।। 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
ACADEMIC (1-BOARD OF STUDIES) SECTION
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संलग्नित महाविद्यालयांतील विज्ञान व तंत्रज्ञान विद्याशाखेतील पदवी स्तरावरील द्वितीय वर्षाचे **CBCS Pattern** नुसारचे अभ्यासक्रम शैक्षणिक वर्ष २०२०–२१ पासून लागू करण्याबाबत.

प रि प त्र क

या परिपत्रकान्वये सर्व संबंधितांना कळविण्यात येते की, **दिनांक २० जून २०२० रोजी संपन्न झालेल्या ४७व्या मा. विद्या परिषद बैठकीतील विषय क्र.११/४७–२०२०**च्या ठरावानुसार प्रस्तुत विद्यापीठाच्या **संलग्नित महाविद्यालयांतील विज्ञान व तंत्रज्ञान विद्याशाखेतील पदवी स्तरावरील द्वितीय वर्षाचे** खालील विषयांचे **C.B.C.S. (Choice Based Credit System) Pattern** नुसारचे अभ्यासक्रम शैक्षणिक वर्ष २०२०–२१ पासून लागू करण्यात येत आहेत.

1. B.Sc.-II Year-Biophysics	2. B.Sc.-II Year-Bioinformatics
3. B.Sc.-II Year-Biotechnology	4. B.Sc.-II Year-Biotechnology (Vocational)
5. B.Sc.-II Year-Food Science	6. B.Sc.-II Year-Botany
7. B.Sc.-II Year-Horticulture	8. B.Sc.-II Year-Agro Chemical Fertilizers
9. B.Sc.-II Year-Analytical Chemistry	10. B.Sc.-II Year-Biochemistry
11. B.Sc.-II Year-Chemistry	12. B.Sc.-II Year-Dyes & Drugs Chemistry
13. B.Sc.-II Year-Industrial Chemistry	14. B.C.A. (Bachelor of Computer Application)-II Year
15. B.I.T. (Bachelor of Information Technology)-II Year	16. B.Sc.-II Year-Computer Science
17. B.Sc.-II Year-Network Technology	18. B.Sc.-II Year-Computer Application (Optional)
19. B.Sc.-II Year-Computer Science (Optional)	20. B.Sc.-II Year-Information Technology (Optional)
21. B.Sc.-II Year-Software Engineering	22. B.Sc.-II Year-Dairy Science
23. B.Sc.-II Year-Electronics	24. B.Sc.-II Year-Environmental Science
25. B.Sc.-II Year-Fishery Science	26. B.Sc.-II Year-Geology
27. B.Sc.-II Year-Mathematics	28. B.Sc.-II Year-Microbiology
29. B.Sc.-II year Agricultural Microbiology	30. B.Sc.-II Year-Physics
31. B.Sc.-II Year Statistics	32. B.Sc.-II Year-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/पदवी–सीबीसीएस अभ्यासक्रम/२०२०–२१/**३३३**

दिनांक : १५.०७.२०२०.

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 B.Sc. BIOINFORMATICS

(For all affiliated colleges)

CHOICE BASED CREDIT SYSTEM (w.e.f. from June 2020 for II year)

Semester	Code	Title of the Course	Hr/Week	Type of Course	Credit	Marks		Total
						ESA	CIA	
I	AECBI-IA	Functional English	4	AEC	4	75	25	100
	CCBI- 1A	Basics of Biocomputing	4	CC	4	75	25	100
	CCBI-2A	Basics of biological science	4	CC	4	75	25	100
	CCBI-3A	Microbiology and Cell Biology	4	CC	4	75	25	100
	Lab course I	Practicals based on AECBI 1A and CCBI1A	03+03	PR	4	100		100
	Lab course II	Practicals based on CCBI 2A and 3A	03+03	PR	4	100		100
					24	500	100	600

Semester	Code	Title of the Course	Hr/Week	Type of Course	Credit	Marks		Total
						ESA	CIA	
II	AECBI - 2A	Business Communication	4	AEC	4	75	25	100
	CCBI - 1B	Genetics	4	CC	4	75	25	100
	CCBI - 2B	Introduction to Bioinformatics	4	CC	4	75	25	100
	CCBI - 3B	Basics of Biochemistry	4	CC	4	75	25	100
	Lab Course III	Practicals based onAECBI2A and CCBI 1B	03 + 03	PR	4	100		100
	Lab course IV	Practicals based on CCBT 2B+ 3B	03 + 03	PR	4	100		100
					24	500	100	600

