ Cell Specification and Pluripotency, Nuclear Reprogramming Unexpected Cellular Plasticity. Stem cell plasticity.

Unit II Stem cell assay protocols and stem cell therapies Isolation of defined stem cell population, Progenitor cell assays, Flow cytometry, cell selection through MAb, Magnetic approaches to cell separation. Stem cell therapies – Clinical applications – neurodegenerative diseases Human embryonic stem cells - Generation of human embryonic stem cell lines; ES cells a tool to study cellular & molecular mechanisms of disease. Use of embryonic stem cells for drug testing

Unit III Regenerative Medicine
Organogenesis Hematopoietic and Vascular Stem Cells ,Mesenchymal and Cardiac Stem Cells Pancreatic and Liver Regeneration , Neural Stem Cells

Unit IV Tissue engineering
Embryonic Stem Cells and Ethics Hematopoietic Stem Cells and Transplantation Cancer Stem Cells ,Cell and Gene Therapy ,Scaffolds for tissue regeneration

References:

1. Nature Insight "Stem Cells," edited by Natalie Dewitt, Nature 414, 87-131, 2001.
2. Cogle, C. *et al.* (2003) An overview of stem cell research and regulatory issues. Mayo Clin Proc 78(8): 993-1003

YOGI VEMANA UNIVERSITY
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Semester VIII

Paper 86013: Proteomics and Protein engineering

Unit I: Introduction to Proteomics - The concept of proteomics, Types of proteomics: Protein expression proteomics, structural proteomics, functional proteomics, applications of proteomics. Structural overview of proteins structures and functions, Protein localization and compartmentalization, Protein structure visualization, protein structure databases, visualization databases and tools, Prediction of secondary, tertiary structures of proteins, protein function prediction and modeling,

Unit II: Tools of proteomics – Technology for protein expression analysis - Protein separation of proteins by 2D electrophoresis – principles, detections, and softwares to handle electrophoretogram, Alternatives of Electrophoresis separation and isolation of protein, Protein digestion techniques. Protein characterization - Mass spectrometry, ESIMS, Tandem MS, MALDI-TOF, QTOF, SELDI, and SALSA. DIGE, SILAC. Mass Spectrometry Protein Identification, Protein Identification through Database Searching, Protein structure analysis - X-ray Crystallography, NMR. CryoEM. Post translational modifications and their predictions through bioinformatics tools. Protein identification through database searching,

Unit III: Functional Proteomics - Protein expression analysis - Protein biochips, Protein microarrays (Ab array, Ag array). Protein - protein Interactions – Phage display, Yeast two hybrid; Protein expression profiling; Protein folding - Chaperones and their role in protein folding. Proteomics approach to protein phosphorylation; protein mining. Making of proteins through rDNA technology - Native and fusion proteins, Yeast expression systems, The baculovirus expression system, Mammalian cell lines.

Unit IV: Protein engineering – Concepts and significance, Methods in protein engineering – Rational design and direct evolution, site directed mutagenesis for specific protein function. Protein engineering of lysozyme, protein engineering of sublitisin, protein engineering - protein design, design of peptide and protein mimics, development of peptide vaccines. Biomarker discovery through proteomics; Pharmaceutical proteomics for drug development.

Reference:

1. Concepts in biotechnology – Balasubramanian
2. Protein Engineering – Moody and Wilkinson.
3. C. Kohner and U L Rajbhandary, Protein Engineering Springer
4. J LCleland and C S Craik. Protein engineering Wiley
5. S Lutz and U T Bornscheuer, Protein enginnering Handbook. Wiley VCH
6. S B Primrose and R M Twyman. Principles of Gene manipulation and Genomics,
7. Principles of proteomics – R M Twyman
8. Principles of proteomics tools for the new biology

YOGI VEMANA UNIVERSITY
5 years Integrated *M. Sc.*, Biotechnology and Bioinformatics
Semester VIII

Paper 86014: Drug design and Targeting

UNIT – I: **Introduction:** History of drug design, Introduction and overview, Drug-receptor interactions/theory, Molecular basis of receptor subtypes, Pharmacogenetics and drug resistence, Molecular Approaches to Drug Mechanism.

