Dr. Babasaheb Ambedkar Marathwada University, Aurangabad
B.Sc. Bioinformatics Syllabus

Semester First

Sr. No.	Subject Name	Credits	Marks
01	(T) Basic English	3	50
02	(T) Basic Concept in computing	3	50
03	(T) Basic Bioinformatics	3	50
04	(T) Basic Statistics	3	50
05	(T) Basic Chemistry	3	50
06	(T) Basic Botany	3	50
07	(P) Basic Bioinformatics	3	50
08	(P) Wet Lab I (Based on Chemistry)	3	50
09	(P) Basic concepts in computing	3	50

Semester Second

Paper No.	Subject Name	Credits	Marks
10	(T) Basic Biochemistry	3	50
11	(T) Structural Bioinformatics	3	50
12	(T) Fundamental of Biological system	3	50
13	(T) Hardware & Networking	3	50
14	(T) Basic Computer of Programming using C Language.	3	50
15	(T) Basic Mathematics	3	50
16	(P) Wet Lab II (Based on Biochemistry)	3	50
17	(P)Structural Bioinformatics & biological databases	3	50
18	(P)Programming in C	3	50

Semester Third

Paper No.	Subject Name	Credits	Maximum Marks
19	(T) Cell Biology	3	50
20	(T) Database Management System	3	50
21	(T) Bioinformatics Method	3	50
22	(T) Introduction to Molecular Genetics	3	50
23	(T) Mathematics II	3	50
24	(T) Microbiology	3	50
25	(P) Technique's in Bioinformatics	3	50
26	(P)SQL/PL- SQL	3	50
27	(P) Visual Basic	3	50

Semester Fourth

Paper No.	Subject Name	Credits	Maximum Marks
28	(T) Object oriented programming using Java	3	50

29	**(T) Essential Technique in Biochemistry and Molecular Biology**	**3**	**50**
30	**(T) Virology**	**3**	**50**
31	**(T) Computational Molecular Biology**	**3**	**50**
32	**(T) Chemoinformatics and Drug Design**	**3**	**50**
33	**(T) Phylogenetics and Molecular Evolution**	**3**	**50**
34	**(P) Object oriented programming using java**	**3**	**50**
35	**(P) Wet lab II (Based on Genetics)**	**3**	**50**
36	**(P) Mini project**	**3**	**50**

Semester Fifth

Paper No.	Subject Name	Credits	Maximum Marks
37	**(T) Recombinant DNA technology**	**3**	**50**
38	**(T) Computational Genomics**	**3**	**50**
39	**(T) Immunology**	**3**	**50**
40	**(T) Biophysical basis for Bioinformatics**	**3**	**50**
41	**(T) Molecular Biology**	**3**	**50**
42	**(T) Data structure and algorithm**	**3**	**50**
43	**(P) Seminar on Emerging Area of bioinformatics**	**3**	**50**
44	**(P) Computational Genomics**	**3**	**50**
45	**(P) Mini project / Wet Lab**	**3**	**50**

Semester Six

Paper No.	Subject Name	Credits	Maximum Marks
45	**(T) Principle of Molecular Genetics**	**3**	**50**
46	**(T) Environmental science**	**3**	**50**
47	**(T) Enzymes and Metabolism**	**3**	**50**
48	**(T) Introduction to Perl Language**	**3**	**50**
49	**(P) Biodiversity & Taxonomy**	**3**	**50**
50	**(P) Introduction to Perl Language**	**3**	**50**
51	**(p) Major Project**	**6**	**150**

B.Sc.Bioinformatics Detail Syllabus

Paper I- Basic English

UNIT I. Programme of writing

Thinking and planning, information, ideas. Topic outline, order of paragraph writing, revising. Use of vocabulary: meaning of words, precise usages synonym, technical terms, nomenclature, context, superfluous words

UNIT II Use of Good English

Noun, pronoun, verb adverb, objective, Conjunction, article tense spelling etc Compilation of experimental records, weiting progress reports

UNIT III Communication skill

Letters and memoranda communication as a part of science. Reading ; How to read, making notes as you read, writing a book review

UNIT IV Helping the reader

Easy reading (how to begin, control, explain, sentence length, rhythm, style) capture and hold readers interest-effective communication. The art of illustrations, figures,

UNIT V The art of thesis and report writing Editing and correcting

Suggested Reading:

1.”Written communication in English" Sarah Freeman

2. "English for students of science", A.Roy,P,L. Sharma

3. Mcmillan Grammer ; A Handbook of "Augustione and Joseph", Orient Longman

4. A new guide to precis writing R.W. Jepson (O,L)

Paper II-(T) Basic Concept in computing

UNIT I Introduction to Computers

Overview and functions of a computer System.Input and output devices .Storage devices: Hard Disk, Diskette, Magnetic Tape, RAID, ZIP devices, Digital Tape, CD- ROM, DVD (capacity and access time) Main Circuit Board of a PC: Chips, Ports, Expansion Slots .

Memory: Register, buffer, RAM, ROM, PROM, EPROM, EEPROM (comparison).Types of Processing: Batch, Real-Time, Online, Offline. History of -Computers: Evolution, Generation of computers (I, II, III, IV, V), Classification of computers (mainframes, mini computers, Microcomputers, special purpose) -comparison with memory, power, cost, size -then and now .

Types of modem computers: The workstation, The Minicomputer, Mainframe Computers, Parallel Processing Computer, The Super Computer

An overview of Computer viruses: What is a virus? Virus symptoms, How do they get transmitted? What are the dangers, General Precautions

UNIT II Introduction to Operating System

Introduction to operating systems: Operating System concept, Windows 98/XP, Windows server NT/2000, UNIX/LINUX

The Internet and its Resources, World Wide Web (WWW): Associated tools, services, resources and various technologies .Searches on Medline, bibliographic databases, etc.

UNIT III Introduction to Computer Network

Computer Networking, OSI Reference Model, Network Topologies and Protocols, Networking gadgets (Router, Switch, etc), Data Communication (ISDN, VPN, DSL, cable modem, cellular modem, etc), Communication

Links (Wire pairs, Coaxial cables, Fiber optics, Microwave, Satellite, etc) .Local Area Network (LAN), Wide Area Network (WAN), Metropolitan Area Network (MAN) .Network Security (Firewall, Packet filtering, etc).

TEXT & REFERENCE BOOKS:

INTRODUCTION TO COMPUTERS AND INFORMATION TECHNOLOGY BY ANURAG SEETHA, RAM PRASAD & SONS, BHOPAL.
COMPUTERS TODAY BY S.K.BASANDRA, GALGOTIA PUBLICATIONS.
FUNDAMENTALS OF INFORMATION TECHNOLOGY BY ALEXIS LEON & MATHEWS LEON, VIKAS PUBLISHING HOUSE, NEW DELHI.

Paper III- (T) Basic Bioinformatics

UNIT I Introduction to Bioinformatics

Definition of Bioinformatics, Origin of Bioinformatics, Overview of available Bioinformatics resources on the web NCBI/ /EBI/EXPASY etc.

UNIT I Basics Internet Use and Search Engines

Fundamentals of Internet, WWW, HTML, URLs Browsers, Netscape/Opera/Explorer Search Engines: Google, PUBMED, NCBI EMBL,GENBANK, Entrez, Unigene, PDB, SwissProt, And TrEMBL.

UNIT IV Introduction to Genes and Proteins

Genome Sequences ORFs, Genes, Intones, Exons, Splice Variants DNA/ RNA
Secondary Structure, Triplet Coding Protein Sequences

UNIT II Biological Databases

Biological Databases, Types of Biological Databases, Nucleic acid sequence databases, GenBank, EMBL, DDBJ.

Protein sequence databases : NBRF-PIR, SwissProt,

Database search engines: Entrez, SRS.

Derived databases: Prosite, BLOCKS, Pfam, Prodom, PRINTS, InterPro
Composite Databases: NRDB, OWL etc.
Structure Databases: PDB, NDB, CATH , SCOP etc.

Reference:

Introduction to Bioinformatics; Attwood
Bioinformatics; C,V. Murthy
Bioinformatics;Baxvanis

Paper IV-(T) Basic Statistics

UNIT I Introduction

Introduction to Biostatistics: Common terms and notations, applications.
Sampling: Representative sample, sample size, sampling bias and sampling techniques.
Data: collection and presentation: Types of data, methods of collection of primary and secondary data, methods of data presentation, graphical representation by histogram, polygon, ogive curve, pie diagram

UNIT II Central Tendency

Measures of central tendency: Mean, Median, & Mode
Measures of variability: Standard Deviation, Standard Error, Range, mean deviation, coefficient of variation.
Correlation and Regression: Positive and Negative Correlation, Calculation of correlation coefficient, regression, linear regression, and regression equation, ANOVA, one and two way classification.

UNIT III Test of Significance

Test of significance: F-test, Z-test, t-test and chi-square test, Probability
Distribution: Binomial, Poison & Normal Distribution
Computer based statistical techniques: Frequency table of single discrete variable, bubble sort, Computation of mean, variance and Standard deviation, t test, Correlation Coefficient.

UNIT IV Probability
Introduction to probability, Definition and types of Probability, Probability distributions , Poisson's distribution, Bernoulli's distribution, Bionomial distribution with examples.

UNIT V Applications of Statistics in Biology
Examples in biology for all statistical measures.

Reference:

1. Campbell R.C. – Statistics for Biologist, Cambridge University Press, Cambridge
2. Ward Law A.C. (1985) – Practical Statistics for Experimental Biologists
3. Daily N.T.J. – Statistical Methods in Biology, English University Press
4. P.S.S. Sunderrao & J. Richard – An Introduction to Biostatistics, Prenticd hall Pvt. Ltd. India
5. Fundamentals of Biostatistics
6. B.K. Mahajan – Methds in Biostatistics, Jaypee brothers medical publisher Ltd.

Paper V-(T) Basic Chemistry

UNIT I

Importance of Chemistry, physical quantities and their measurement in Chemistry, SI Units, uncertainty in measurements and use of significant figures, Unit and dimensional analysis, Matter and its nature, laws of chemical combinations, atomic, and molecular, masses mole concept, molar masses, percentage composition and molecular formula, chemical stoichiometry.