SY - III

Semester	Code	Title of the Course	Hr/Week	Type of Course	Credit	Marks		Total
						ESA	CIA	
III								
	CCBI-1C	Molecular Biology	4	CC	4	75	25	100
	CCBI-2C	Biodiversity and Phylogenetics	4	CC	4	75	25	100
	CCBI-3C	Bioprogramming using C	4	CC	4	75	25	100
	DSEBI-4C	Biostatistics / Advance Bioprogramming	4	DSE	4	75	25	100
	SEC-I	IA)Programing in C++ language / IB) Metagenomics	2	SEC	2	25	25	50
	Lab CourseV	Practicals based on CCBI 1C+2C	03 + 03	PR	4	100		100
	Lab Course VI	Practicals based on CCBI 3C+4(	03 + 03	PR	4	100		100
					26	550	100	650

Semester	Code	Title of the Course	Hr/Week	Type of Course	Credit	Marks		Total
						ESA	CIA	
IV	CCBI-1D	Basics of Immunology	4	CC	4	75	25	100
	CCBI-2D	Database management system	4	CC	4	75	25	100
	CCBI-3D	Programming in Perl	4	CC	4	75	25	100
	DSEBI-4D	Biochemical Techniques / Immunoinformatics	4	DSE	4	75	25	100
	Sec-II	IIA):Analytical Techniques for Bioinformatics / IIB)Plant pathology	2	SEC	2	25	25	50
	Lab Course VII	Practicals based on CCBI 1D+ 2D	03 + 03	PR	4	100		100
	Lab CourseVIII	Practicals based onCCBI 3D+ 4D	03 + 03	PR	4	100		100
					26			650

S.R.T.M. university, Nanded

Molecular Biology - CCBI-1C

Maximum Mark: 75 **Hours: 40** **Credits: 4**

Objective: To understand the basics of molecular biology, functioning and transfer of genetic material.
Learning outcome: Students will be able to understand about the structure, modification and functioning of elements of central dogma of biology.

Unit 1: DNA structure, replication & repair.
DNA: Structure, Properties, Cot curve
DNA replication: models & mechanism of DNA replication, Eukaryotic and Prokaryotic replication, Enzymes involved in replication (Helicase, gyrase, primare, DNA polymerases, ligase)
DNA Repair: Direct repair– Photo Reactivation, Excision, mismatch, Recombination repair, SOS repair.

Unit 2: Transcription and RNA processing
Prokaryotic: Initiation, Elongation & Termination, Structure of RNA polymerase, Role of sigma factor, Promoter.
Eukaryotic: Initiation, Elongation & Termination, Upstream & downstream Promoters, Enhancer, RNA Polymerase I, II & III.
Co & Post transcriptional modification in m-RNA- 5'capping, Intron Splicing, polyadynylation. RNA processing & Transport.

Unit 3: Translation and post translational modifications
Prokaryotic and Eukaryotic translation.
Co & post translational modifications in proteins, Heat shock proteins, Chaperons & Chaperonins.
Properties of genetic code, Roles of RNAs.

Unit 4: Regulation of gene expression
Regulation of transcription in prokaryotes, Operon concept, types of operon (trp, ara, lac) and their mechanism.

Reference Books:

1. Upadhya- Molecular Biology- Himalaya pub.
2. Watson – Molecular biology of gene- Pearson pub.
3. David Freifelder- Microbial Genetics – Narosa Pub.
4. David Freifelder– Molecular Biology – Narosa pub.
5. Gardner – Principals of Genetics – Wiley international pub.
6. Albert Bruce- Molecular biology of the cell- garland science.
7. Loddish - Molecular cell biology – W-H. freeman
8. Lewin – Genes X- Oxford
9. Baig, Telang and Ingle-Amruta - Fundamentals of Cell and Molecular biology
10. T.A. Brown – Genomes – Garland Science

Practical's:

1. Study of Ames test
2. Study of fluctuation test
3. Isolation and quantitation of DNA from bacteria.
4. Isolation and quantitation of DNA from Yeast.
5. Effect of UV radiation on yeast / bacteria
6. Study of DNA repair mechanism by photo reactivation.
7. Agarose gel electrophoresis of genomic DNA & plasmid DNA
8. Isolation of Lac mutant by using Replica plate method.
9. Determination of Tm value of DNA.