UNIT – II: **Drug discovery: technology and strategies:** Introduction, Important parameters for drug discovery, drug discovery technologies, target discovery strategy, strategy to identify possible drug targets, target validation. Structure-based drug design, QSAR and drug design, use of docking program.

UNIT – III: **Structural biology and virtual screening for drug discovery:** Introduction, target identification strategies for screening of drug, predicting functionally important regions from structure, validation and drug ability of targets, virtual high throughput in silico screening. Role of biomarkers in drug development.

UNIT – IV: Targeting Molecular Pathways for Drug Discovery: Targeting signal transduction, Designing receptor antagonists, Designing drugs vs. central dogma targets. Cell cycle target identification and validation, strategies for identification of inhibitors for CDKs. Ion channel drug discovery and technologies. Drugs discovery for cancer and HIV. CADD – Introduction to drug design, drug design approaches, CADD methods, ADME – Tox property prediction.

Reference Books:

1. Greer, J., Eickson, J.W,Baldwin,JJ and Varney,MD..Application of the three-dimensional structures of protein targe molecules in structure- based drug design.
2. Cohen,N.c. Molcular modeling SW and methods for medicinal chemistry.
3. Kuntz, I.D, Meng, EC; and shoichet, BK structure – based Molecular Design.
4. Kanny lal dey :Ingerious drugs of India. Hand book of spectrophotometric data of drugs.
5. Bioinformatics – Methods and applications by Rastogi

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5 years Integrated *M. Sc.*, Biotechnology and Bioinformatics
Semester VIII

Elective 2: 86015: Animal System Physiology

Unit I. Cardiovascular System: Comparative anatomy of heart structure, myogenic heart, specialized tissue, ECG – its principle and significance, cardiac cycle, heart as a pump, blood pressure, neural and chemical regulation of all above.

Unit II. Respiratory system: Comparison of respiration in different species, anatomical considerations, transport of gases, exchange of gases, waste elimination, neural and chemical regulation of respiration.

Unit III. Nervous system: Neurons, action potential, gross neuroanatomy of the brain and spinal cord, central and peripheral nervous system, neural control of muscle tone and posture.

Unit IV. Excretory system: Comparative physiology of excretion, kidney, urine formation, urine concentration, waste elimination, micturition, regulation of water balance, blood volume, blood pressure, electrolyte balance, acid-base balance.

References:

1. C.L. Prosser, Comparative Animal Physiology. W.B. Saunders & Company
2. R. Eckert. Animal Physiology. Mechanisms and Adaptation. W.H. Freeman & Company
3. W.S. Hoar. General and Comparative Animal Physiology
4. Schiemdt-Nielsen. Animal Physiology. Adaptation and Environment. Cambridge
5. C.L. Prosser. Environment and Metabolic Physiology. Wiley-Liss, New York.

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Semester VIII

Elective 2: 86015: Agricultural Biotechnology

Unit I: Production of commercially useful compounds by cell culture Secondary plant products useful to mankid; cultured plant cells and tissues as asource of secondary products; cell line selection and commercial production of pharmaceutically important compounds using cell culture techniques; physical andchemical factors that influence the production of secondary metabolites in vitro; induction of hairy root cultures and their uses; biotransformations using cell culture methods; production and use of biopesticides

Unit II: Molecular aspects of beneficial plant microbe association Types of plant microbe association; symbiotic and other beneficial associations, pathogenic association; Rhizobium plant interaction and biological nitrogen fixation; plant microrhizal association in plant improvement; plant microrhizal and the molecular mechanism of antagonistic process

Unit III: Molecular biology of biotic and abiotic stress Introduction to biotic and abiotic stress; Biotic stresses – viral resistance, bacterial resistance, fungal resistance, insect resistance; Abiotic stresses – drought tolerance, salt tolerance, temperature tolerance, submergence tolerance, photooxidative stress.