UNIT II

Three states of matter, gaseous state, gas laws (Boyle's Law and Charles Law), Avogadro's Law, Grahams'Law of diffusion, Dalton's law of partial pressure, ideal gas equation, Kinetic theory of gases, real gases and deviation from ideal behaviour, van der Waals' equation, liquefaction of gases and critical points, Intermolecular forces; liquids and solids.

UNIT III

Earlier atomic models (Thomson's and Rutherford) , emission spectrum of hydrogen atom, Bohr's model, of hydrogen atom, Limitations of Bohr's model, dual nature of matter and radiation, Heisenberg uncertainty principle, quantum mechanical model of atom (quantum designation of atomic orbitals and electron energy in terms of principal, angular momentum and magnetic quantum numbers), electronic spin and spin quantum numbers, Pauli's exclusion principle, general idea of screening (constants) of outer electrons by inner electrons in an atom, *Aufbau* principle, Hund's rule, atomic orbitals and their pictorial representation, electronic configurations of elements.

UNIT IV

Chemical energetics

Some basic concepts in thermodynamics, first law of thermodynamics, heat capacity, measurement of □U□and □H, calorimetry, standard enthalpy changes, thermochemical equations, enthalpy changes during phase transformations, Hess's Law, standard enthalpies of formation, bond enthalpies and calculations based on them.Kossel -Lewis approach to chemical bond formation, ionic bonds, covalent bonds, polarity of bonds and concept of electronegativity, valence shell electron pair repulsion (VSEPR) theory , shapes of simple molecules, valence bond theory, hybridization involving s, p and d orbitals and shapes of molecules □ and □ bonds; Molecular orbital theory involving homounclear diatomic molecules; Hydrogen-bonding.

UNIT V Solid state Chemistry
Classification of solids based on different binding forces: molecular, ionic, covalent and metallic solids, amorphous and crystalline solids; unit cells in two dimensional and three dimensional lattices, calculation of density of a unit cell, packing in solids, voids, number of atoms per unit cell in a cubic unit cell, point defects, electrical and magnetic properties.

Paper VI Basic Botany

UNIT -I
Taxonomy and its significance, Plant kingdom.Outline of Bentham and Hooker system of classification up to order level with merits and demerits. Concepts of floral formula and floral diagram.International code of Botanical nomenclature (ICBN)

UNIT -II
Histology, Tissue types - Meristematic, permanent, Types of Vascular Bundles, Stelar types and evolution.

UNIT -III
Plant physiology,Nitrogen metabolism,Role of Nitrogen in plants
Sources of Nitrogen of plants, Biological nitrogen Fixation
Glycolysis and TCA cycle.

UNIT -IV
Genetics, Mendelism, Law of dominance, law of segregation and law of independent assortment, Chromosome - eukaryotic chromosome structure, Giant chromosomes, Polytene chromosomes, Lampbrush chromosome

UNIT -V
Ecology - Ecological Factors, Biotic and Abiotic Soil and its constituents, Composition of soil, Organic matter and Humus
Soil organisms, Soil waterSoil ErosionWind erosion, Water erosion, Causes of soil erosion, Control of Soil erosion, Ecosystem,Components of ecosystems, Study of fresh water ecosystem, Study of fresh water ecosystem

Reference :
1) Taxonomy of vascular blauts - Lawrence.
2) Anatomy of seed plants - Esau.
3) Diversity of microbes and cryptogams - Anil k. Thakur, Sushil K. Bassi
4) Cryptogamic Botany - Smith.
5) Genetics - Arora, Sandhu.
6) An Introduction to Plant Anatomy - Eams
7) Ecology by M. P. Arora.
8) Elements of ecology - Brij Gopal, N. Bhardwaj.
9) Fundamentals of plant physiology - V. K. Jain.
10) Plant physiology by Devliu and Witham.
11) Introduction to Paleobatany - S. N. Agashe.
12) Paleobotany - Shukla and Mishra.

Paper VII - (P) Basic Bioinformatics

1. Exploring the integrated database system at NCBI server and querying the PUBMED and GenBank databases using the ENTREZ search engine.
2. Exploring the integrated database system at EBI server and searching the EMBL Nucleotide database using the SRS search engine.
3. Exploring and querying the SWISSPROT database
4. Exploring and querying the PIR database
5. Exploring and using the derived databases: PRO SITE, PRINTS, BLOCKS, Pfam and Prodom for pattern searching, domain searches etc.

Paper VIII- (P) Wet Lab I (Based on Chemistry)

1. Cell organelles study with permanent slides
2. Meiosis
3. Mitosis
4. Study of Osmosis
5. Microtomy
6. TC of stem, pollen grain, stigma, leaves, root

7. Xylem, Phloem
8. Titration
9. Paper chromatography of amino acid
10. Paper chromatography of carbohydrates
11. TLC
12. Estimation of carbohydrates by qualitative methods
13. Estimation of carbohydrates by quantitative methods
14. Cell disintegration
15. Estimation of Oil
16. Nitrogen analysis by micro Kjeldahl method
17. Study of different Lab equipments (@ 10 Principle and use of it)
18. Study of different sterilization techniques (Principle and use of it)

Paper XI-(P) Basic Concept in computing

1. Hands-On experience and regular usage: Tutorials (Typing, Windows 98/XP, Internet, UNIX, etc), applications. And utilities of Windows 98/XP, Browsers (I.E., Netscape), surfing the Internet, Search Engines, using E-Mail/Web mail, ftp
2. Downloading and installing software/plug-ins on Windows 98/XP (Acrobat Reader, Post Scripts Viewer, etc)Pine, telnet, basic Unix commands Searching/Surfing on the WWW.
3. Word Processing (Microsoft Word): Creating, Saving & Opening a document, Editing, Inserting, Deleting, Formatting, Moving & Copying Text, Find & Replace, Spell Checker & Grammar Checker (Thesaurus), Document Enhancement (Borders, Shading, Header, Footer), Printing document (page layout, Margins), Introduction to the use of Wizards & Templates, Working with Graphics (Word Art),
4. Working with Tables & Charts, Inserting Files (pictures, Databases, Spreadsheets) Spreadsheet Applications (Microsoft Excel): Worksheet Basics (Entering information in a worksheet, Saving & Opening a worksheet, Editing, Copying & Moving data, Inserting, Deleting & Moving Columns & Rows, Clearing Cells & Formatting cells), Working with workbooks, Working with formulae and functions, Printing worksheets, An introduction to the use of advanced spreadsheet concepts, Database "Management (Sorting records, Finding records, Adding & Deleting records, Filtering records in a worksheet), Working with Macros, Creating and using multiple worksheets
5. Database Applications (Microsoft Access): Fields, Records, Files, Organization of Files, Access Modes; Database, Relational Database; Primary and Secondary Key, Working with databases & tables, Creating a Database, Appending, Updating Records Querying, Reports, Forms and sub forms, Sorting, Filters, An introduction to use of Macros, Modules, Wizards with database applications
6. Creation of Computer Presentations with graphics (Microsoft Power Point): Creation of slides, Rapid Presentation design using wizards, Inserting graphs & charts Action buttons, Transitions, Build and Animation effects Introduction to Multimedia Tools & Devices Searches on Medline, bibliographic databases, etc.

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Semester II

Paper X (T) Basic Biochemistry

UNIT I Water
Water as the universal biological solvent; concept of osmolarity.

UNIT I Biomolecules
Carbohydrates: monosaccharides, oligosaecharides, polysaccharides, proteoglycans and glycoproteins. Lipids: fatty acids, acylglycerols; phospholipids, sphingolipids, cholesterol and membranes Isoprenoids, icosanoids and their biological importance.
Proteins: amino acids and peptides; primary, secondary, tertiary and quaternary structures; structure, function and evolutionary relationships; protein -protein interactions protein folding; allosteric proteins.
Nucleic acids: bases, nucleotides, RNA and DNA; different structural forms of DNA; denaturation, renaturation and hybridization of DNA; different types of RNA; Protein-nucleic acid interaction.
Enzymes: details of enzyme nomenclature and classification; units of enzyme activity; coenzymes and metal cofactors; temperature and pH effects; Michaelis-Menten kinetics; Inhibitors and activators; active site and catalytic mechanisms; covalent and non-covalent regulations; isoenzymes; osmolytes and intracellular

modulation of enzymes.

UNIT III Metabolic Systems
Organization of metabolic systems: enzyme chains, multi enzyme complexes and multifunctional enzymes; anaplerotic sequences and amphibolic pathways; pacemaker enzymes and feedback control of metabolic pathways; shuttle pathways; energy charge.
Oxidation of glucose in cells: high-energy bon~ glycolysis, citric acid cycle and oxidative phosphorylation.

References:
Biochemistry; Deb
Outline of Biochemistry; Cohn and Stumpf
General Biochemistry; Lehninger, Nicolson and Cox

Paper XI - (T) Structural Bioinformatics

UNIT I Introduction
Define Bioinformatics and structural bioinformatics, fundamentals of protein structure, fundamentals of DNA & RNA structure, computational aspects of high throughput Crystallographic macromolecular structure determination, Macromolecular structure determination by NMR Spectroscopy, Electron Microscopy, Molecular visualization.

UNIT II Biological Databases
NCBI, DDBJ, EMBL, Classification of biological Databases with GenBank. Nature of all biological databases. Proteomics databases
The PDB format, mmCIF formats and other data formats, the protein data bank, the nucleic acid database, other structure – based databases.
Comparative features-protein structure evolution and the SCOP databases, the CATH domain structure databases, structural quality assurance all-atom contacts; a new approach to structure validation, structure comparison and alignment.

UNIT III Structure and Functional assignment & protein Interactions
Secondary structure assignments, identifying structural domains in proteins, Inferring protein function from structure.
Prediction of protein-protein interaction from evolutionary information, electrostatic interactions.

UNIT IV Protein as Drug Target
Principles and methods of docking and ligand design, structural bioinformatics in drug discovery, CASP and CAFASP experiments and their finding, homology modeling.

UNIT V Structure Prediction
Fold recognition method, AB INITIO Methods, prediction in 1-D; secondary structure mwmbrane helices and accessibility, Structural genomics.

Reference:

Structural Bioinformatics by Phillip E. Brurne & Helge Weissig, A John Wiely & Sons Publications.