S.R.T.M. university, Nanded

Biodiversity and Phylogenetics - CCBI-2C

Maximum Mark: 75 **Hours: 40** **Credits: 4**

Objective: To understand the basics biodiversity and working of databases.

Learning outcome: Students will be able to understand concepts like biodiversity, species richness in India, phylogenetics and various databases for studying biodiversity.

Unit 1: Biological Diversity and classification systems

Biological diversity of life. Two, Three, five kingdom classification system benefits and drawbacks

Types of diversity: Genetic diversity, Species diversity, Ecological / ecosystem diversity, etc.

India as mega biodiversity nation, Hotspots of diversity, Diversity informatics in India, challenge and potential.

Unit 2: Biodiversity Databases

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 3: Species Identification databases and Metadata

Barcode of life, Delta, IT IS, Databases and softwares for identification of species

Metadata: Definition, standards, needs for standards.

Metadata & biodiversity

Unit 4: Phylogenetis

Introduction, Genome complexity, Relationship between phylogenetic analysis and multiple sequence alignment.

Evolutionary trees: Rooted & Unrooted trees, cladogram, dendogram, etc.

Methods for phylogenetic prediction: Maximum parsimony method, Distance based alignment.

Software packages for phylogeny prediction.

Reference Books:

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's:

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

S.R.T.M. university, Nanded

Bio-programing using C language - CCBI-3C

Maximum Mark: 75 **Hours: 40** **Credits: 4**

Objective: To understand the basic entities of a program, control flow and structure.
Learning outcome: Students will be able to develop logics which will help them to create programs in C.

Unit I:Introduction to C
The character set, constant and types, variables and keywords, types of C variables,
C Instructions: Type declaration instruction, arithmetic instruction, and integer and float conversion, types conversions in assignment, hierarchy of operations, storage classes and their scope rules.

Unit II: Control Structure And Array
Decision making statements: if statement, use of logical operation, decisions using switch.
Looping statement: for, while, do while, break, continue, go to statements.
Arrays: Introduction, arrays initializations, bounds checking, types of array, passing array elements to a function.

Unit III: Functions and Strings
Function: Introduction, Arguments and local variables, returning function results, default return type and the type void passing values between function, declaration of function type, recursion, and function with variables arguments.
Character String: What are strings, standard library string functions: strlen( ), strcpy ( ), strcat ( ), strcmp( ).

Unit IV: Pointer, Structures and Union
Pointers: Introduction to Pointers, Operations on Pointers, Pointers and Functions, Pointers and Arrays.
Structure: Declaration, initialization, structure variables, accessing structure elements, arrays of structures, functions and structures, structures within structures.
Union: Introduction, accessing union elements, difference between structure and union.

Unit V: Input /Output in C
Console I/O functions: printf(), scanf(), getch(), getchar(), putchar(), gets(), puts().
Disk I/O functions: High level file I/O or standard functions fopen(), fclose(), fgets(), fputs(), fread(), fwrite(), fseek(), feof(), fflush(), Use of command line arguments.

Reference Books:
1. Let us C - Yeshwantkanetkar – BPB Publication
2. Programming in ANSI C - E. Balagurusamy -TATA Macgraw hill
3. Turbo C/C++ - The complete reference - H. Schildt

Practicals:

1. Study of structure of C program.
2. Program for basic operations
3. Write C programs using control and looping statements.
4. Write C programs for Functions.
5. Write C programs using arrays, pointers, structures and unions.
6. Write C programs using Strings.
7. Write C programs for input/output functions.