Unit IV: Biotechnology for crop improvement Conventional methods for crop improvement; tissue culture in crop improvement; genetic engineering in for increasing crop productivity by manipulation of photosynthesis, nitrogen fixation, nutrient uptake efficiency; Genetic engineering for abiotic stress tolerance; Molecular breeding; plants as bioreactors

References:

1. Principles of plant breeding by Robert W allard
2. Plant cell, tissue and organ cultute Applied and fundamental aspects by Bajaj and Reinhard
3. Plant tissue culture and biotechnology by W Barz

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Semester VIII

Practical 86011P: Proteomics

1. Isolation and purification of protein
2. SDS - PAGE
3. Separation of protein through 2D PAGE
4. Mass spectroscopy MOLDI TOF
5. protein structure prediction by bioinformatics
6. Protein structure prediction and classification
7. Bioinformatics in support of proteomic research
8. Searching protein sequence databases with FASTA and BLAST
9. Protein structure visualization
10. Secondary structure prediction
11. Protein structure prediction. Structure visualization, Secondary structure prediction, Structural prediction through homology modeling,

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Semester VIII

Practical 86012P: Microbial and Environmental Biotechnology

1. Production of alcohol by *S. Cerevisiae*
2. Production of citric acid by *A. niger*.
3. Production of streptomycin by fermentation.
4. Production of wine from grapes.
5. Production of glutamic acid.
6. Production of protease/glucose isomerase by batch fermentation.
7. Preparation of toxoid from a toxin.
8. Immobilization of an enzyme by gel-electrophoresis.
9. Immobilization of whole cells for enzyme/antibiotic production by gel entrapment.
10. Characterization of microbes useful in biodegradable organic matter destruction.

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Semester VIII

Practical 86013P: Drug design

1. Drug –receptor interactions (Molecular docking)
2. Chemo informatics
3. Drug bank-Drug card analysis
4. Protein structure analysis
5. Restriction site analysis
6. Retrieval of Human annotated gene from Entrez database

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Semester IX

Paper 96011: Cell signaling and Cancer Biology

Unit I:
Cell signaling - Intracellular signaling, types of signal receptors - Cytosolic, Nuclear & Membrane bound receptors, Hormones and their receptors, cell surface receptor, signaling through G-protein coupled receptors, Chemo receptors of Bacteria (Attractants & Repellents), signal transduction pathways, secondary messengers, protein kinases, regulation of signaling pathways, bacterial and plant two-component signaling systems, bacterial chemotaxis and quorum sensing.

Unit II
Cellular communication: Regulation of hematopoiesis, general principles of cell communication, cell adhesion and roles of different adhesion molecules, gap junctions, extracellular matrix, integrins, neurotransmission and its regulation.
Host parasite interaction - Recognition and entry process of different pathogens like bacteria, viruses into animal and plant host cells. Pathogen induced diseases in plants and animals.

Unit III:
Cancer - basic concepts, Introduction and Characteristics of Cancer Cells, Types of Tumors, Factors in the development of Cancer, Genetic Alterations in Cancer Cells, modulation of cell cycle in cancer, Causes of Cancer,

Unit IV:
Molecular Basis of Cancer – Genetic rearrangements in progenitor cells, oncogenes, tumor suppressor genes, growth factors. Cancer and the cell cycle, virus-induced cancer, metastasis, interaction of cancer cells with normal cells, Signal transduction mechanisms, telomerase, apoptosis, angiogenesis and metastasis, chemical carcinogens, cancer therapy. Therapeutic interventions of uncontrolled cell growth.

References

1. The Cell by Cooper.
2. Cell and Molecular biology – De Robertis and De Robertis (1998) Waverly Pvt.
3. "Cancer Biology", Raymond W. Ruddon, Oxford University Press
4. Cell & Molecular Biology by Gerald Karp (2nd Ed.) Wiley publishers.
5. The World of the cell by Becker, Reece, Poenie (3rd edition) Benjamin Publishers.
6. Molecular Biology of the cell by Bruce Alberts.
7. The biochemistry of Cell Signalling-Ernst J.M.Helmreich. Oxford Press.
8. The world of Cell. 5th edition- Becker, Kleinsmith, Harden,-Pearson Publishers.

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Semester IX

Paper 96012: Metabolomics

Unit I: Introduction to metabolomics:
Introduction, background and definitions of metabolomics; Why has metabolomics become important? Metabolomics, Endometabolome, Exometabolome; Approaches for metabolomics – targeted and nontargeted. What is a metabolite library? UIUC Metabolomics, Metabolomics –metabolite identification. .

