।। सा विद्या या विमुक्तये ।।
स्वामी रामानंद तीर्थ मराठवाडा विद्यापीठ, नांदेड
"ज्ञानतीर्थ" परिसर, विष्णुपूरी, नांदेड - ४३१६०६ (महाराष्ट्र)
SWAMI RAMANAND TEERTH MARATHWADA UNIVERSITY NANDED
"Dnyanteerth", Vishnupuri, Nanded - 431606 Maharashtra State (INDIA)
Established on 17th September 1994 – Recognized by the UGC U/s 2(f) and 12(B), NAAC Re-accredited with 'A' Grade
25 1994 - 2019 SILVER JUBILEE YEAR

ACADEMIC (1-BOARD OF STUDIES) SECTION

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संलग्नित महाविद्यालयांतील विज्ञान व तंत्रज्ञान विद्याशाखेतील पदव्युत्तर स्तरावरील प्रथम वर्षाचे CBCS Pattern नुसारचे अभ्यासक्रम शैक्षणिक वर्ष २०१९–२० पासून लागू करण्याबाबत.

प रि प त्र क

या परिपत्रकान्वये सर्व संबंधितांना कळविण्यात येते की, **दिनांक ०८ जून २०१९ रोजी संपन्न झालेल्या ४४व्या मा. विद्या परिषद बैठकीतील ऐनवेळचा विषय क्र.११/४४–२०१९** च्या ठरावानुसार प्रस्तुत विद्यापीठाच्या **संलग्नित महाविद्यालयांतील विज्ञान व तंत्रज्ञान विद्याशाखेतील पदव्युत्तर स्तरावरील प्रथम वर्षाचे** खालील विषयांचे **C.B.C.S. (Choice Based Credit System) Pattern** नुसारचे अभ्यासक्रम शैक्षणिक वर्ष २०१९–२० पासून लागू करण्यात येत आहेत.

1. Bioinformatics
2. Biotechnology
3. Boichemistry
4. Botany
5. Chemistry
6. Computer Management
7. Computer Science
8. Dairy Science
9. Environmental Science
10. Herbal Medicine
11. Information Technology
12. M.C.A.
13. Microbiology
14. Physics
15. Software Engineering
16. System Administration & Networking
17. Zoology

सदरील परिपत्रक व अभ्यासक्रम प्रस्तुत विद्यापीठाच्या **www.srtmun.ac.in** या संकेतस्थळावर उपलब्ध आहेत. तरी सदरील बाब ही सर्व संबंधितांच्या निदर्शनास आणून द्यावी.

'ज्ञानतीर्थ' परिसर,
विष्णुपुरी, नांदेड – ४३१ ६०६.
जा.क्र.: शैक्षणिक–१/परिपत्रक/पदव्युत्तर–सीबीसीएस अभ्यासक्रम/२०१९–२०/**४६४**
दिनांक : ११.०७.२०१९.

स्वाक्षरित/–
उपकुलसचिव
शैक्षणिक (१–अभ्यासमंडळ) विभाग

प्रत माहिती व पुढील कार्यवाहीस्तव :

१) मा. कुलसचिव यांचे कार्यालय, प्रस्तुत विद्यापीठ.
२) मा. संचालक, परीक्षा व मूल्यमापन मंडळ यांचे कार्यालय, प्रस्तुत विद्यापीठ.
३) प्राचार्य, सर्व संबंधित संलग्नित महाविद्यालये, प्रस्तुत विद्यापीठ.
४) साहाय्यक कुलसचिव, पदव्युत्तर विभाग, प्रस्तुत विद्यापीठ.
५) उपकुलसचिव, पात्रता विभाग, प्रस्तुत विद्यापीठ.
६) सिस्टम एक्सपर्ट, शैक्षणिक विभाग, प्रस्तुत विद्यापीठ.