S.R.T.M. university, Nanded

Biostatstics- DSCBI-4C

Maximum Mark: 75 **Hours: 40** **Credits: 4**

Objective: To understand Statistical approach to bioinformatics

Learning outcome: Students will learn the general Basic of Biostatistics which would help them to solve data related programs and also would help them during development of database and programming

Unit 1:Introduction

Definition; Concept of statistical population; Concept of statistical sample Concept of Data – Discrete and continuous data; Representation of data – Histogram, PolyGram, Frequency curve, Pie Diagram Measures of Central Tendency Concept of central tendency; Arithmetic Mean: Definition, Formulae and computation for ungrouped and grouped data; Weighted arithmetic mean; median: Definition, Formulae and Computation for ungrouped and grouped data; Quartiles: definition, formulae and computation for ungrouped and grouped data; Mode: definition, formulae and computation for ungrouped and grouped data.

Unit 2:Measures of Dispersion

Concept of dispersion; Range: definition, formulae and Computation for ungrouped and grouped data; Standard Deviation: Definition, Formulae and Computation for ungrouped and grouped data. Variance: Definition, Formulae and Computation for ungrouped and grouped data; Coefficient of variance: Definition, Formulae and Computation for ungrouped and grouped data.

Unit 3:Probability Permutation and combination

Sample space, Events and Types of events; Classical definition of probability and axioms of probability; Theorems on Probability: i) 0<= P(A)<= 1 ii) P(A) + P(A')=1 iii) P(A U B)= P(A)+ P(B) iv) P(A U B)= P(A)+P(B)-P(A B) Conditional probability and Bayes' theorem; Problems on Probability Set Theory Introduction; Set Notation and Description; Subsets, Venn diagram, Set Operations

Unit 4: Matrix Algebra

Addition, subtraction and multiplication of matrix, transpose of matrix,inverse of matrix, conjugative matrix Limits and Complex Numbers Limits of sequences, series, limit of functions, the Fibonacci sequence, complex plane, algebraic operations, exponential function of complex variable, Oscillations

Reference Books:

1. Sheldon M. Ross: Introduction to probability models, 9th Edition, Academic Press, 2007.
2. Gilbert Strang: Linear Algebra and its application, 4th Edition, Cengage Learning, 2006.
3. NCERT class 12 mathematics books.

Practical's:

1. Problems based on above statistical methods
2. Problems based on above Mathematical methods

S.R.T.M. university, Nanded

Advance bio-programming- DSCBI-4C

Maximum Mark: 75 **Hours: 40** **Credits: 4**

Objectives: To create expertise in advance programming language python.
Learning outcome: Students will be able to run and develop databases and tools.

Unit 1: Python Basic Introduction:
what is python? Features, comparing python with other languages, installing python, testing python, basic input output, mathematical operations, data types.
Practice: Installing Python, testing Python version

Unit 2: Control statements
If-else, for loop, while loop, break, dealing with files, functions and module creation, error handling
Practice: Practice programming based on conditional statements, control statements. Creating modules and programming using python modules. Programs using file handles.

Unit 3: Python and Object oriented programming
Object paradigm and python, creating classes, inheritance, creating new datatypes, making our code private, additional resources and self-revaluation
Practice: Creating class, new data types. Programs on inheritance.

Unit 4: Regular expressions and BioPython
Introduction to regular expression (REGEX) regex syntax the re module: compiling a pattern, REGEX examples, pattern replace, REGEX in bioinformatics: cleaning up a sequence , additional resources, Introduction to biopython .
Practice: Programming using regular expressions

References:

1. Python for Bioinformatics ,Sebastianbassi ©2010 by Taylor and fancies group,LLC
2. Programming Python, Mark Lutz, 4th Ed. O'Reilly Pub.

Practical: Based on syllabus.

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Programming using C++ language- SEC-1A

Maximum Mark: 50 **Hours: 20** **Credits: 2**

Objective: To understand how C++ improves C with object oriented.
Learning outcome: Students will learn how to inline functions for efficiency and performances and how to design C++code for reuse.