Unit II: Analytical platforms
Spectroscopy – UV-Vis, FT-IR, Raman, NMR (C13, H1, N15), Metabolite isolation and analysis by Mass Spectrometry, Sample preparation (fractionation, enrichment, derivatization), Mass (LC/GC-MS, DIMS, IRMS, MALDI-TOF). Chromatography – Column, TLC, HPTLC, HPLC, FPLC, GC, UPLC.

Unit III: Metabolome Foot printing and Finger printing and metabolic target analysis. Quenching protocols for microbial metabolite profiling. Metabolites and their pathways; KEGG pathways, MetaCyc, The Human Metabolome Databases, Biocart; Computational modeling of metabolic control and pathway simulation.

Unit IV: Prospects
Metabolic pathways discovery and disease characterization; Drug metabolisms and pharmacology; Mining of novel and new metabolites; Environmental sciences and toxicology: Molecular markers and systematics. Integrated analysis of transcriptomics and metabolomics; industrial applications. Nutritional applications

References:

1. Measuring the metabolome: current analytical techniques. Dunn etal (2005).
2. Metabolomics: Methodologies and applications LIN (2006)
3. Metabolome analysis Birkemeyer et al (2005)
4. Metabolomics and system biology Kell (2004).
5. The Handbook of Metabolomics and Metabolomics by John C. Lindon, Jeremy K. Nicholson

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5 years Integrated *M. Sc.*, Biotechnology and Bioinformatics
Semester IX

Elective 3: 96013: Nanobiotechnology

Unit I

Introduction to nanobiotechnology: Definitions, history of nanotechnology; motivation for nanotechnology; nanoparticles, bionanomaterials and their properties; preparation of nanoparticles, calculating the size and concentration of nanoparticles.

Unit II

Nanoparticles fabrication – micro and nanolithocraphy; characterization – structurally (XRD, TEM, SEM, STM, AFM), chemically, optically and transport; outline design of enzyme reactors based on nano-structured materials; Use of biological organisms (biological methods) for nanoparticle synthesis, Magnetotactic bacteria for natural synthesis of magnetic nanoparticles; Viruses as components for the formation of nanomaterials; Role of plants in nanoparticle synthesis.

Unit III

Nanobiotechnology and its advanced biomedical applications covering topics like medical nanorobotics, artificial organ, DNA chip, smart bomb for cancer, nanodiagnostic tool for cancer, treatment nanosystem for heart, nanosurgeries, Nano drug delivery system, nanobiotechnology for HIV virus and its diagnosis and treatment, etc. Nanotechnology for tissue regeneration. DNA based nanomechanical devices.

Unit IV

Nanoparticles as molecular labels and imaging applications. Nanodevices for sensing and therapy. Environmental and safety aspects of bio-nanotechnology and Potential Health Impact of Nanoparticles, Nanosensors, nanobiolistics. Nanotribology, Concept of nanotoxicology.

References

1. Bionanotechnology: Lessons from Nature by David S. Goodsell
2. Nanotechnology by Mark Ratner and Daniel Ratner, Pearson Education.
3. Nanomaterials by A.K. Bandyopadhyay; New Age International Publishers
4. Nanomedicine, Vol. IIA: Biocompatibility by Robert A. Freitas
5. Handbook of Nanostructured Biomaterials and Their Applications in Nanobiotechnology - Hari Singh
6. Nanobiotechnology; ed. C.M.Niemeyer, C.A. Mirkin.

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5 years Integrated *M. Sc.*, Biotechnology and Bioinformatics
Semester IX

Elective 3: 96013: Medical Biotechnology

Unit I: Genetic disease – Chromosomal disorders, gene controlled diseases (autosomal and X-linked disorders, Mitochondrial disorders); identification of disease; functional cloning; positional cloning; candidate gene approach (Marfans, alzeimers); molecular basis of human disease; Genomic imprinting.