Paper XII- (T) Fundamental of Biological system

UNIT I Evolution and Biodiversity
Evolutionary concepts: Theories on evolution (origin of life). Prokaryotes -Bacteria, virus, fungi, Lichens, Plant diversity and animal diversity. Origin of species and Macro evolution, Variation, specification , molecular evolution, Duplication, Hemoglobin, Cylochrome C- Mimicry and Coloration - Adaptive radiation.

UNIT II Universal Cell Concepts
Cell as unit of life- Structure of prokaryotic and eukaryotic cell Differences in plant and animal cells. Cell transport across plasma membrane. Mechanism of transport in vascular plants and animals. Cell reproduction, Cell cycle, Mitosis and Meiosis.

UNIT III Cell energetic

Structural organization of mitochondria. Respiratory electron transport chain. Redox carriers. Mechanism of electron transport. Oxidative photosynthesis. Structure and function of ATPase in ATP production. Chemiosmotic theory.
Structural organization of chloroplast Photosynthetic pigments and role in photosynthesis. Photophosphorylation. Photosystem I and II. Cyclic and Non-cyclic photophosphorylation. CO_2 fixation pathways (Calvin Pathway)

UNIT IV Few important cell organcelles

Structure and functions of endoplasmic reticulum. Golgi complex- structure and function. Nucleolus and ribosomes.

UNIT V Ecological Concepts

Basic ecological principles. Population and community ecology. Principles of animal behavior, Social behavior. Food chain, Food web in ecosystem. Human impact on world ecosystem

Reference:

1. Cell Biology - Organdie structure and function by David E. Sadava, Jones and Bartlert Publishers, London.
2. Sharma, F.D,, Elements of Ecology, Rastogi Publications , Meerut
3. Jha, A.P., Genes and Evolution. MacMillan India Ltd.
4. T, Subramanian. Developmentaf Biology
5. Ambrose, E.J, and Dorothy M, Easty,, Cell Biology If Edition. The English language Book Company Limited, New Delhi

Paper XIII- (T) Hardware & Networking

UNIT I Introduction to Hardware
Hardware : Definition , introduction to hardware parts of computers in detail.

UNIT II Network Security
Network Security: Introduction to Information & Network Security, General security fundamentals
Network Security Fundamentals, Network Defense, Incident Response, Elements of security. With terminology, Risk Assessment Auditing, Security Policies , Introduction to security services & Attacks
IDS/Firewalls (Introduction and types), Tools and techniques involved in info. & Network security
Types of attacks (General information), Encryption/decryptions , Current & future technologies (like wireless, biometric etc.) and security concerns.

UNIT III Data security:
Classification of data security threats, protection mechanism (authentication, access control, access rules)

UNIT IV Data Accuracy
General issues regarding Biological Databases; Representation of errors due to (machines, 3D structural and sequence data of proteins and nucleic acid, Proteomics and Micro array data)

Paper XIV- (T) Basic Computer Programming using C Language.

UNIT–I

Overview of C, Feature of C, Structure of program, Variables, Expression, Identifiers, Keywords, Data types, Constants.

Operator: Arithmetic, Logical, Relational, Conditional and Bitwise operators, Precedence and associatively of operators, Types conversion in expression

Basic input/output and library functions Single Character Input/Output i.e. getch(), getchar(), getche(), putchar(), Formatted input/output i.e. printf() And scanf(), Library Functions – concepts mathematical and character functions.

Control structures- If Statement, If…….Else Statement, Nesting Of If ……..Else Statement, Else If Ladder, ? : Operator, Switch Statement, Compound Statement, Loop Controls – For, While, Do-While Loops, Break Continue, Exit, Goto Statement .

UNIT–II

The Need of a Function, User Defined and Library Function, Prototype of a Function, Function Argument, Return Values and Nesting of Function, main(),Command Line Argument, Recursion, Calling of Functions, Array as Function Argument, Scope and Life of Variables - Local and Global Variable, Storage Class specifier – Auto, Extern, Static, Register, Preprocessor Directive.

UNIT–III

Arrays-Single And Multidimensional Arrays, Array Declaration And Initialization Of Arrays, String : Declaration, Initialization, String Functions

Structure and union-Defining Structure, Declaration Of Structure Variable, Accessing Structure Members, Nested Structures, Array Of Structures, Structure Assignment , Structure As Function Argument, Function That Return Structure, Union

UNIT-IV
Pointers- The & And * Operators, Pointers expressions, Pointers V/s Arrays, Pointer to functions, Functioning returning pointers.

Dynamic memory allocation Introduction, Malloc, Calloc, Sizeof, Free, Relloc Functions Bitwise operator

UNIT–V
File management-Defining, Opening a File & Closing a File, Text file, Binary file, Functions for File Handling: fopen, fclose, gets, puts, fprint, fscanf, getw, putw, fputs, fgets,fread, fwrite, Random access to files : fseek, ftell, rewind, file name as Command Line Argument.

Graphics on your PC, Initialize Graphics Mode, Functions used In Graphics - Drawing a Point on The Screen, Drawing – lines, rectangle, ovals, circles, arcs, polygon, filling colors, Using Text in Graphics Display.

Reference :

programming in c by e. balaguruswami, tmh publications
programming with c by gottfried, schaums outlie series, tmh publications
thinking in c by mahapatra, phi publications
graphics programming in c by stevens, bpb publication
programming in c by r subburaj, vikas publishing

Paper XV- (T) Basic Mathematics

UNIT I
Calculus: Limits, Complete Differentials, Partial differentials of functions with one variable and multiple variables.
Integration: Definite and non-definite integral; Series, Logarithms Mathematical Techniques Ordinary differential equations (first order), Partial differential equations- example from biology. Special functions - Bessel, Legendre
2D Coordinate geometry: Equation of a line, circle, ellipse, parabola, hyperbola

3D Geometry: Equation of sphere, cone Trigonometric functions: Sin, Cos, Tan, Co~ Series expansion of these. Functions and other related functions Vector -Addition, subtraction, dot, cross, scalar triple product, divergence, curl of a vector, equation of normal
Matrix algebra: Addition, subtraction, multiplication, transpose inverse, and conjugate of matrix etc.
Logic: Boolean logic Addition, subtraction, multiplication and division using binary, octal and hexadecimal systems. Fundamentals of Set theory. Fourier transform, Laplace Transform & other standard transforms.

Paper XVI- (P) Wet Lab II (Based on Biochemistry)

1. Estimation of carbohydrates by qualitative methods
2. Estimation of carbohydrates by quantitative methods
3. Purification of polysaccharides
4. Acid values and iodine number of fat
5. Saponification values of fats
6. Isolation and purification of lipids from microbes and eukaryotes
7. Phosphate estimation
8. Ammonia estimation
9. Simple assays for vitamins and hormones
10. Estimation of pKa values of amino acids
11. Preparation of starch, glycogen, Lecithin, cytochrome C

Paper XVII- (P) Structural Bioinformatics

1. Exploring the PDB & NDB: Database searches, understanding entry contents and file formats, etc.
2. Visualization of tertiary structures, quaternary structures, architectures and topologies of proteins and DNA using molecular visualization software such as RasMol, Cn3D, SPDBV, Chime etc.
3. Prediction of secondary structures of proteins using at least 5 different methods with analysis and interpretation of the results. Comparison of the performance of the different methods for various classes of proteins.
4. Prediction of tertiary structures of proteins using Homology Modeling approach: SWISSMODEL, SWISS-PDB Viewer.
5. Prediction of tertiary structures of proteins using at least 3 methods for fold recognition along with analysis and interpretation of results.
6. Calculation of binding energy of inhibitors and analysis of active sites of enzymes using appropriate software .

Paper XVIII - (P) Programming in C
Programs & Assignments based on Theory.

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Semester III

Paper XVIII Cell Biology

Unit - I Prokaryotic and Eukaryotic cell – Plasma membrane – Structure and function – Transport across the Plasma membrane.

Unit - II Nucleus and Nucleolus – Structure of Chromatin - Cell division.

Unit - III Structure and function of Mitochondria – Respiration – Structure and function of chloroplast – Carbon dioxide fixation pathways.

Unit - IV Endoplasmic reticulum - Golgi apparatus - Lysosomes

Unit - V Ribosomes - Protein synthesis – RNA types - Post Translational modification of Proteins.DNA as the genetic material – Gene concept – Gene regulation.

Reference:
1. Cell Biology – Rastogi (2002)
2. Cell and Molecular Biology – De Roberties (2000)
3. Molecular Biology of the Cell – B. Alberts et al (2000)

Paper XIX- (T) Database Management System

UNIT- I

Introduction to database systems-Operational Data, File Management Vs Data Management, characteristics of Database approach, An Architecture for a Database System, Advantages and Disadvantages of DBMS, Data associations - Entities, Attributes and Associations, Relationship among Entities, Representation of Associations and Relationship, Data Model Classification, Entity Relationship Model,Relational Data Model, Network Data Model, Hierarchical Data Model .Objects – Relational Model Objects, Relationship, Composite Objects, Procedures, Types and Inheritance.

UNIT-II

Relational data structure-A Review of Set Theory, Relations, Domains and Attributes, Tuples, Keys. Integrity Rules Extensions And Intensions, Base Tables, Indexes Relational Algebra and Operations, Retrieval Operations, Relational Calculus and Domain Calculus.

UNIT-III

Relational database design-Universal Relation, Anomalies in a Database, Normalization Theory, Functional Dependencies. Closure of a Set of F.D Covers, Non Redundant and Minimum Cover, Canonical Cover, First, Second and Third Normal Forms, Relations with more than one Candidate Key, Good and Bad Decompositions, Boyce Codd Normal Form, Multivalued Dependencies and Fourth Normal Form, Join Dependencies and Fifth Normal Form.

UNIT-IV

Query processing-Query Processing Stages, Query Interpretation, Equivalence of Expression, Query Execution Statistics. Query Execution Plan, Query Estimation, Query Evaluation, View Processing, Integrity & Security, Need for Integrity and Security Integrity Constraints.

The distributed databases -Motivation for Distributed Database . Distributed Database concepts, Types of Distribution Architecture of Distributed Databases, The Design of Distributed Databases, Distributed Query Processing, Recovery In Distributed Systems, Commit Protocols for Distributed Databases, Multi Database System. Distributed Databases feature in Contemporary Database Management System.