Unit – 1: Introduction and basic concepts of C++
Procedure Oriented Programming, Object Oriented Programming Paradigm, Basic concepts of OOP's, Benefits and Applications, Structure of C++ program

Unit – 2: Tokens, Operators and Functions in C++
Keywords, Identifiers, Data-types, Operators in C++, Operator precedence and associativity, Function, function prototype, default arguments, Reference variable, call by reference, return by reference, Inline function, function overloading

Unit – 3: Class and object, Constructor and destructor
Specifying a class and object, Nesting of member function, Memory allocation for objects, Static data member, static function, Friend function, Returning objects
Constructor, Types of constructor, Destructor

Unit – 4: Inheritance and polymorphism, Input / Output Operation
Types of inheritance, Virtual base class, Operator overloading (Unary and binary), Virtual function and there rules, Pure virtual function, Abstract class, Pointer to object, This pointer
Console I/O operation, formatted I/O, unformatted I/O, C++ classes for console I/O, C++ stream classes for file I/O, Opening and closing file, sequential and random access, Error handling during a file operation, command line arguments, Templates, template function, template class.

Reference Books:-
1) The C++ Complete Reference -TMH Publication
2) Object-Oriented Programming with C++ -E-Balgurusamy
3) Let us C++ -Yashwantkanetkar

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Metagenomics- SEC-1B

Maximum Mark: 50 **Hours: 20** **Credits: 2**

Objective: To understand the basics of metagenomics.

Learning Outcome: Students will learn microbial metabolism and inturn would help them to analyze data and alter genome for desired purpose.

Unit 1: Introduction to Metagenomics

What is metagenomics; Types of metagenomes: Amplicon, Shotgun, Functional; Amplicon metagenomics: History, phylogenetic marker, examples; Shotgun metagenomics: History and examples; Functional metagenomics: Examples

Practice: Amplicon metagenomics, Shotgun metagenomics, Functional metagenomics

Unit 2: Metagenomics case studies

Metagenomic analysis of soil microbial communities, Analysis of Bacteriophage;

Metagenomics and its applications to the Study of the Human Microbiome; Archaeal Metagenomics: Bioprospecting Novel Genes and Exploring New Concepts.

Practice: Metagenomic analysis of soil microbial communities, Metagenomic Analysis of Bacteriophage, Study of the Human Microbiome.

Unit 3: Library construction & analysis of metagenomic libraries

Cataloging microbes: phylogenetic tree and construction - Construction of a metagenomic library; Analysis of Metagenomic Libraries; Sequence-based Metagenomics Analysis; Function based Metagenomics Analysis; Phylogenetic analysis and Comparative genomics Softwares& Tools.

Practice: Construction of a metagenomic library, Analysis of Metagenomic Libraries, Sequence-based Metagenomics Analysis, Phylogenetic analysis and Comparative genomics Softwares& Tools.

Unit 4: Metagenomics in environmental studies

Application of Metagenomics to Bioremediation; Applications of Metagenomics for Industrial Bioproducts; Escherichia coli host engineering for efficient metagenomic enzyme discovery; Next-generation sequencing approaches to metagenomics; Stable isotope probing: uses in metagenomics; DNA sequencing of uncultured microbes from single cells

Practice: Applications of Metagenomics for Industrial Bioproducts, Stable isotope probing, etc.

References:

1) Diana Marco Universidad Nacional de Cordoba, Argentina, “Metagenomics: Theory, Methods and Applications”, Caister Academic Press,2010.

2) Diana Marco Universidad Nacional de Cordoba,Argentina “Metagenomics: Current Innovations and Future Trends”,Caister Academic Press,2011.

Practical: Based on syllabus.

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Basics of immunology- CCBI-1D

Maximum Mark: 75 **Hours: 40** **Credits: 4**

Objective: To understand fundamentals of immune system of human body

Learning outcome: Students will learn the general aspects of immune cells, and immune responses to diseases caused.

Unit 1: Overview of immune system

History, innate and acquired immunity, passive immunity, infection.

Immunoglobulin

Antibodies: Antibody – structure and function, antigen, antigen-antibody reaction, Complement fixation

Unit 2: Cells of immune system

Differentiation of stem cell, structure of B-cell, T-cell, Microphage, nature killer cell, Organs of immune system.

Unit 3: Immune response

Humoral immune response, Cellular immune Response, MHC I &II complex. Concept of Graft rejection

Unit 4: Immunodeficiency Diseases

Primary immunodeficiency, secondary immunodeficiency, Autoimmunity.