Swami Ramanand Teerth Marathwada University, Nanded

SYLLABUS M.Sc. BIOINFORMATICS

CHOICE BASED CREDIT SYSTEM (June 2019)

Semester	Code	Title of the Course	Hr/Week	Type of Course	Credit	Marks		Total
						ESA	CIA	
I	BI-I	Fundamentals of Bioinformatics	4	CC	4	75	25	100
	BI-II	Biochemistry	4	CC	4	75	25	100
	BI-III	Computing foundations in Bioinformatics	4	CC	4	75	25	100
	BI-IV (Elective)	(I) General Microbiology (II) Cell Biology and Genetics	4	DSE	4	75	25	100
	Lab course-I	Practicals based on course BI-I and BI-II	4+4	PR	4	100		100
	Lab course-II	Practicals based on course BI-III and BI-IV	4+4	PR	4	100		100
	Total for Sem -I				**24**	**500**	**100**	**600**

Semester	Code	Title of the Course	Hr/Week	Type of Course	Credit	Marks		Total
						ESA	CIA	
II	BI-V	Molecular Biology and Genetic Engineering	4	CC	4	75	25	100
	BI-VI	Immunoinformatics	4	CC	4	75	25	100
	BI-VII	Programming using C++	4	CC	4	75	25	100
	BI-VIII (Elective)	(I) Databases and tools in Bioinformatics (II) Biodiversity and Phylogenetic Analysis	4	DSE	4	75	25	100
	Lab course-III	Practicals based on course BI-V and BI-VI	4+4	PR	4	100		100
	Lab course-IV	Practicals based on course BI-VII and BI-VIII	4+4	PR	4	100		100
	Total for Sem -II				**24**	**500**	**100**	**600**

M.Sc. Bioinformatics (Semester Pattern) I Semester

BI -I: Fundamental of Bioinformatics Marks: 75 Hours: 45

Salient features: To understand basic concept of Bioinformatics
Utility of course: To uncover computational Approach & databases in Bioinformatics.
Learning Objective: The student should be able to understand basic research methods in bioinformatics.
The student will choose biological data, submission and retrieval it from databases and design databases to store the information. To understand the essential features of the interdisciplinary field of science for better understanding biological data also able to demonstrate the bioinformatics databases, perform text-and sequence-based searches and analyze the results.
Prerequisites: basic knowledge about Biomolecules, computer operation and knowledge of Internet.

Unit – I: Introduction
Various Definitions; History of Bioinformatics; Bioinformatics in business; Scope of Bioinformatics; Bioinformatics Applications; Nature of biological data.

Unit – II: Introduction to Biological databases
What is Database? Types of Databases; Biological databases: Primary databases Protein sequence databases Structural databases Derived Databases Specialized Microarray databases. Genome & genetic disorders Genome databases;

Unit – III: Information Search and data retrieval
General propose search engine - Google, biological Search engine -Entrez, SRS etc. Bibliographic resources related to Life Sciences viz., PubMed, BioMed Central, etc warehousing and Data mining concept. Database Similarity Searching – FASTA, BLAST. Searches on Medline, etc.

Unit – IV: Sequence Alignments and Visualization
Introduction to Sequences, alignments and Dynamic Programming; Local alignment and Global. Alignment (algorithm and example), Pairwise alignment (BLAST and FASTA Algorithm) and Multiple sequence alignment (Clustal W algorithm)

Unit – V: Scoring Matrices
PAM, BLOSUM, etc

References
1. Computers Today by Sanders D. H., McGraw Hill.
2. Fundamentals of Computers by Rajaraman V., PHI.
3. Computer Fundamentals by P. K. Sinha.
4. Computer Architecture and Organizations by J. P. Hayes, Mc Graw Hill.
5. Computer Network by Andrew S. Tanenbaum, PHI.
6. Inter Networking With TCP/IP: Principles, Protocol And Architecture by
7. D.E. CornerVol1, 2nd Edition Prentice Hall, 1991.
8. Linux. The Complete Reference.