UNIT-V

Oracle as enterprise database server.

Client and server communication (SQL) Data Definition Language (DDL) - Creating, Altering & Dropping Tables, Integrity Constant,

Data Manipulation Language (DML) - Select Insert, Update, Delete Commands,Transaction Control Using ,SQL - Commit, Rollback, Savepoint Command, Data Controlling Using SQL - Grant, Revoke, Set Role, SQL functions,Indexes and views

PL/SQL, SQL & PL/SQL, Differences, Blocking Code for Clarity, Using Variables, Constant and Data Types, Assigning Data Base Values to Variables, Select Into ….. Cursors using Flow Control and Loop Statements, Goto Statement. Error handling built in PL / SQL Exceptions, User - Defined Exceptions, Unhandled

Exception, the Raise - Application - Error Procedure.

PL / SQL Programs Anonymous PL / SQL Blocks, Stored Procedure, Function & Packages, Using Database Triggers.

Reference :

1. An introduction to database system (3rd ed.) by *c. j. date*
2. Database system concepts by *henry f. korth*
3. Database management systems by leon & leon , vikas publications.
4. An introduction to database system by *bipin c. desai*
5. Fundamentals of database system (2^{nd} ed.) by *elemesri and s. navathe*
6. Oracle a beginners guide by michael abbey & michael j. corey tmh publications

Paper XX- (T) Bioinformatics Method

Unit I Pairwise sequence alignment
Nature and sequence of pairwise sequence alignment and database searching.Principle and method of pairwise sequence alignment, local and global alignment, BLAST , FASTA, identity & similarity, alignment algorithms.Dot plot, substitution matrices, gap penalty, database similarity searches and discovery of conserved patterns in protein sequences and structures , structural significance of alignment.

Unit II Multiple sequence alignment
Definition and significance of multiple sequence alignment, consensus sequence, protocol for multiple sequence alignment , manual , progressive and nonprogressive methods , Clustal W software , multiple aligmnment by PSI-BLAST, predictive methods using DNA and protein sequences.

Unit III Method for gene expression analysis
Introduction to microarray technology, sources of variability, raw data, design of microarray experiments , Low level analysis, data management procedures, Diagnostic plots, Dye intensity bias corrections(cDNA microarray) , statistical inference on differential expression , EST clustering , TIGR gene indices, accessing levels of gene expression using EST's.

Unit IV Biomolecular Modeling
Concept of homology modeling, input data for homology model building, methods for modeling at different levels of complexity , methods of loop modeling and side chain modeling , software for homology modeling , computer and graphic representation of simple molecules and peptides , use of structural databases in molecular modeling, concepts of geometry optimization and energy minimization , introduction of molecular dynamic simulation and monte carlo simulation, concepts and applications of macromolecular docking.

Unit V Phylogenetic Analysis
Concepts of phylogeny, homology, analogy, orthology and paralogy, phylogenetic data analysis , tree building methods , tree evaluation & interpretation methods , Distance and parsimony, Nature , scope and applications of phylogenetic softwares.

Reference:

1. Andreas D. Bazavanis and B.F. Francis (Eds.) Bioinformatics: A Practical Guide to Analysis of Genes and Proteins, Wiley Interscience Publishers.
2. Thomas Lengauer (Eds.) Bioinformatics – Genomes to Drugs, Vol. I: Basic Technologies, Wiley-WCH publishers.
3. Jay A. Glasel and Murray P. Deutscher (Eds.) Introduction to Biophysical Methods for Protein and Nucleic Acid Research, Academic Press.
4. T.K. Attwood and DJ Parry Smith Introduction to Bioinformatics, Pearson education, Asia.
5. S. Sundara Rajan and R. Balaji Introduction to Bioinformatics, Himalaya publishing house.
6. T. Schlick Molecular Modeling and Simulation – an Interdisciplinary Guide, Springer.

Paper XXI- (T) Introduction to Molecular Genetics

Unit I The Physical Nature of Genetic Material
The molecular structure of prokaryotic and eukaryotic chromosomes – a prokaryotic chromosome is packed into a small space, the sequence of eukaryotic chromosome is complex, the eukaryotic chromosome is tightly patched, the eukaryotic chromosome has specialized sequences.
Proof for DNA is genetic material – DNA, the primary origin of transformation, the amount of DNA per cell is constant and chemically stable, phages were used to confirm that DNA is genetic material, RNA, the chemical nature of DNA and RNA, DNA replicates using itself as a template, semi conservative replication, bidirectional replication, replication using both strands as template, replication in eukaryotes must deal with many chromosomes and must be extremely accurate, replication of viruses and plasmid DNA.

Unit II Omics and Code
Transcription, translation, and the genetic code, proteins determine the phenotype of an organism, transcription is the passing of information from DNA to RNA, eukaryotes modify mRNA after transcription, mRNA sequences are translated into sequences of amino acids, the genetic code is simple.
Regulation of gene expression, regulation of gene expression occurs at many levels, transcriptional control 1: the lac operon, transcriptional control 2: attenuation, and termination, methylation and DNA binding proteins

control gene expression, gene regulation can occur at posttranslational level, DNA sequence rearrangements can permanently alter gene expression.

Unit III Genetics of other Microorganisms
The genetics of bacteria and their viruses, bacteria are easily grown, bacterial mutants are highly varied, bacterial conjugation, complex process involving plasmids, transformation involves cellular uptake of DNA, phage genetics has revealed information about the gene, transduction is useful for mapping.
Gene mutation and repair, categories (types) of mutations, spontaneous mutations caused by natural phenomena, induced mutations are the result of environment, biological repair reverses many mutations. Changes in chromosome number and structure, polyploidy is an increase in the number of chromosome sets, anauploidy is a gain or loss of individual, chromosome rearrangements are changed in chromosome structure. Recombination and transposable elements, conjugation, transformation, and transduction, transposable elements, bacterial transposable elements, eukaryotic transposable, biological significance of recombination and transposable elements.

Reference:

Genetics: A Molecular Approach by Peter J. Russell, Pearson Benjamin Cummings San Francisco Boston NewYork.
Modern Genetic Analysis – Integrating Genes and Genomes by Anthony J.F. Griffiths, William M. Gelbert, Richard C. Lewontin and Jeffrey H. Miller, W.H. Freeman and Company New York.
The Science of Genetics by Atherly, Girton, and McDonald, Saunders College Publishing.

Paper XXII Mathematics II

Unit : I Geometric Transformation – Plane Linear Transformation properties – Rotation – reflection – Translation – Successive and Inverse Transformation – (through Matrix Theory).
Unit : II Cosets and Lagrange's Theorem – Normal sub groups and quotient Groups – Different types of Morphisms of Groups Fundamental Theorem of Homomorphism.
Unit : III Graph Theory – Basic concepts – Finite and infinite Graphs – Incidence and Degree ideas on vertices – Isomorphism, Subgraph, walks - paths and circuits.
Unit : IV Connected Graphs and Disconnected Graphs and components – Euler Graphs – Hamiltonian paths and circuits.
Unit : V Trees – properties of Trees – Pendent vertices – Distance and centres in a Tree – rooted and Binary Trees.
Text Books
1. For Unit I : " Discrete Maths" , by B.S.Vatssa- wishwa Prakashan (A Division of wiley Eastern ltd -1993, - Chennai.
2. For Unit II : "Modern Algebra", by Dr.S.Ariumugam and Mr.S.Thanga pandi Issac – (section 3.8, 3.9 of Chapter 3 New Gamma Publicating House – Palayam Kottai, 1997.
3. For Unit III , IV & V : Graph – Theory by Narshing – Deo - Prentice Hall of India Private Limited., 1997.
Reference Books
1. Transformation geometry
2. Modern Algebra by Sri S.Narayanan and Sri T.K.Manickavachagam (S.Viswanathan Printers and Publishers Pvt.Ltd, 1993)
3. Theory of Computing by John – C Martin – MC Graw – Hill series -1993.

Paper XXIII Microbiology

UNIT I
Overview of history of Microbiology - Biogenesis and abiogenesis Contributions of Redi,Spallanzani, Needham, Pasteur, Tyndal, Joseph Lister, Koch [Germ Theory], Edward Jenner andFlemming [Penicillin], Scope of Microbiology.
Classification of Microbes - Systems of classification, Numerical taxonomy, Identifying characters forclassification, General properties and principles of classification of microorganisms Systematics of bacteria, Nutritional types [Definition and examples]. Classification on the basis of oxygen requirement.

UNIT II
Concept of Sterilization - Definition of sterilization, dry and moist heat, pasteurization,tyndalization; radiation, ultrasonication, filtration. Physical and Chemical methods of sterilization;disinfection sanitization, antisepsis sterilants and fumigation. Determination of phenol coefficient ofdisinfectant.

UNIT III
Stains and staining techniques – Definition of auxochrome , chromophores, dyes, Classification of stains, Theories of staining, Mechanism of gram staining, acid fast staining, negative staining, capsule staining, flagella staining, endospore staining.

UNIT IV
Microbes in Extreme Environment – Nature, special features of the thermophilic, methanogenic andhalophilic Archaea; photosynthetic bacteria, Cyanobacteria some Archaea who live in extreme conditions like cold, and space.
Pathogenic Microorganisms – List of common bacterial, fungal and viral diseasesof human beings [Name of the disease, causative pathogen, parts affected]

UNIT V
Basic concepts of Virology - General characteristics of viruses, differences between bacteria and viruses. Classification of viruses Physical and chemical Structures of different Viruses.