Reference Books:

1. Eli Benjamini, coico, sunshine, immunology (fourth edition)
2. N.V. shastri, Principles of immunology (himalaya publication house)
3. Immunology – Kuby- W.H. Freeman
4. Essentials of Immunology- Roitt I. M.- Blackwell
5. Immunology- Nandini Shetty- New Age International
6. Textbook of Microbiology – Anantnarayan and Panikar-Orient Longman
7. Immunology- A.K. Abbas- Elsevier

Practical's:

1. Immunodignostics (demonstration using Kits- Widal, VDRL)
2. Determination of Blood Group
3. Immunodiffusion, Immuno Electrophoresis, Western Blotting,
4. Differential Leukocyte Count
5. Lymphoid organ, Cell and their microscopic observation

6. Immunization, collection of Serum
7. Purification of antibody from Serum

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Database management system- CCBI-2D

Maximum Mark: 75 **Hours: 40** **Credits: 4**

Objective: To understand fundamentals of DBMS

Learning outcome: Students will learn the principles of DBMS, why and how data is indexed, how and where data is stored in storage media.

Unit 1: Relational Database

Introduction; Codd's 12 rules; Principles of RDBMS; Comparison between HDB-NDB-RDB; Concept of domain; Tuple; Cardinality; Oracle data type; Interactive SQL; Oracle & client server technology; Data manipulation in Database Management system (DML commands); DDL commands; Creating Tables; Insertion of Data in to table; Viewing data in Table; Renaming table , Destroying tables; Examining the objects created by Users; Working with ASCII file from the SQL prompt.

Unit 2: Manipulation on Oracle Tables

Competition on table data; Oracle table; Dual, Sys- date; Oracle functions; Data Constraint; Data constraints; Defining different constraints on table; User constraints table; defining dropping integrating constraints in the Alter table command; default value concept.

Unit 3:SQL, PL/SQL

Grouping data from table in SQL; Sub queries, joins, using the Union. Introduction; Generic PL/SQL; PL.SQL execution environment. Oracle transaction; Processing PL/SQL for block; What is cursor? cursor for loops.

Unit 4:Database Objects

Store procedure and functions; Where do stores procedure and function resides; How oracle engine execute procedure and function; Advantage using procedure and function; procedure V/S function; Syntax of creating procedure and function.

Reference Books:

1. Database System Concept –By Koarth
2. Modern Database Management –Iv-Edition By Fred R.Meffadden, Jeffrey, A. Hoffer(Aw)
3. Principle of Database Management – By James Martin.
4. Database Management System – By Bipin Desai
5. Plsql – The Programing Language of Oracles by Ivan Bay Rows – Ii Edition Bpb Publication

Practical's:

1. Creating and manipulating tables by using DDL and DML commands
2. Study of different oracle functions.
3. Study of different oracle constraints.

4. Study of grouping data from tables with SQL.
5. Study of sub queries and joins with SQL.
6. Study of PL/SQL

S.R.T.M. university, Nanded

Programming in Perl- CCBI-3D

Maximum Mark: 75 **Hours: 40** **Credits: 4**

Objective: To introduce benefits of biological programming language.
Learning outcome: Students will be able to develop logics and perform various task on biological sequence data.

Unit 1: Getting Start with Perl
Introduction, computer program & programming language, Perl's benefits, portability, speed & program maintenance.
Installing perl, running perl Programs, finding help, text editors.
The Art of Programming: Individual approaches to programming, bio programming strategies, the programming process.
Sequence & Strings:
Introduction to sequences and string, A program to store a DNA sequence, different ways of concatenating DNA fragments.

Unit 2: Basic Operators and file handling
Variables in perl, Operator and its types, Concatenating & repeating string operators.
Pattern matching: working of pattern matching operator, anchoring the patterns, patterns matching function, program to calculate the reverse complement.
Lists & Arrays: Introduction to lists, storing lists in array variables, more about lists & arrays, Array library function.
File Handling: Operations performed on a file, determining a status of a file.

Unit 3: Control statements, subroutine and hashes
Control Flow & Looping Statements: If statements, If – else, while, until, single line conditional statement, the 'For' statement the 'for each' statement, the 'do' statement, the last, next, redo, continue statements.
Subroutines & Hashes: Introduction & advantage of subroutines, writing subroutines, use of local variable & passing parameter to subroutines, returning a value from subroutines, passing data to subroutines, hashes & its creations from an array variable.