Practical:
1. Study architecture of computer system. 2. Study of different modern computers.
3. Study of computer networks and network topologies
4. Study of internet ,
5. Practical bases on Windows o/s
6. Practical bases on Linux O/S

BI -II: Biochemistry Marks: 75 Hours: 45

Salient features: To understand basic concept Biochemistry.
Utility of course: To Identify and define different types of biomolecules. Important structural features of Biomolecules and Stabilizing interactions.
Learning Objective: Understand the principles, concepts and facts in different types of Biomolecules
Prerequisites: basic knowledge about Biomolecules.

Unit – I:
Biochemistry: Chemical basis of life; Composition of living matter; Structure of atoms, molecules and chemical bonds. Water -properties, pH, ionization and hydrophobicity. Thermodynamic principles in biology, Concept of free Energy and redox potential Stabilizing interactions (Van der Waals, electrostatic, hydrogen bonding, hydrophobic interaction,etc.).
Unit-II:
Nucleic acids: Primary, secondary and tertiary structure of nucleic acids, double stranded DNA and biological significance, forms of DNA, Physical properties of double stranded DNA, Types of RNAs and their biological significance. DNA Supercoiling
Unit – III:
Carbohydrates: Classification occurrence, structure, function and properties of monosaccharide, oligosaccharide and polysaccharides. **Lipids:** Classification, structure and functions of major lipids, Triglycerides, Phospholipids, Glycolipids and lipoproteins-structure and function. Role of lipids
Unit – IV:
Proteins: Properties and classification, primary, secondary, tertiary and quaternary structure of proteins with example, structural comparison at secondary and tertiary levels. Ramachandran plot.
Unit – V:
Enzymes: Historical perspectives, general characteristics, nomenclature and classification. Methods of isolation, purification and characterization of enzymes. Concept of enzyme assay, enzyme activity, coenzymes and isoenzymes. Principles of catalysis.

Text and Reference:
1. Principles of Biochemistry - Lehninger , Nelson, Cox, CBS publishers
2. Fundamentals of Biochemistry - Voet and Voet- John Wiley and Sons, Inc.
3. Biochemistry - Zubay - WCB publishers
4. Harper's Biochemistry - R.K.Murray, D.K.Granner, P.A.Mayes –McGraw Hill
5. Biochemistry - L. Stryer-W.H. Freeman
6. Biochemistry –Rawn
7. Biochemistry- U Satyanarayana
Practicals:
1. Study of General and Safety Rules of Biotechnology Laboratory
2. Concept of Buffers, pH, Morality and Normality (Problem solving and preparation)
3. Reaction of amino acids, sugars, lipids
4. Estimations of Carbohydrates and Sugars
5. Estimation of amino acids, proteins
6. Titration of amino acids and determination of pKa
7. Estimations of DNA & RNA
8. Enzyme activity study
9. UV visible fluorescence & IR spectroscopy absorption spectra

BI-III Computing foundations in Bioinformatics Marks: 75 Hours: 45

Salient features: To understand basic concept computer and use of internet.

Utility of course: get acquainted with fundamentals of computers, use various operating systems and Understand basic concepts in computing and networking

Learning Objective: Understand the basic concepts, types and working of compute.

Prerequisites: basic knowledge about computer

Unit – I:

Overview and functions of a computer system, storage, devices, memory, etc.Types of Processing: Batch, Real-Time, Online, Offline Types of modern computers: The workstation, The Minicomputer, Mainframe Computers, Parallel Processing Computer, The Super Computer, etc. The Internet and its Resources, World Wide Web (WWW): associated tools, services, resources and various terminologies; Introduction to operating systems; File System Concept – NTFS, Fat, ext, etc.

Unit – II:

OSI Reference Model, TCP/IP, topologies and protocols, designing networks; 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) Network security fundamentals: types of attacks, firewall, packet filtering

Unit – III:

Classification of data security threats, protection mechanism (authentication, access control, access rules) An overview of Computer viruses: How do they get transmitted? What are the dangers? General Precautions to be taken. Encryption/Decryptions techniques; Current & future technologies (Grid Computing, VPN, Cloud computing, wireless, mobile computing, biometrics etc.)