Unit II: Microbial Diseases and Host Pathogen Interaction: Normal microbiota; Classification of infectious diseases; Reservoirs of infection; Nosocomial infection; Emerging infectious diseases; Mechanism of microbial pathogenicity; Nonspecific defense of host; Humoral and cell mediated immunity; Vaccinnes; Immune deficiency; Human disease caused by viruses, bacteria, and pathogenic fungi.

Unit III: Chemical Synthesis and oligo nucleotides and PCR reaction in disease, diagnostics and other potentialities. Expression systems and Markers for identification of transformed and transected genes; transient transfection, stable transfection and targeted transformation. Viral markers – diagnostic and therapeutic markers. Markers for evaluation of therapeutic response. Reverse genetics, Random and site directed DNA mutagenesis.

Unit IV: Diagnostics and therapeutics, Prenatal diagnosis – invasive techniques and noninvasive techniques; Diagnosis using protein and enzyme markers. DNA/RNA based diagnosis. Gene therapy; Antisense therapy, protein aptamers, intrabodies. Vectors used in gene therapy. Stem cell therapy, nanomedicine. Strategies for the Expression of therauptic portions and proteins of commercial importance in heterologus systems.
Viral therapies – current targets and candidate drugs for viral infections in humans. Application in molecular medicine – the applications of recombinant viruses. Viral vectors and viral antigens in molecular diagnosis and therapy. Metabolomics and significance.

References:

1. Introduction to Human molecular genetics – Strachen
2. Human genetics molecular evolution – Mc Conkey
3. Principles and practice of Medical Genetics, I,II,III volumes

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5 years Integrated *M. Sc.*, Biotechnology and Bioinformatics
Semester IX

Elective 4: 96014: Bioethics, Biosafety, and IPR

Unit I
Biotechnology and Society – Social, ethical and legal aspects of biotechnology. Implications of biotechnology on health, environment, food and sustainable agriculture.
Beneficial application and development of research focus to the need of the poor, identication of directions for yield effect in agricultural, aqua cultural, bioremediation.

UNIT I
Ethical issues - introduction, causes of unethical acts, ignorance of laws , codes policies and procedures, recognition, friendship, personal gains, ethical decision making ,teaching ethical values to scientist , good laboratory practices, good manufacturing practices, laboratory accreditation. Bioethics and biosafety regulations

UNIT II
Environmental and health aspects of biotechnology – Genetically engineered microorganism – introduction of novel species and natural equilibrium – environmental security and safety – precautionary measures – Genetically modifies foods –health safety, biosafety concern with radioactivity.
Prenatal diagnosis – Genetic screening – surrogate mothers, manipulation of human genome – gene therapy- cloning, technology transfer.

Unit IV
IPR – definition – classification and forms, Rationale for protection of IPRs, importance of IPRs in the fields of science and technology. Patenting – Examples of Patents in Biotechnology. Essential requirements for IPR procedures of filling. Global and Indian Biodiversity Act, Indian Patent Act and their revised versions. Regulatory mechanisms in releasing GMOs. Plant breeders rights, WTO, GATT & TRIPS.

References:

1. Sasson A. Biotechnologies in developing countries present and future, UNESCO publishers, 1993.
2. Singh K. Intellectual Property rights on Biotechnology, BCIL, New Delhi. Gene cloning – Brown
3. Concepts in Biotechnology – Balasubramanyam.D
4. Safety, Moral, Social and Ethical issues related to geneticalls modified foods – Smith J.E.
5. Environmental Biotechnology- Forster and wase

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Semester IX

Elective 4: 96014: Advanced Bioinformatics

Unit I: Medical Informatics: Introduction, origin of Medical informatics, applications of computers in medicine, clinical data bases and models. Tele medicine.

Unit II: Clinical Bioinformatics: Introduction, micro arrayas-computer assisted analysis of signaling pathways, Web based resources for clinical bioinformatics, Developing decision support system for clinical bioinformatics, e-consulting.

Unit III: Immuno informatics: International immuno genetics information system (IMGT)- Introduction. IMGT genome data bases, Web resources, IMGT ontology. Concepts. IMGT choreography.

Unit IV: Allergen bioinformatics: Introduction, Allergen data bases, need for specialized databases, Features of ADB, Allergome, SDAP, Patenting invention in Bioinformatics.