Paper XXIV - (P) Technique's in Bioinformatics

Pairwise sequence alignment & sequence analysis with BLAST , FASTA and study of various BLAST programs and assignments.
Multiple sequence alignment and analysis with CLUSTAL X and CLUSTAL W
Phylogenetic analysis
Phylogenetic analysis with PHYLIP software using different phylogenetic methods.
Structure visualization softwares RasMol,RasTop , Cn3D, SpdbViewer etc.
Prediction of secondary and tertiary structures with different softwares using different methods

Paper XXI- (P) SQL/PL- SQL

(Note: in all the following programs, students should take examples from bioinformatics as far as possible.)
SQL assignment
Using the following tables

- PET_OWNER (ownerID, name, phone, email, street, city, state, zip.)
- PET (petID, name, type, breed, dob, ownerID)

Write SQL statements to do the following:

1. Write CREATE TABLE statements to create the tables shown above. (Be sure to first check to see if the table already exists and drop the old one if necessary.)
2. Write SQL statements to add at least three rows to the PET_OWNER table.
3. Write SQL statements to add at least five rows to the PET table.
4. Write a SQL statement to display all of the columns and all of the rows of PET. Do not use * notation.
5. Write a SQL statement to display the name, breed, and type of all pets on file.
6. Write a SQL statement to display the name, breed, and type of all pets that are of type "Dog" and breed "Poodle."
7. Write a SQL statement to display the name, breed, and type for all pets that are not of type cat, dog, or fish.
8. Write a SQL statement to display all owners in the 5012 zip code.
9. Write a SQL statement to display the pet's name breed, and the owner's name.
10. Write a SQL statement to count the number of pets on file.
11. Write a SQL statement to count the number of pets in the 5003 zip code.
12. Write a SQL statement to display the names and phone numbers of all cat owners.

Paper XXIVI- (P) Visual Basic

1.Integrated Development Environment of VB, User Interface Designing, Basics of Event driven programming.

2.Form- Designing, Showing & Hiding

3.VB language -Data Types, Variables & Constant, Arrays, Dynamic Arrays, Array as function, Collections, Procedures, Arguments passing, Functions, Returning Values. Control flow Statements: if-then, if-then-else, Select case, looping statement: Do-Loop, For-Next, While-Wend, Nested Control Structure, Exit statement.

4.Basic Active X Control, Properties & Methods - Text box, List box, combo box, Scroll bar, Slider & Fire Controls. Advance Active X Control - Common Dialog controls, Color, font, File open, file save, print help, tree View & list View Controls.
5.Graphics controls - ImageBox & PictureBox, Coordinate System, Graphics methods- Text Drawing, Lines & Shape, Filling Shapes, Grid methods

Menu editor: Pull-down, Pop-up and Dynamic menus

6.Multiple Document Interface - Parent & Child Forms & Methods.
OLE - Basics, OLE control Properties & Methods, Developing applications with OLE control, OLE at Runtime.

7.Error handling in VB - Types of Errors, Error handling methods and functions

8.Database Programming with VB – Database Models, Visual data manager, DATA Control- methods, Properties, Connectivity with database, DATA bound controls

RDO Data control, creating & using database with object model.

ADO data control, creating & using database with object model, Attaching Queries with database.DATA Report Designer

9.Visual Basic & Internet programming- HTML Pages Basics, Server Client Interactions, DHTML Basics, Accessing Internet in VB using Web browser control and Internet Explorer Object.

10.Introduction to VB SCRIPT

Reference:
special edition using visual basic 6.0 by *brian siler prentice hall(2000)*
mastering visual basic 6 by *evangelos petroutsos bpb publications*
beginner's guide to visual basic 6 by *reeta sahoo & g.b.sahoo,khanna publishing house*
peter norton's guide to visual basic 6 by *peter norton*
beginning visual basic 6 by *peter wright, shroff publishers*
programming in visual basic 6.0 by mohammed azam, vikas publishing house
visual basic 6 super bible by *david jung, boutain, pardum,*

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SEMESTER IV

Paper XXVVII Object Oriented Programming Using JAVA

UNIT I Introduction
Introduction, the Java platform, a development cycle for java applications, basic data types, variables, literals, constants, expressions, arithmetic operators, relational operators, bit level operator, logical operators, string operator, casting, control structures, selection control statements, iteration control statements, break and continue, switch control statements, array, command line arguments.

UNIT II Classes
Classes, Constructors, Methods, Equality and equivalence, Static fields, Static Methods, A static application, Data members initialization, the keyword ”this”, an example: the complex number class.

UNIT III Inheritance
Constructors, Methods, Instance of and class methods, Packages Access control, final and abstract, polymorphism, Interfaces, Exceptions.

UNIT IV I/O
Input output, Byte oriented streams, Buffered byte oriented streams, Data buffered byte oriented streams, Character oriented stream, Standard input, Threads, The Producer & Consumer example, synchronized methods, Wait & Notify, JAR files.

UNIT V Java Interface

Java Native Interface, The definition of native methods, Numeric parameters and return values, Using Strings, Using non static methods and non static fields, Assessing static fields, Calling non static methods from C, Using arrays, Exceptions, Ant, A first example, Projects, targets, task elements and properties, A more complicated example.

Reference:

1. Eckel B, Thinking in Java (3rd Edition) Prentice Hall.2002. Available on-line at http://jamesthornton.com/eckel/
2. Flanagan D, Java in a Nustshell: A Desktop quick reference (3rd Edition), O'Reilly,1999.
3. Holzner S, Java2, The Coriolis Group, 2000.
4. Horstmann C, Computing concepts with java 2, essentials (2nd Edition), Wiley 2000.
5. Horstmann C and Cornell G, Core Java, Volume II – Advanced Features, The sun Microsystems press, 2000.
6. Horstmann C and Cornell G, Core Java, Volume I – Advanced Features, The sun Microsystems press, 2001.
7. Lemay L and Cadenhead R, Java 2 Guida Completa. Apogeo s.r.l., 2000.
8. Sun Microsystems, The Java tutorial. A practical guide for programmers. Available online at http://java.sun.com/

Paper XXVIII (T) Essential Technique in Biochemistry and Molecular Biology

Unit I

Basic Principles

Biochemical studies, units of measurement, weak electrolytes, buffer solutions – their nature and preparation, pH and oxygen electrodes, quantitative biochemical measurements, principles of clinical biochemical analysis, safety in the laboratory.

Cell culture techniques

Introduction, cell culture laboratory and equipment, safety considerations in cell culture, aseptic techniques and good cell culture practice, types of animal cells and their characteristics in culture, bacterial cell culture, plant cell culture, potential use of cell cultures.

Centrifugation

Introduction, basic principles of sedimentation, types, care and safety aspects of centrifuges, preparative centrifugation, analytical centrifugation.

Unit II

Microscopy

Introduction, the light microscope, optical sectioning, imaging living cells and tissues, the stereomicroscope, the electron microscope, imaging and biochemistry, specialized imaging techniques, image archiving, presentation, and further information.

Molecular Biology, Bioinformatics, and Basic Techniques

Introduction, structure of nucleic acids, genes and genome complexity, location and packaging of nucleic acids, functions of nucleic acids, the manipulation of nucleic acids, basic tools and techniques, isolation and separation of nucleic acids, molecular biology and bioinformatics, molecular analysis of nucleic acid sequences, the polymerase chain reaction, nucleotide sequencing of DNA.

Recombinant DNA and Genetic Analysis

Introduction, constructing gene libraries, cloning vectors, hybridization and gene probes, screening gene libraries, applications of gene cloning, expression of foreign genes, analyzing genes and gene expression, analyzing whole genomes, pharmacogenomics, molecular biotechnology, and its applications.

Unit III

Immunochemical Techniques

Introduction, production of antibodies, purification and fragmentation of immunoglobulin, immunoprecipitation, labeling antibodies, immunoblotting, immunoassays, immunohisto/cytochemistry, affinity, and avidity, immunochemical use of surface Plasmon resonance.

Protein Structure, Purification, Characterization and Function Analysis

Ionic properties of amino acids and proteins, protein structure, protein purification, protein structure determination, proteomics, and protein function.

Mass Spectrometric Techniques

Introduction, ionization, mass analyzers, detectors, structural information by tandem mass spectrometry, analyzing protein complexes, computing and database analysis.

Unit IV
Electrophoretic Techniques
General principles, support media, electrophoresis of proteins, electrophoresis of nucleic acids, capillary electrophoresis, microchip electrophoresis.
Chromatographic techniques
Principles of chromatography, chromatographic performance parameters, liquid chromatography (LPLC and HPLC), adsorption chromatography, partition chromatography, ion-exchange chromatography, molecular exclusion (gel filtration) chromatography, affinity chromatography, gas-liquid chromatography, thin-layer (planar) chromatography, selection of a chromatographic system.
Spectroscopic techniques I: Atomic and Molecular Electronic Spectroscopy
Introduction, X-ray spectroscopy, ultraviolet and visible light spectroscopy, spectrofluorimetry, circular dichroism spectroscopy, turbidimetry and nephelometry, luminometry, atomic spectroscopy, lasers.

Unit V
Spectroscopic Techniques II: Vibrational Spectroscopy and Electron and Nuclear Spin Orientation in Magnetic Fields
Introduction, infrared and Raman spectroscopy, electron spin resonance spectroscopy, nuclear magnetic resonance spectroscopy.
Radioisotope Techniques
The nature of radioactivity, detection and measurement of radioactivity, other practical aspects of counting radioactivity and analysis of data, inherent advantages and restrictions of radiotracer experiments, safety aspects, applications of radioisotopes in the biological sciences.
Enzymes
Characteristics and nomenclature, analytical methods for the study of enzyme reactions, enzyme steady-state kinetics, enzyme active sites and catalytic mechanisms, control of enzyme activity.
Cell Membrane Receptors
Receptors for cell signaling, quantitative aspects of receptor-ligand binding, techniques for the study of receptor-ligand binding, molecular structure of receptors, mechanisms of signal transduction, receptor-desensitization and trafficking.

Paper XXIX virology

Classification and General properties of plant, animal and bacterial viruses,
Bacteriophages - lytic cycle & lysogeny. Structure of viruses, assembly of viral membrane.
Life cycle and replication of viruses:
RNA-negetive strand (VSV), positive strand (Polio), segmented [Influenza]
Retrovirus- RSV and HIV
DNA- adenovirus and SV-40
Cultivation in cell culture, chick embryo and animal inoculation.
Persistent chronic and acute viral infections.
Mechanism of interferon and antiviral therapy.
Host virus interactions; plant and animal.