Unit –IV:

Features of MS Windows – GUI, Multitasking etc. Elements of Windows – Desktop, Windows, Applications, Icons, Group window etc. Main modules of Windows O.S. – Program Manager, File manager, Control Panel, Networks, Print manager. Switching between applications – Running MS DOS applications, Windows Help. Study of Windows important files – DLL, INI, etc.

Unit –V:

Introduction to Linux – Features of Linux; Hardware Requirements Installation. Linux Commands and Utilities – Add User, alias, at, banner, batch, bind, cat, cd, chmod, chown, chroot, cp, cpio, dc, dd, df, dir, du,dump, grep, zip, unzip, gzip, halt, hostname, kill, locate, lpc, lpd, lpr, lprm, ls,mail, man, mcopy, mdel, mdir, mformat, mkdir, mlevel, more, mount, mt, mv, passwd, ping, , ps, pwd, rm , rmdir, set, shutdown, sort, stat, su,tar,tree, umount, unzip, vdir, vi, view, wc, who, whoami, zip,

References

1. Computers Today by Sanders D. H., McGraw Hill.
2. Fundamentals of Computers by Rajaraman V., PHI.
3. Computer Fundamentals by P. K. Sinha.
4. Computer Architecture and Organizations by J. P. Hayes, Mc Graw Hill.
5. Computer Network by Andrew S. Tanenbaum, PHI.
6. Inter Networking With TCP/IP: Principles, Protocol And Architecture by
7. D.E. CornerVol1, 2nd Edition Prentice Hall, 1991.
8. Linux. The Complete Reference.

Practical:

1. Study architecture of computer system
2. Study of different modern computers.
3. Study of computer networks and network topologies
4. Study of internet
5. Practical bases on Windows O/S and Linux O/S

BI-IV (Elective) - (I) Microbiology **Marks: 75 Hours: 45**

Salient features: To understand basic concept of microbiology

Utility of course: get acquainted with fundamentals of microbiology.

Learning Objective: To make students understand the essential features of the microbiology

Prerequisites: Basic knowledge of microorganism

Unit - I:

History of Microbiology, Development of Microbiology in 19thcentury, Developments in 20thand 21stCenturies with respect to Vaccination and Chemotherapy and Contributions of Nobel Laureates in Immunology, Molecular Biology & Biotechnology, Applications of Microbiology.

Unit - II:

Morphological and differentiating characters of microorganisms: Bacteria Rickettsia Protozoa Algae Fungi (Molds and Yeasts) Viruses, viroids and prions Principles in classification of Bacteria (Introduction to Bergey's Manual of Determinative and Systemic Bacteriology) and viruses (ICTV)

Unit – III:

Units of measurement. Modern SI units (Length, volume, Weight) Microscopy : Bright field microscopy: Structure, working of and ray diagram of a compound light microscope; Concepts of magnification, numerical aperture and resolving power. Types, ray diagram and functions of – condensers, eye-pieces and objectives Aberrations in lenses - spherical, chromatic, comma and astigmatism Principles, construction, working and applications of: i.Dark field microscopy ii.Fluorescence microscopy Confocal microscopy

Unit - IV:

Staining Techniques and Sterilization and Disinfection

Unit - V:

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

Text and Reference:

1. General Microbiology-Stainer.- MacMillan Press Ltd.
2. Brock, Biology of Microorganisms, Madigan, M.T.. Martinko. -Prentice Hall.
3. Microbiology, Pelczar, M.J. Jr., Chan, E.C.S. and Kreig, N.R., -Tata McGraw Hill.
4. Microbial Genetics, Freifelder, D. -Jones, Bartlett Publishers.
5. Microbiology - A Laboratory Manual, Cappuccino, J.G. and Sherman, N. -Addison Wesley.
6. Bacterial and Bacteriophage Genetics– Edward Birge- Springer
7. Mathews Plant Virology- Academic Press
8. Virology Principles and Applications- John Carter, Venetia A. Saunders-Wiley
9. Introduction to Modern Virology IV l edition- Dimmock, Primrose
10. Plant Virus- M.V. Nayudu- Tata McGraw Hill