References:

1. Introduction to mathematical methods in bioinformatics – Alexande Isaev
2. Clinical bioinformatics – Ronald J.A. Trent.
3. Immuno informatics – Christain schobasch and Shoba Ranganathan
4. Computational methods in Biomedical research – R. Khattree and D.N. Naik.
5. Bioinformatics by C.S.V. Murthy.
6. Bioinformatics methods and protocols by Stephen Misener & S.A. Kravet

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Semester IX

Elective 5: 96015: Developmental Biology

Unit I
Basic concepts of development: Potency, commitment, specification, induction, competence, determination and differentiation; morphogenetic gradients; cell fate and cell lineages; stem cells; genomic equivalence and the cytoplasmic determinants; imprinting; mutants and transgenics in analysis of development.

Unit II
Gametogenesis, fertilization and early development: Production of gametes, cell surface molecules in sperm-egg recognition in animals; embryo sac development and double fertilization in plants; zygote formation, cleavage, blastula formation, embryonic fields, gastrulation and formation of germ layers in animals; embryogenesis, establishment of symmetry in plants; seed formation and germination.

Unit III
Morphogenesis and organogenesis in animals: Cell aggregation and differentiation in *Dictyostelium*; axes and pattern formation in *Drosophila*, amphibia and chick; organogenesis – vulva formation in *Caenorhabditis elegans;* eye lens induction, limb development and regeneration in vertebrates; differentiation of neurons, post embryonic development-larval formation, metamorphosis; environmental regulation of normal development; sex determination.

Unit IV
Morphogenesis and organogenesis in plants: Organization of shoot and root apical meristem; shoot and root development; leaf development and phyllotaxy; transition to flowering, floral meristems and floral development in *Arabidopsis* and *Antirrhinum.*
Programmed cell death, aging in animals and senescence in plants

References:

1. Animal Embryology

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Semester IX

Elective 5: 96015: Oxidative stress, antioxidant defense in health & disease

Unit I: Chemistry of Oxygen Free radicals – definition, Oxygen radicals – types, mechanism of formation, environmental factors in generation of free radicals. Effect of free radicals on bimolecules – carbohydrates, lipids, proteins and nucleic acids. Oxidative stress related disorders.

Unit II: Free radicals, Oxidative stress and lipid peroxidation -Non enzymatic lipofusion (age pigments) –enzymatic - leukotrienes- mediators of allergy, asthma - Prostaglandins- mediators of inflammation and cancer

Unit III: Oxidative stress and degenerative disorders
-Inflammation
- Chronic respiratory disorders-asthma
- Cardiovascular disease- atherosclerosis
- Neurodegenerative disorders- stroke, Parkinsosn's, Alzheimer's
- Diabetes
- Cancer
- Aging

Unit IV: Antioxidant protection from oxidative damage; enzymatic and nonenzymatic protectants – glutathione, vitamins, minerals. Natural products. Biopharming. Golden rice. Functional food. Neutraceuticals and health.

References

1. Free radical biology

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Semester IX

Practical 96011P: Cancer Biology

1. Identification of cancer cells
2. Cell proliferation assay
3. Cell signaling

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Semester X

Paper 06011: Research methodology and Scientific writing

Unit I

Introduction to research methodology- What is research? Basic and applied research. Significance of Research. Essential steps in research, Literature survey - defining the research problem, Formulation and Validation of hypothesis - Designing experimental techniques and Execution of designed experiments – Data compilation and analysis - Presentation of research findings in graphs or tables - Preparation of technical report/manuscript for publication in peer reviewed scientific journals.

UNIT – II: Design of the experimental programme- variable in the experiments, materials and methods, application of methods. Progress of research – evaluation of results, statistical approach, comparison with existing methodologies, validation of findings, research communications.

Unit III

Scientific writing - Research report, thesis and dissertation, Manuscript/research article, review monographs. Preparation of Manuscript/Dissertation for research proposals. Introduction or review of literature, aims and objectives, Materials and methods, Result analysis – evaluation of results, statistical approach, Discussion and comparison of results, literature citation, bibliography and reference, impact factor of journals.