Reference:
1. Clark M S & Wall W. J. (1996) Chromosomes, Chapman & Hall, London.
2. Textbook of Medical Physiology by A.C. Guyton and J. E. Hall, W.B. Saunders Publication, 9th Edition , 1996
3. Physiology Illustrated by Lipfold and Cogdell
4. Cells by David Prescott
5. Cell Structure and Function by Loewy and Gallant
6. Essential Cell Biology by Albert Bray et al, Garland Publication New York 1997
7. Introduction to Modern Virology by Dimmock and Primrose
8. Molecular Virology by Alan Cann
9. Madigam M.T., Martinko J.M and Parker J. (2001) Biology of Microorganisms 9th ed. Prentice Hall Int. (U.K.) Ltd, London.
10. General Microbiology by Stanier, Adelberg and Ingraham, The Macmillan Press Ltd, Hong Kong.

Paper XXX Computational Molecular Biology

UNIT I Introduction
Computational molecular biology, Introduction to pragmatic analysis of nucleic acid sequence.

UNIT II Biomolecular Sequence analysis
Motifs in sequences: Localization and extraction, protein sequence analysis prediction of secondary structural features.

UNIT III Biopolymer structure calculation and prediction
Discrete models of biopolymers, Protein structure folding and prediction, DNA- protein interactions: target prediction.

UNIT IV Genome analysis
Methods of computational genomics, Computational aspects of comparative genomics.

UNIT V Methods
Computational Methods for studying the evolution of the all extra chromosomal with mitochondrial genome.

Reference:
1. Bioinformatics & Functional genomics by Jonathan Pevsner, A john Wiely & Sons Publications.
2. Essentials of genomics & Bioinformatics by C.W. Sensen, Wiely-VCH.

Paper XXXI Chemoinformatics and Drug Design

Unit I: Basics of Cheminformatics & Medicinal Chemistry
Introduction to Cheminformatics, Evolution of Cheminformatics, History of Chemical Information Science, Use of Cheminformatics, Prospectus of Cheminformatics
History of Medicinal Chemistry, Prodrugs and Soft Drugs , Drug Targets , Drug Solubility, Natural Resources of Lead Compounds, Pharmacokinetics & Drug Metabolism, Biological Testing and Bioassays, Preclinical Testing and Clinical Trial, Synthesis, Patenting and Manufacture, Complexes and Chelating Agents, Molecular Modeling Using Computers

Unit II: Modern Combinatorial Chemistry & Chemical Information Sources
Combinatorial Chemistry Technologies & Libraries, Solution Phase Synthesis, High-Throughput Synthesis and Screening, Combinatorial Libraries, Analytical Methods, Biopanning, Peptide Display Libraries: design and Construction
Chemical Literature, Chemical Information Searches, Chemical Information Sources, Chemical Name and Formula Searching, Analytical Chemistry (Constitutional Chemistry), Chemical History, Biography, Directories, and Industry Sources

Unit III: Cheminformatics Database Design & their Management
Chemical Database Design, Bio Catalysts Database, The MOS Database, The Failed Reaction Database, Protecting Groups Database, Solid-Phase Synthesis Database
Unit IV: Data Sequencing Mining and Visualization
An Introduction to Data Mining, Data Mining: Broad Aspects Visualizing Data Mining Models, Software- Past and Present Developments, Application Visualization System, Software for Chemical Data Mining, Data Mining & human Genome

Unit V: Drug Design and Discovery
Contour of Drugs, Development of New Drugs, chemical & physiochemical parameters in Drug design, Design of enzyme inhibitors, Drug metabolism, Structure Based drug Designing, Drug Discovery, computation techniques in drug design process.

Reference:

1. An Introduction to Chemoinformatics - Andrew R. Leach, Valerie J. Gillet
2. Chemoinformatics in Drug Discovery (Methods and Principles in Medicinal Chemistry) - by
3. Mannhold, Raimund, Wiley-VCH Verlag publication
4. .Chemoinformatics: A Textbook - by Johann Gasteiger, Thomas Engel
5. Basic Cheminformatics: A Textbook - By Mercato Inglese

Paper XXXII Phylogenetics and Molecular Evolution

Unit I: Molecular basics of evolution and Evolutionary change of amino acid sequences
Evolutionary tree of life, mechanism of evolution, structure, function of genes, mutational change of DNA, codon usage. Evolutionary change of amino acid sequences: Amino acid differences, proportion of different amino acids, Poisson correction, gamma distance, bootstrap variance, co variance, amino acid substitution matrix, mutation rate and substitution rate.

Unit II: Evolutionary change of DNA sequences
Nucleotide differences between sequences, estimation of nucleotide substitutions, gamma distances, numerical estimation of evolutionary distances, aligning of nucleotide sequence, handling sequence gaps in estimation of evolutionary distances. Synonymous and non synonymous nucleotide substitutions. Evolutionary pathway methods, likelihood methods with codon substitution

Unit III: Phylogenetic Trees and Different Methods for phylogenetic Inference
Phylogenetic trees: Types of phylogenetic trees, Topological differences, tree building methods. Phylogenetic inference- distance methods: UPGMA, LS methods, ME, NJ. Phylogenetic inference- Maximum parsimony method : finding Maximum parsimony trees, strategies of searching MP trees, consensus trees, estimation of branch lengths, weighted parsimonies, MP method for protein data, Phylogenetic inference- Maximum likelihood method: Computational procedure of ML methods, models of nucleotide substitutions protein likelihood methods, theoretical foundation of ML methods.

Unit IV: Accuracies, statistical test of phylogenetic trees and Molecular clocks & linearised trees
Accuracies, statistical test of phylogenetic trees : optimization, principle and topological errors, interior branch tests, bootstrap tests, tests of topological difference, advantages and disadvantages of different tree building methods. Molecular clocks and linearised trees: Molecular clock hypothesis, relative rate tests, phlyogenetic test, linearised trees.

Unit V: Genetic polymorphism and evolution
Ancestral amino acid and nucleotide sequences, Genetic polymorphism and evolution: evolutionary significance of genetic polymorphism, analysis of allele frequency data, DNA polymorphism, statistical tests for detecting selection. Population trees from genetic markers: genetic distance from allele frequency data, analysis of DNA sequence by restriction enzyme, analysis of RAPD data, statistical methods, genome projects, molecular biology and evolution

References:

1. Molecular Evolution and Phylogenetics-by Masatoshi Nei and Sudhir Kumar
2. Computational Methods in Phylogenetic Analysis - by Arun Jagota and Majid Masso
3. Phylogenetic Systematics -by by Willi Hennig, D Dwight Davis
4. The Phylogenetic Handbook: A Practical Approach to DNA and Protein Phylogeny -by Marco Salemi and Anne-Mieke
5. Statistical Methods in Molecular Evolution (Statistics for Biology and Health)- by Rasmus Nielsen
6. Molecular Evolution: A Phylogenetic Approach - by Roderic D. Page and Edward C. Holmes
7. Bioinformatics and Molecular Evolution - by Paul G. Higgs and Teresa Attwood
8. Techniques in Molecular Systematics and Evolution - by Rob DeSalle, Gonzalo Giribet, Ward Wheeler, and Go

Paper XXXIII (P) Object oriented programming using java

All assignments based on theory.

Paper XXXIV- (P) Wet lab II (Based on Genetics)

1. Estimation of proteins by folin Lowry and biurets methods.
2. Determination of isoelectric pH of amino acids.
3. Estimation of DNA.
4. Estimation of RNA.
5. Determination of Tm of DNA.
6. Isolation of protein-casein from milk, hemoglobin from RBC.
7. Staining of microorganism – gram staining, acid fast staining.
8. Microscopic examination of bacteria, yeast, and molds.

9. Isolation and maintenance of microorganism by plating techniques and serial dilution methods.
10. Isolation of pure cultures from soil, water, and air.
11. Growth curve of pure cultures from soil, water, and air.
12. Study blood group with the help of a kit.
13. Widal test.
14. Study of immune cells TLC/DLC.
15. Assay of antibiotics.
16. ELISA with kit.

Paper XXXV (P) Mini project

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SEMESTER V

Paper XXXVI (T) Recombinant DNA technology

UNIT I Enzymes used in Recombinant DNA Technology

Outline of Recombinant DNA technology. Essential Enzymes involved in Recombinant DNA Technology – Restriction endonucleases (Type I, II and III endonucleases). Recognition sequences. Ligation of DNA fragments and ligases. Its properties and specificity. DNA polymerases (Type I & II). Polynucleotide Kinases, phosphate and reverse transcriptase. Restriction digestion, ligation and transformation. System that safeguard DNA (DNA methylation and DNA repair)

UNIT II Cloning & Expression Vectors-Plasmids

Introduction Plasmids and Vectors. Lambda phage Vectors. M13 phage as a vector for DNA sequencing. Cosmids as vectors. Phagemids as vectors. BACs, PACS, YAC & MAC as vectors for cloning large DNA segments. Plant & animal viruses as vectors. Transposons as vectors.

UNIT III Chimeric DNA, Molecular probes and gene libraries

Restriction cleavage, construction of restriction map. Cloning in plasmid vector and lambda phage and cosmid vectors. Hosts for cloning vectors. Preparation of probes,labeling of probes. Amplification of DNA probe signals. Techniques used in molecular probing and applications of molecular probes. Recombinant DNA technology with reference to cloning and production of interferon and insulin. Applications of Genetically Engineered Microorganisms (GEMS)

UNIT IV PCR, Gene amplification and applications

Basic PCR. Different schemes of PCR. Inverse PCR, Anchored PCR, PCR site directed mutagenesis, Cloning, expression and sequencing of PCR products. Asymmetric PCR for DNA sequencing. PCR walking. Reverse transcribed (RT) PCR. Applications of PCR in Biotechnology and Genetic Engineering. Gene tagging, PCR for confirming the presence of transferred gene, human genetics using PCR. DNA fingerprinting using PCR.

UNIT V Molecular Maps

Molecular markers. Restriction fragment length polymorphism- RFLPs, Random Amplified Polymorphic DNAs (RAPDs), Variable Number of Tandem Repeats (VNTRs). Mini satellites, microsatellites, simple Sequence Repeats (SSRs). Ribosomal DNA. Amplified Fragment Length Polymorphism(AFLPs). Single Nucleotide Polymorphism (SNP).

Genetic maps using molecular makers. Cytogenetic maps using molecular markers and physical maps using molecular maps.