Practicals :

1. Preparation of liquid and solid media for growth of microorganisms.
2. Isolation and maintenance of organisms from soil and water by plating, streaking and serial dilution
3. Plate, Slants and stab cultures, Storage of microorganisms.
4. Study of microbial growth and factors affecting on growth temperature, pH, carbon and nitrogen
5. Staining and Microscopic examination of bacteria, yeast and molds
6. Assay of antibiotics and demonstration of antibiotic resistance.
7. Analysis of potable water and determination of MPN.
8. Biochemical characterization of selected microbes.
9. Measurement of Size of microorganism by Micrometry

BI-IV (Elective) - (II) Cell Biology and Genetics Marks: 75 Hours: 45

Salient features: Describe the important structure and function of the cell and all cell organelles
Provide basic genetic terminology and describe the organization and development of the genetic makeup on cellular, chromosomal and gene level and be able to explain the basic molecular genetics mechanisms in relation to the structure and function of the cells. Explain different hereditary patterns for genetic diseases and be able to describe different ways at a general level to identify disease genes
Utility of course: Describe in general terms how life began on earth. Students will able to study the organic and inorganic molecules which are necessary for life and explain the structure and function of organelles.

Learning Objective: On completion of this course students will be able to acquire knowledge about cell, cellular Architecture cell division and cell cycle. Basic microbial genetics and Human genetics

Prerequisites: Basic knowledge about cell and genetics

Unit - I:
Origin of Life Prokaryotic & Eukaryotic Cells (Cellular Architecture) Structural Organization and Function of Intracellular Organelles Cell Membrane – Structure and Function Membrane Transport
Unit - II:
Genomic Organization in Prokaryotes & Eukaryotes, Cell Division and Cell Cycle
Unit - III:
Cell Signaling – Different mechanisms of signal transduction, concepts in signal network, second messenger, molecules involved in various signaling pathways such as G-protein coupled receptors, protein kinases, calcium binding proteins; Cancer.
Unit - IV:
Heredity and Variation Mendelism – Experiments in Garden Pea, Monohybrid & Dihybrid Crosses, Dominance,
Segregation and Independent Assortment.
Unit - V:
Alleles, Multiple Alleles, Gene Interactions, Epistasis, Pleiotropy, Complementation Tests. Linkage, Crossing over and chromosome maps, chromosome theory of Inheritance. Maternal effects and Cytoplasmic inheritance.

References
1. Campbell, Essential Biology (Abridged), Cambridge.
2. Starr & Taggart, Biology: The Unity and Diversity of Life.
3. Geoffry.M Cooper and Robert.E.Hansmann : The Cell
4. Gardner E : Principles of Genetics
5. Gupta P.K : Cytology, Genetics and Evolution
6. Snustad, Simmons: Principles of Genetics.
7. Introduction to Genetic Analysis Eighth Edition, Griffiths, Wessler

Practical:
1. Problems based on Genetics.
2. Cell types of plants- Microtomy/ maceration of various tissue explants and identification
3. Study of Mitosis and Meiosis
5. Study of Membrane transport, osmosis
6. Microscopic observation and staining of microbes and cells
7. Study of karyotypes of genetic disorders and normal
8. Cell fractionation and study of cell organelles

M.Sc. Bioinformatics (Semester Pattern) II Semester

BI-V Molecular Biology and Genetic Engineering Marks: 75 Hours: 45

Salient features: To understand basic concept of Molecular Biology and Genetic Engineering

Utility of course: To uncover molecular biology and Genetic Engineering

Learning Objective: To study and understand the Genomic Organization in Prokaryotes and Eukaryotes, Transcription in Prokaryotes and Eukaryotes and techniques in biology

Prerequisites: basic knowledge molecular biology and genetics engineering.