Unit – IV

Survey of Biotechology Industries in AP/South India visit to industries. Interaction with pharmaceutical industry in Drug designing, production and marketing.

References:

6. Sasson A. Biotechnologies in developing countries present and future, UNESCO publishers, 1993.
7. Singh K. Intellectual Property rights on Biotechnology, BCIL, New Delhi. Gene cloning – Brown
8. Concepts in Biotechnology – Balasubramanyam.D
9. Safety, Moral, Social and Ethical issues related to geneticalls modified foods – Smith J.E.
10. Environmental Biotechnology- Forster and wase
11. Biotechnological Innovations in Environmental Management – Leach and Van Dam-mieras

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Semester X

06011T: PROJECT WORK

Duration of project - 3 months

Students are required to carry out a research project of 3 month duration related to Biotechnology and bioinformatics. Arrangements could also be made to pursue research studies at institutions other than the relevant faculties of Yogi Vemana University. In such circumstances, the student is assigned with two supervisors: an internal supervisor from the panel of teachers and an external supervisor from the institution where the research project is carried out. After completion of project, students have to submit their project dissertation to the Yogi Vemana University, Kadapa and also to be given project viva and presentations in the presence of departmental board and external examiner.

YOGI VEMANA UNIVERSITY
Department of Biotechnology and Bioinformatics

Non-core-1: Introduction to Bioinformatics

Unit I:
What is bioinformatics? Goals of Bioinformatics; Scope of Bioinformatics; Applications and limitations of Bioinformatics. Generation of large scale molecular biology data (through genome sequencing, protein sequencing). Introduction to Internet and internet resources of biology interest.

Unit II:
What is database? Types of databases; General Introduction of Biological Databases;Nucleic acid databases (NCBI, DDBJ, and EMBL). Protein databases (Primary, Composite, and Secondary). Specialized Genome databases (SGD, TIGR, and ACeDB). Structure databases (CATH, SCOP, and PDB). Information retrieval from biological databases.

Unit III:
Introduction to sequences, sequence alignments – Pairwise alignment (BLAST and FASTA) and multiple sequence alignment(Clustal W).Methods for presenting large quantities of biological data: sequence viewers (SeqVISTA), 3D structure viewers (Rasmol).

Unit IV:
Introduction to phylogenetics, construction of phylogenetic tree.
Introduction on molecular modeling and drug design.
Role of bioinformatics in Genomics, proteomics and metabolomics.

References

1. Text book of Bioinformatics – S C Rastogi
2. Bioinformatics – Ghosh
3. Essential bioinformatics - Xiong

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Department of Biotechnology and Bioinformatics

Non-core-2: Bioactive Natural Products – From Basic Research to Industrial Applications

Unit I: Introduction to bioactive natural compounds
Terpenes, phenols, flavonoids, tannins, quinones, amines and alkaloids, anthocyanins, amino acids, and nucleosides. Bioactive compounds and future perspectives. Production of natural products by plant tissue culture, and molecular farming.

Unit II: Isolation and characterization of bioactive compounds
Solvent extraction, Separation by chromatography methods. Bioassay directed fractionation. Isolation of phenols, nucleosides, and alkaloids. Characterization by UV, IR, NMR and MS spectroscopy. Biological activity screening against microbes and cancer cells, toxicity evaluation through teratological study and mutagenic and carcinogenic study.

Unit III: Therapeutic applications of bioactive compounds
Anesthetics, Sedatives and hypnotics, Anticonvultants, Muscle relaxants, CNS stimulants, Antipyretic analgesics, Cardiovascular drugs, Antihistamines, diuretics, NSAIDS, antimalarials, Antibiotics, antivirals, Anticancer agents. Insulin and oral hypoglycemic agents, Steroids, Antipsychotics (Tranquilizers).

Unit IV: Natural products in drug discovery
Important parameters for drug discovery. Concept of lead molecule. Computational approaches for the discovery of natural lead structure. Strategies for development of Drug from natural products –CADD methods, QSAR and drug design, use of docking program. Natural product derived pharmaceuticals.

References:

1. Modern phytomedicine (2006)
2. Medicinal chemistry (2009)