Reference:

1. Molecular Biology and Genetic Engineering by P. K. Gupta, Rastogi Publications, Meerut, 2005.
2. Genetic Engineering, 200 by Nicholl.
3. Principals of Gene Manipulations, 1994 by Old and Primrose, Blackwell Scientific Publications.
4. Biotechnology by B. D. Singh.
5. Genome by Brown.

Paper XXXVII (T) Computational Genomics

UNIT I Application Domains
Genome Project of Model organism, the human genome project, genetic diseases, Pharmaceutical bioinformatics and drug discovery, agri-food and Genomics

UNIT II DNA Technologies
Genomic mapping and positional cloning, with emphasis on plant science, sequencing technology, a DNA micro array fabrication strategy for research laboratories.

UNIT III Protein Technologies
Two dimensional gel electrophoresis and mass spectroscopy for proteomic studies, Proteome analysis by capillary electrophoresis.

UNIT IV Biotools
Using the molecular biology data, tools for DNA technologies, tools for protein technologies, structure informatics, genomics data representation through images, Interaction databases.

UNIT V Ethical, legal and social issues
Ethical aspects of genomics research and Banking, genomics-five years from now.

Reference:

1. Bioinformatics – A Practical guide to the analysis of genes & proteins by Andreas D. Baxevanis & B.F. Francis Ouellette, A John Wiely & Sons Publications.
2. Bioinformatics & Functional genomics by Jonathan Pevsner, A John Wiely & Sons Publications.
3. Essential of Genomics & Bioinformatics by C. W. Sensen, Wiely-VCH.

Paper XXXVIII (T) Immunology

Unit I: Basic Concept
Basic concept of immunity,innate immunity,its determinant & Significance,phagocytosis,acquired immunity,humoral cellular specificity of immune response,active & Passive immunity,Cells & Organs of immune system:hematopoisis,surface markers on cells on their differentiation,from pluripotent stem cell,primary lymphoid organs,lymphatic systems

Unit II Antigens & Antibodies
Immunogenecity & antigens: immunigenecity & antigenecity of a compound factor,influencing antigencity,haptons,adjuvant,epitopes,chemical basis of antigen specificity,biological system & immunogenecity.
Antibodies: Basic structure,time structure,classes of antibodies & their Biological activities,Antigeneic determinant of antibodies,forces of antigen,Antibody interaction.

Unit III The Recognition of Antigen
B-Cell receptor: structure & Organisation, Ig Super family,T-cell receptor: Structure & organization PCR-CD3 complex,T-cell accessory molecules,alloreactivity of T-cells,Alpha,Beeta,gamma,gega . T.cells
MHC: General Organisation & Inheritance,hyplotypes,structure & organization of class I & II MHC,Polymorphism MHC & its tissue distribution,its role in imuune responses,antigen processing,presentation of endogenous,exogenous antigen & non-peptide bacterial antigen,Self MHC restriction

Unit IV : Lymphocyte activation & regulation & Effector mechanism
T-cell: maturation in thymus,positive & negative selection in thymus activation by interaction with an presenting cell,signal transduction,accessory molecules,their role in activation of T-cell.Clonal energy,Machanism of tolerance, B-cells:Maturation,T-dependent & independent activation,germinal center,Ag induced B-cell differentiation.B-cells tolerance,effector mechanism: Cytokines as intracellular messenger,their properties,receptors,TH1 & TH2 balance,its significance,cell mediated effector mechanism,regulation of immune response

1.Roitt I M, Essential Immunology, Blackwell Scientific publication
2.Weissman L Wood,Immunology,Benjamin Cummings
3.Kuby-Immunology
4. Sities D P Basic & clinical Immunology Appleton & Lang Press
5. Ellis, Vaccinies,A new approach to immunology

6.W E Paul, Fundamental of Immunology,Ravan press
7. D M Weir-Experimental immunology,4 volume
8. Williams Paul- Fundamental of Immunology
9. Abbas-cellular & molecular Immunology
10.Rose-Manual of clinical & laboratory Immunology
11. Benjamin- Immunology, a short course
12.Joshi-Immunology
13.Janeway-Immunobiology
14.Brooks-Medical Microbiology

Paper XXXIX (T) Biophysical basis for Bioinformatics

Unit I Physicochemical concepts in Biomolecular Studies
Definition and scope of biophysics, water as an unusual solvent, molecular structure and physicochemical properties of water. Acid and bases, concept of pH, measurement and calculation of pH, buffers and stability of their pH, buffer capacity, titration behavior and ionization equilibria of biomolecules, pK and pI values, stereoisomerism and optical activity in amino acids and sugars.

Unit II Biophysical Aspects of Structural Organization of Biomolecules
Structural levels and physical configuration of proteins, Ramchandran plot and its significance, stabilizing forces and conformational properties of proteins, characteristics of protein folding, conformational properties and stabilizing forces of nucleic acids and their constituents, structural hierarchy in carbohydrates and lipid structures, concept and significance of macromolecular interactions in defining structure-function relationships, architecture of protein and nucleic acid assemblies.

Unit III Biomembrane organization and transport
Principles of membrane organization and stability, various membrane models, components of cell membrane, membrane fluidity, mobility of membrane proteins, specialization of plasma membrane, transport across membrane, concepts and mechanisms of simple and facilitated diffusion, electrodiffusion, osmosis, osmotic pressure, osmotic equilibrium, electro osmosis, mechanism of active transport, selectivity and iron specificity of biomembranes, role valinomysin and gramicidin in iron transport, exocytosis and endocytosis.

Unit IV Methods for Biophysical Characterization of Macromolecules
Production and properties of X-rays, principles of X-ray diffraction, Bragg's law, derivation of Bragg's equation, X-ray spectrometer, unit cell, reciprocal lattice concepts, Miller indicies and determination of crystal structure, crystallographic elucidation of Biomolecular structure, nature and significance of X-ray data for polypeptide and DNA. Principles of NMR spectrum, NMR spectrometer, chemical shift, spin-spin coupling, interpretation of NMR spectra, application of NMR in biomolecular characterization, ultracentrifugal analysis, sedimentation velocity, sedimentation equilibrium and density gradient centrifugal methods, principles and utility of UV-VIS, IR, Raman, CD and ORD spectra in biomolecular analysis, viscometric analysis of biomolecules.

Unit V Methods for Biophysical Characterization of Cellular Systems
Principle and utility of compound, phase constrast, interference, fluorescence, polarizing, and transmission and scanning electron microscopes, CCD camera, flow cytometry, radioisotope tracer techniques, computer assisted semen analysis, NP completeness, polynomial time, polynomial time verification, NP completeness and reducibility, NP completeness proof, NP complete problems.

Unit VI Data Structures

Reference:

1. Introduction to algorithms by Thomas Coreman, Leisersons, Rivest.
2. Data structures using C and C++ by Andrew Tanenbum.
3. Computer Algorithms by Horowitz and Sahani.

Paper XXXX Molecular Biology

Unit I

DNA as the vehicle of inheritance- Experimental evidence -Griffith, McLeod, McCarty and Avery,Herschey-Chase experiments.

Definition of Gene,organization of genes and non-coding DNA in prokaryotes and Eukaryotes - unique, moderately repetitive and highly repetitive DNA sequence, Satellite DNA.Cot value. (12 hrs)

Unit II

DNA replication in prokaryotes, mode of replication, Semiconservativo modes of replication. An overview of replication-replication eye, replication forks, semi discontinuous replication, Okazaki fragments, RNA primers-Enzymes of replication- DNA polymerases I, II, III, Topoisomerases, Helicases binding proteins and ligases. (12 hrs)

Unit III

Replication in E. coli-replisomes,event at OriC(initaion), events on the replication fork (elongation) and termination.Fidelity of replicaion σ (sigma) or rolling circle mode of replication in φ 4 x174.Eukaryotic DNA polymerases. Inhibitors of replication.(12 hrs)

Unit IV

Repair of DNA - types of damages,repair by direct reversal of damage, excision repair, recombination reopair, SOS repair. Mutation-definition, type of mutations such as (spontaneous and induced) point mutation.

Gene mutation and chromosomal aberrations. Cause of mutation-chemical and physical agents. (12 hrs)

Unit V

Recombinant DNA technology-Role of restriction endo-nucleases,plasmid and cosmid cloning vectors.

Brief outline of molecular cloning.Applications or recombinant DNA technology. (12 hrs)

BOOKS RECOMMENDED

1. Biochemistry of Nucleic acids-Adam et al
2. Molecular Biology -David Friefelder
3. Molecular Biology of gene-James and Watson
4. Principle's of Biochemistry-Lehninger, Nelson and Cox.

Paper XXXXI (T)Data structure and algorithm

UNIT-I
Introduction to data structures, Abstract data types

Stacks - Introduction to stack & primitive operation on stack, Stack as an abstract data type, Stack's applications - Infix, post fix & Prefix expressions, Recursion, Multiple stacks

Queues -Introduction to queues, Primitive Operations on the Queues, Queue as an abstract data type, Circular queue, Dequeue, Priority queue.

UNIT-II
Linked List - Introduction to the Linked List, Operation on Linked List, Linked List representation of stack and Queue,Header nodes.

Types of Linked List - Doubly Linked List, Circular Linked List, Application of Linked List.

UNIT-III
Trees -Basic Terminology of Trees, Binary Trees, Tree Representations as Array & Linked List

Binary tree representation, Traversal of binary trees - In order, Preorder & post order, Application of Binary tree, Threaded binary tree

Balanced tree, AVL tree, B-tree, B+ & B* trees, Conversion of General Tree to Binary Tree, Counting Binary Trees, 2-3 Trees, algorithm for manipulating 2-3 Trees.

UNIT-IV
Searching - Sequential Searching, Binary search and their Comparison.

Sorting - External & Internal sorting, Insertion sort, Selection sort, Quick sort, Bubble sort, Heap sort, Merge sort, Comparison of sorting methods Algorithms of sorting and searching in Linked list and Arrays.

UNIT–V
Tables - Hash table,Collision resolution Techniques.

Graphs - Introduction to graphs, Basic Terminology, Directed, Undirected & Weighted graph, Representation of graphs, Warshall's algorithem for path matrix and shortest path

Graph Traversals-Depth first & Breadth first search.

Spanning Trees, minimum spanning Tree, The basic Greedy Strategy for computing Algorithm of Kruskal, and Prim

Applications of Graphs : Shortest path and Longest Path Problems.