Unit – I:

Genomic Organization in Prokaryotes and Eukaryotes. Chromosome and Chromatin Structure, Structural and Numerical alterations of Chromosomes. Gene Mutations and their molecular basis Experiments Proving genetic material is stored in DNA, Cot Curve, C value paradox.

Unit – II:

DNA replication in Prokaryotes and Eukaryotes; DNA replication in □phage and □ X174 (Rolling Circle Replication), DNA damage, DNA repair, DNA recombination. Mechanisms of Transpositions in eukaryotes and Viruses with specific examples

Unit – III:

Transcription in Prokaryotes and Eukaryotes; Post transcriptional processing in Prokaryotes and Eukaryotes; Structural and functional aspects of Genetic Code; Mechanism of Translation : Protein Synthesis and Post – Translational Modifications Gene regulation: Operons Lac, Tryptophan and Arabinose Operons. Gene regulation in Eukaryotes: Gene silencing, RNA interference.

Unit – IV: Techniques of Gene Manipulation and Enzymes involved. Vectors- Plasmids Phages, Artificial vectors –Cosmids, Phas.mids and Expression vectors. Methods of Gene Transfer, Identification of recombinant DNA and transformants, Construction of gene libraries, cDNA and Genomic Library, Applications of rDNA Technology

Unit – V:

Polymerase chain reaction, Gene sequencing –enzymatic and chemical, shotgun sequencing. Blotting techniques, Molecular markers : Physical and Genetic RFLP, RAPD, AFLP, SNP etc, DNA Finger printing and DNA foot printing DNA Bar coding, Chromosome Walking, Chemical Synthesis of Gene.

References

1. Molecular Biology of the Gene : James D.Watson
2. Robert F. Weaver : Molecular Biology
3. Watson J.D: Molecular Biology of the Gene.
4. Old R.W Primrose: Principles and Techniques of Gene Manipulation
5. Lewin B: Gene VIII
6. Frefielder D: Essentials of Molecular Biology
7. T.A. Brown: Gene Cloning and DNA Analysis
8. Peter J Russell: Genetics A Molecular approach
9. Fundamentals of Cell and Molecular biology-Baig, Telang and Ingle-Amruta

Practicals

1. Study and isolation of mutants by Replica plate technique
2. Isolation of antibiotic resistant bacteria by gradient plate method
3. Study to mutation and repair in bacteria /yeast
4. Study of spontaneous mutation by Fluctuation test
5. Isolation of genomic DNA/RNA from bacteria, animal and plant cells.
6. Isolation of plasmid DNA /Phage DNA.
7. Spectroscopic analysis of DNA/ RNA
8. Agarose gel electrophoresis.
9. Study of in vitro transcription and translation

BI-VI Immunoinformatics Marks: 75 Hours: 45

Salient features: To understand basic concept of immunology and informatics databases
Utility of course: To make students understand the essential features of immunology and informatics databases
Learning Objective: The student should be able to understand basic immunology and databases for immunology.
Prerequisites: basic knowledge about immune system.

Unit – I:

infection, immunity, types of immunity, Cells and organs of immune system. Humoral and cellular immune response. Activation of T and B cells Cytokines. Immunoregulation; Hybridoma Technology, Monoclonal antibodies, immunoglobulins. Antigen, Antibodies, Antigen-antibody reactions. Complements and complement activation.

Unit – II:

B cell differentiation B cell, membrane proteins. T cell differentiation, T-cell receptor complex, Major histocompatiability complex, MHC restriction.

Unit – III:

Immunostimulants, immunomodulants and ELISA. Immunologic tolerance. Hypersensitivity, Auto immunity, Immuno deficiency diseases. Transplantation immunology, tumor immunology and immune hematology.

Unit – IV:

MHC peptides –Structure and interactions QSAR based predictions of epitopes. Epitope modification, epitope mapping tools, Allergenicity prediction. Vaccine design and system immunology.