Unit 4: The Genetic Code and bioprogramming
Introduction to genetics code & codon table, Standard IUB/IUPAC nucleic acid codes, Standard IUB/IUPAC amino acid codes., ranslating codons to amino acids (using hashes), translating DNA into proteins, sequence file formats, FASTA format, Transcription: DNA & RNA.
Introduction to BioPerl
Introduction to Python: introduction, comparison with Perl

Reference Books:

1. James Tisdall 2001 “Beginning Perl For Bioinformatics” O’reily& Associates.
2. Schwartz, Foy and Phoenix, “Learning Perl” sixth Edition

Practicals:

1. Write a simple program like program for storing DNA sequence in a variable
2. Write programs by using different perl operators.
3. Write programs for file handling.
4. Write programs by using lists and arrays.
5. Write programs for pattern matching, conditional and looping statements.
6. Write programs by using subroutines and hashes.

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Biochemical technique DSEBI-4D

Maximum Mark: 75 **Hours: 40** **Credits: 4**

Objective: To understand principle and working of instrumentation used in Biotechnology.
Learning Outcome: Students will learn how different instruments works, their application and purpose of usage.

UNIT-I: MICROSCOPY & SPECTROSCOPY:
Light Microscopy: Simple & Compound Microscope, Phase contract Microscope, Electron Microscope (TEM/SEM) (Principle, Theory, ray diagram, Image formation and applications). Spectroscopy: General principle, Electromagnetic Spectrum, radiation energy & atomic structure, Types of Spectra & their biochemical usefulness. Basic law of absorption, Visible & Ultraviolet Spectroscopy, application in biology.

UNIT-II: CHROMATOGRAPHY:
Adsorption chromatography, Partition chromatography: Paper Chromatography, TLC, Column Chromatography, Ion exchange chromatography, GC.

UNIT-III: CENTRIFUGATION:
Centripetal Force, Centrifugal force, basic principle of centrifugation, centrifuge type, types of rotor density gradient centrifugation, Nature of density gradient, preparative centrifugation, Differentials centrifugation & applications.

UNIT-IV: ELECTROPHORETIC TECHNIQUES:
General Principles, Law & High voltage electrophoresis, Agarose, PAGE & SDS PAGE. Isoelectric focusing (IEF), Pulse field gel electrophoresis. Factors affecting on Electrophoretic Mobility.

Text & References:

1. Biophysical Chemistry- Upadhyay, Upadhyay and Nath-Himalaya
2. Practical Biochemistry- Wilson & Walker -Cambridge
3. Practical Biochemistry- David Plummer- Tata McGraw Hill
4. Principles of Biochemistry- Lehninger –Kalyani Publications
5. Light Microscopy in Biology-A.J. Laccy.
6. Instrumental Methods of Chemical Analysis- Chatwal Anand- Himalaya
7. Instrumental Methods of Chemical Analysis –B.K. Sharma-Goel
8. Physical Biochemistry-D. Friefilder

Practical's:

1. Study and Care of Microscope, Observation of Microscopic samples
2. Study of Colorimeter and determination of Lambda Max.

3. Study of UV-Visible Spectrophotometer by analysis of DNA, RNA and protein
4. Study of Paper Chromatography/ TLC by separating biomolecules or plant pigment
5. Principals and working of different centrifuges.
6. Study of Paper/PAGE/ SDS-PAGE/ Agarose Gel Electrophoresis

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Immunoinformatics-DSEBI-4D

Maximum Mark: 75 **Hours: 40** **Credits: 4**

Objective: To understand fundamentals of Immunology in bioinformatics

Learning outcome: Students will learn the general Basic of immune-related databases, and servers to produce Insilco -structure of vaccines

Unit I:Introduction to Immunoinformatic and Immunological Databases

Introduction to immunology & Bioinformatics, immunoinformatics, the immune system, cellular immunity, antibody mediated immunity. Immunological databasesdbMHC-MHC database at NCBI, T-cell epitope databases, B-cell epitope databases