Reference:

fundamentals of data structure by *s. sawhney & e. horowitch*
data structure by *tremblay & sorrenson*
data structure *schaum's outline series, mcgraw hill publication*

Paper XXXXII (P) Seminar on Emerging Area of bioinformatics

Paper XXXXIII (P) Computational Genomics

UNIT I Application Domains
Genome Project of Model organism, the human genome project, genetic diseases, Pharmaceutical bioinformatics and drug discovery, agri-food and Genomics

UNIT II DNA Technologies
Genomic mapping and positional cloning, with emphasis on plant science, sequencing technology, a DNA micro array fabrication strategy for research laboratories.

UNIT III Protein Technologies
Two dimensional gel electrophoresis and mass spectroscopy for proteomic studies, Proteome analysis by capillary electrophoresis.

UNIT IV Biotools
Using the molecular biology data, tools for DNA technologies, tools for protein technologies, structure informatics, genomics data representation through images, Interaction databases.

UNIT V Ethical, legal and social issues
Ethical aspects of genomics research and Banking, genomics-five years from now.

Suggested Reading:

4. Bioinformatics – A Practical guide to the analysis of genes & proteins by Andreas D. Baxevanis & B.F. Francis Ouellette, A John Wiely & Sons Publications.
5. Bioinformatics & Functional genomics by Jonathan Pevsner, A John Wiely & Sons Publications.
6. Essential of Genomics & Bioinformatics by C. W. Sensen, Wiely-VCH.

Paperr XXXXIV (P) Mini project / Wet Lab V (Based on Immunology ,virology, RDT)

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SEMESTER VI

Paper XXXXV (T) Principle of Molecular Genetics

UNIT I
Early concepts of inheritance; Discussion on Mendel's paper; Sex determination, differentiation and sex-linkage, Sex-influenced and sexlimited traits; Linkage, recombination and genetic mapping in eukaryotes, Somatic cell genetics.

UNIT II
Structural and numerical changes in chromosomes; Nature, structure and replication of the genetic material; Organization of DNA in chromosomes; Mutations and mutagenic agents.

UNIT III
Genetic code and protein biosynthesis; Gene regulation, Genes in development; Extra chromosomal inheritance, Male sterility and incompatibility; Recombination in bacteria, fungi and viruses, tetrad analysis.

UNIT IV
Inheritance of quantitative traits; Concepts in population genetics; Genes and behavior; Genetics and evolution; Recombinant DNA technology;Genetic fine structure analysis, Split genes, Transposable genetic elements, Overlapping genes, Pseudogenes, Oncogenes, Gene families; An overview of some recent discoveries in the field of genetics.

Reference:
Klug WS & Cummings MR. 2003 *Concepts of Genetics*. Peterson Education.
Lewin B. 2008. *Genes IX*. Jones & Bartlett Publ.
Russell PJ. 1998. *Genetics*. The Benzamin/Cummings Publ. Co.
Strickberger MW.1990. *Genetics*. Collier MacMillan.
Tamarin RH. 1999. *Principles of Genetics*. Wm. C. Brown Publs.
Uppal S, Yadav R, Subhadra & Saharan RP. 2005. *Practical Manual on*

Paper XXXXVI (T) Environmental Science

UNIT I
Definition, Scope and Importance of Environmental Science: Definition; Multidisciplinary nature of the environmental Science; Scope and importance; Introduction to global environmental problems.
Physical and Chemical Environment of Man: Evolutionary history of the earth; Ecosphere and its components such as Atmosphere, Hydrosphere, Lithosphere and Biosphere; Structure of atmosphere; Physical parameters of the earth like solar radiation, pressure, humidity, visibility and climate etc.; Distribution of water on the earth; Hydrological cycle.

UNIT II
Ecological Concepts: Definition and scope of ecology; Subdivisions of Ecology, Concept of Ecosystems, their structure and functioning; Energy flow; Food chains and food webs; Ecological pyramids; Biogeochemical cycles of nitrogen, oxygen and carbon, Types of Ecosystems, Aquatic, deserts, forests and grassland ecosystems.

UNIT III
Environment and the Human Population: Population growth and its dynamics; Population growth patterns; Age pyramids; Malthus theory; Distribution of the world population; Problems of population explosion; Family welfare programmes.

UNIT IV
Environmental Pollution: Definition, sources, effects and control; Air, water, marine, noise and thermal pollution; Nuclear hazards; Pollution from solid wastes and its management; Drinking water treatment. ` (6)
Socio-Environmental Issues and Environmental Ethics: Sustainable

development; Energy related problems; Nuclear accidents; Problems of resettlement and rehabilitation of people with examples; Environmental effects of urbanization, industrialization and consumerism; Stockholm Conference on Human Environment; Environmental ethics.

Reference:

1. Environmental Science – Enger, Smith and Smith W.M.C. Brown company publication
2. Environmental Science - Taylar and Miller
3. Environmental Biology – Vishwaswarup Mukahrjii
4. Environmental Science – Botkin and Kelter, John Wiley and Sons, New York.
5. Environmental Science – S.C. Santra
6. Principles of Environmental Biology – Nayer
7. Fundamental of Ecolgoy – Odum E.P.
8. Environmental Science - Neble

Paper XXXXVII (T) Enzymes and Metabolism

Unit I

Introduction - chemical nature and general characterization - nomenclature, IUB system of enzyme classification, specificity, enzyme units, active site, mode of action - Lock and key theory and induced fit theory.

Enzyme Kinetics - Introduction to chemical kinetics, rate and order of reactions, factors affecting the enzyme activity, derivation of Michaelis - Menton Equation. Line - Weaver and Burk plot, Eadie- Hofstee plot. Enzyme inhibition - Competitive, non- competitive and uncompetitive inhibitions (kinetic derivations not required). (12 hrs)

Unit II

Introduction -free energy - free energy of hydrolysis of ATP and other organophosphates.

Role of High energy compounds - Electron transport chain- Components and reactions of ETC. Role of ETC - Oxidative Phosphosylation - Chemi Osmotic hypothesis. P/O ratio, uncouplers of oxidative phosphorylation. (12 hrs)

Unit III

Introduction to intermediary metabolism. The basic metabolism pathways,anabolic, catabolic and amphibo lic pathways.

Approaches to biochemical investigations, perfusion of isolated organ, slice techniques, trace techniques and mutant studies for elucidation of metabolic pathways. (12 hrs)

Unit IV

Carbohydrate metabolism - fate of absorbed carbohydrates. The glycolytic pathway - aerobic and anaerobic glycolysis, energitics, glucogenolysis, regulation of glygogen metabolism, citric acid cycle and its regulation. (12 hrs)

Unit V

Pentose phosphate pathway. Uronic acid pathway. Gloxylate cycle - Entner - Duodroff pathway. Fate of fructose, galactose and mannose. Photosynthesis-light and dark reactions. (12 hrs)

Reference:

1. Enzymes Seagal
2. Biochemistiy Voet and Voet
3. Harper's Biochemistry - Murray
4. Biochemistry - Stryer
5. Text book of Biochemistry - SathyaNarayana

Paper XXXXVIII (T) Introduction to PERL language

UNIT I
Getting started with Perl
Accessing and installing Perl and BioPerl
Running Perl programs ,Editors , Finding help , Using modules, The Art of Programming

UNIT II

The Programming process , Algorithms , Sequences and Strings , Variables , Arrays
Files , Motifs and Loops , Flow control ,String operators , Writing files , Subroutines

UNIT III

Arguments , Command line arguments , Passing data to subroutines , Modules and Libraries , Debugging .

UNIT IV

Hashes , Translating DNA into Proteins , Working with the FASTA Format ,
Reading frames , Introduction to Regular Expressions

Reference:
Introduction to Perl , O'Reilly
Perl Black Book, Perl Black Book-2nd Edition Holzner Steven, Dreamtech
Beginning Perl for Bioinformatics

Paper XXXXIX (T) Biodiversity & Taxonomy

UNIT I
Basic concept of Biodiversity – What is Biodiversity, Why should we conserve it, Elements of Biodiversity - Ecosystem Diversity, Genetic Diversity, Species Abundance & Diversity, Patterns ofSpecies Diversity.
Global patterns of Biodiversity – measuring biodiversity, Cataloging and Discovering Species,Geographical Patterns of Species Richness, Biogeography, Importance of Distribution Patterns(Local Endemics, Sparsely Distributed Species, Migratory Species), GAP Analysis.

UNIT II
Biodiversity & Conservation – Overexploitation threatening living species,
International Trade, Animals threatened by International trade, Controlling International Trade (Enforcement, Reservations, Illegal Trade), Free
Trade & the Environment, Free Trade & Conservation, Common patterns of
Overexploitation.
Exotic Species – Plants, Invertebrates, Fishes, Amphibians, Reptiles, Birds, Mammals, Detrimental .Effects of Exotic Species.
Endangered Species Conservation – The US Endangered Species Act, State
Endangered Species Acts Successes and Failures of the Endangered Species Act, Role of ESA in Habitat Protection, Critical Habitat, Problems with the Endangered, Species Act, Habitat Conservation Plans. (5 Periods)

UNIT III
Ethics of Conservation – Values of Biodiversity, Biopiracy, Hybridized plants, GM crops (benefits & criticism), Economic Value of Biodiversity & Legal, Ethical and Conservation issues related to uses of biodiversity, Global Conservation Issues.

UNIT IV

Basic concept of Taxonomy – Classification, Construction of Phylogenetic tree, Systematics, Cladistics, Cladograms, Phenetics, Nomenclature.

Taxonomy in relation to Chromosomal morphology & Evolution – chromosomal evolution, whylocation of genes matter, evolutionary oddities about chromosomes, evolutionary effect of rearrangements of chromosomes, karyotypic orthoselection, chromosomal evolution & speciation.

UNIT V

Molecular Taxonomy in relation to DNA characteristics & Protein sequences – modes of molecular evolution, Neutral theory of Molecular evolution, genetic markers for taxonomic purposes, comparing total genome by DNA-DNA hybridization, comparing DNA sequences,

Cladistics, biological identification through DNA barcodes, chromosome painting, establishing molecular homology using protein sequences.

Paper XXXXX (P) Major Project

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