Unit – V:

Immunological Databases - AntigenDB database, Kabat database and HLA Database Tools - IgBLAST PREDEP

References

1. Roitt Elbs: Essential Immunology
2. Kuby immunology Kindt Goldsby
3. DAVID J Hentges Microbiology and Immunology
4. Paul W.E Fundamental immunology
5. Helen Chappel $ Mansel Haeney Essential clinical immunology
6. R.Ananthanarayan and C.K. Jayaram: Text book of Microbiology
7. John W Kimball MAXWELL Introduction to immunology
8. Daren R. Flower Immunoinformatics predicting Immunogenicity In Silico.

Practical:

1. Determination of ABO Blood group
2. Determination of total leukocyte count
3. Determination of differential leukocyte count
4. Radial immunodiffusion, double diffusion
5. Study of Ag-Ab reactions Widal, VDRL
6. Immuno electrophoresis
7. ELISA, Western Blotting
8. Rocket immuno electrophoresis
9. Radioimmunoassay
10. Hybridoma Technology

BI -IX: Programming using C language **Marks: 75 Hours: 45**

Salient features: To understand basic concept in c language.
Utility of course: know basic concepts in programming and develop programming skill to solve biological problems
Learning Objective: Be able to implement, test, debug, and document programs in C, Understand low-level input and output routines
Prerequisites: Basic knowledge of computer

Unit – I:
Types Of Programming Languages , Introduction To C ,Historical Development Of C Language, Structure Of C Program.C Fundamentals The C Character Set ,Identifiers And Keywords ,Data Types, Constants, perators Used In C ,Variables And Types Of C Variables , Declaration, Expressions ,Statements ,Symbolic Constants ,I/O Statements used in C.

Unit – II:
Branching: If Statement, If-Else Statement, If-Else Ladder, Switch Statement. Looping: While Loop, Do-While Loop, For Loop, Nested Control Structures, Jumps In Loop- Break Statement, Continue Statements, Goto Statement

Unit – III:
What Is An Array? , Declaring And Initializing An Array , One-Dimensional Array , Multi- Dimensional Array , Passing array to function, Strings- What Are Strings ,Declaring And Initializing String Variables ,Reading And Writing Of String , Standard Library Functions User-Defined Functions , Return Types , Passing Arguments To A Functions , Scope And Life Time Of Variables In Function, Nesting Of Functions ,Recursion ,Functions And Array.

Unit – IV:
Introduction To Pointers, Declaring And Initializing Pointers , Accessing A Variable Through Its Pointer , Pointer Expression , Pointers And Arrays, Pointers And Character Strings , Array of Pointer and pointer to pointer Introduction ,Structure ,Structure Initialization , Array Of Structures, Arrays Within Structure, Structure Within Structure ,Introduction To Union

Unit – V:
Automatic Storage Class, Register Storage Class, Static Storage Class External Storage Class. Introduction ,Defining And Opening A File ,Closing A File ,Input/Output Operations On File ,Error Handling During I/O Operations ,Random Access To file

References
1. Programming With C By Byron Gottfried Second Edition, Tata-Mcgraw-Hill
2. Let Us C By Yashwant Kanetkar 4th Edition Bpb Publication.
3. Pointers In C By Yashwant Kanetkar 3rd Edition.
4. Programming in Ansi C by E. Balagurusami

Practical:
1. Study of structure of C program.
2. Write C programs using control and looping statements.
3. Write C programs using arrays, pointers, structures and unions.
4. Write C programs using Strings.
5. Write C programs for Functions.
6. Write C programs for file handling
7. Write C programs using consol I/O functions

BI-VIII (Elective) (I) Databases and tools in Bioinformatics Marks:75 Hours: 45

Salient features: understand the nature of biological data and need for biological databases to understand and explore major bio-molecular sequence databases (organization and contents); search and retrieve data from the databases using their respective search engines

Utility of course: To uncover computational databases & tools in Bioinformatics

Learning Objective:

Understand and appreciate the need and significance of sequence analysis and the bioinformatics approaches for the same, understand algorithms for sequence analysis and understand the application of methods for analysis of the biomolecular sequence data

Prerequisites: Basic knowledge of bioinformatics databases and tool

Unit – I:

protein sequences and identification , proteomics experiment, function analysis, sequence sites, features and motifs, protein structure, and similarity search/alignment databases and tools

Unit – II:

Sequence alignment, similarity search, characterization/annotation databases and tools

Unit – III:

Structure analysis databases and tools

Unit -IV:

System Biology, evolutionary Biology databases and tools

Unit -V:

ChEBI (Chemical Entities of Biological Interest) – dictionary of small chemical compounds
ChEMBL – bioactive drug-like small molecules
PDBeChem – chemical components present in PDB entries

Reference Books

1) "Bioinformatics: Databases And Algorithms" by Guatham N
2) "Bioinformatics: A Concept-Based Introduction" by Venkatarajan Mathura and Pandjassarame Kangueane
3) "Bioinformatics: Tools and Applications" by David Edwards and Jason Stajich
4) Bioinformatics: Principles and Applications by Zhumur Ghosh

Practical:

1. Study of structure of protein sequence, function analysis
2. Study of similarity search/alignment databases and tools
3. Study of 3D structure visualization
4. Study of characterization/annotation databases
5. Study of Structure analysis databases and tools
6. Study of chemical structurs by using ChEBI, ChEMBL,PDBeChem etc

BI-VIII (Elective) II) Biodiversity and Molecular Phylogenetics Marks:75 Hours: 45

Salient features: to study Biodiversity and Molecular Phylogenetics

Utility of course: study and understand Biological diversity of life biodiversity databases and Phylogenetics

Learning Objective: get acquainted with diversity of life, Databases and software for identification of Species

Prerequisites: Basic knowledge of Biodiversity and Molecular Phylogenetics

Unit – I:
Biological diversity of life; India as mega biodiversity nation; Hotspots of diversity; Genetic diversity; Species diversity; Ecological / ecosystem diversity. Diversity informatics in India, challenge and potential.

Unit – II:
Species 2000; Tree of life; National Biological Informatics Infrastructure; International Committee on taxonomy of viruses (ICIV) and ICTVDB. Animal Virus Information System (AVIS); Global biodiversity information facility (GBIF); Other biodiversity databases.

Unit – III:
Barcode of life;Delta; ITIS; Databases and softwares for identification of Species. Metadata- Definition; Metadata standards; Metadata & biodiversity; Need for metadata standards

Unit – IV:
Introduction; Relationship between phylogenetic analyses and multiple sequence alignment; Genome complexity; Evolutionary trees Rooted & Unrooted trees; Methods for phylogenetic prediction , Maximum parsimony method, Distance based alignment; Soft ware package for phylogeny prediction.

Unit – IV:
Comparison of Phylogenetic Trees obtained using DNA seq. Vs. protein seq.Vs. Full genomes. Need for addition of other properties towards total phylogenetic analysis; Comparative methods for detection of species / organism relationships; Gene duplication, Horizontal transfer, Domain evolution; Study of co-evolution: Plant-insect interactions. Host-parasite interactions. Viral evolution.

References
1. Bioformatics sequence and genome analysis – by David W. Mount.
2. Practical taxonomic computing – by Pankhurst R.J
3. Molecular Evolution a Phylogenetic Approach by R. D. M. Page and E.C. Holmes, Blackwell Scientific, 1998.
4. Fundamentals of Molecular Evolution by D. Graur and W-H Li, 2nd Edition, Sinauer Associates.

Practical:
1. Study of different biodiversity databases and retrieval of biodiversity information from them
2. Study of database structures and designing biodiversity databases
3. Study of different species identification systems.
4. Study of different methods for sequence alignment.
5. Study of different methods for phylogenetic prediction