Practice: Immunological Databases, T-cell epitope databases, B-cell epitope databases

Unit II: Descriptors/Topics

Immunological Tools Experimental and theoretical description of peptide-MHC binding, selection of epitopes using bioinformatics, prediction of proteasome processing, Predictions of Class I and Class II MHC Epitopes, IEDB analysis Resourse, CTLPred, Population Coverage analysis, Epitope conservancy analysis

Practice: Predictions of Class I and Class II MHC Epitopes, IEDB analysis Resourse, CTLPred

Unit III:Descriptors/Topics

Computational Vaccinology Introduction to vaccines, Different generations of Vaccines, Concepts of reverse vaccinology, case study of Reverse Vaccinology with Meningococcus B, Comparision of Traditional Vaccinology and Reverse Vaccinology

Practice: case study of Reverse Vaccinology, Vaccine databases

Unit IV:Regular expressions

Tools & servers for computational Vaccine design-from Genome to Vaccine.

Practice: Tools & servers for computational Vaccine design-from Genome to Vaccine

References:

1) Kuby IMMUNOLOGY. 2007 by W. H. Freeman and Company.

2) Immunoinformatics: Bioinformatic Strategies for Better Understanding of Immune (2008), Wiley Publications.

3) Predicting Immunogenicity in Silico Series (2013): Methods in Molecular Biology, Flower, Darren R.

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Analytical techniques in bioinformatics-SEC-IIA

Maximum Mark: 50 **Hours: 20** **Credits: 2**

Objective: To understand how proteins are isolated, sequenced and purified.
Learning outcome: Students will learn the basics of proteins, and how bioinfo could be used to alter ar model the protein structure.

Unit-I:

Spectroscopy: UV Visible, NMR, ESR, Atomic Absorption, Raman Spectroscopy

Practice: practical based on Spectroscopic analysis of biomolecules

Unit II:

Protein isolation, Estimation, Protein sequencing methods, detection of post translation modification of proteins.

Practice: Practical based on protein isolation and analysis

Unit III:

Proteome-General Account; Tools of proteome analysis. DNA microarray: understanding of microarray data and correlation of gene expression Methods of Genome sequencing, EST, STS, GSS database and their generation Whole Genome comparison.

Practice: 1) Tools of proteome analysis

2) Practical Study of EST, STS, GSS database.

Unit IV:

Sequencing methods: Genome sequencing: High-throughput sequencing, shot-gun sequencing. sequence alignment pair-wise, multiple sequence alignment along with molecular phylogenetics

Practice: 1) Tools for sequence alignment.

2) Gene prediction and Protein Structure Prediction

Reference Books:

1. Wilson, K, Walker, J.: Principles and Techniques of Practical Biochemistry. 5th Ed. - Cambridge University Press, Cambridge 1999.
2. Biotechniques: Theory & Practice: Second Edition by SVS Rana, Rustogi Publications.

3. Biochemical Methods of Analysis: Saroj Dua And Neera Garg: Narosa Publishing House, New Delhi.
4. Bioanalytical Techniques: M.L. Srivastava; Narosa Publishing House, New Delhi.
5. Hobert H Willard, D.L. Merritt and J.R.J.A. Dean, instrumental methods of analysis, CBS Publishers and Distributors, 1992
6. Handbook of Analytical Techniques Published Online: 2008. Helmut Günzler, Alex Williams. Wiley Interscience.
7. Analytical Tools for DNA, Genes & Genomes: by Arseni Markoff, New Age.

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Plant Pathology-SEC-IIB

Maximum Mark: 50 **Hours: 20** **Credits: 2**

Objective: To understand how bioinformatics is relevant in diagnosis of plant pathogens.
Learning outcome: Students will learn how pathogens infect plants, their life cycle, pathogenesis effect on plant and databases used to study this pathogens and help them to eradicate.

Unit 1: Fundamentals of plant pathology
Scope, importance, history and advancement of plant pathology, classification of plant diseases on the basis of causal organism and symptoms, field and laboratory diagnosis- Isolation of plant pathogens from infected plant parts, soil and air, Pure culture technique, Koch's postulates for pathogenicity.

Unit 2: Plant disease development
Disease development- Mode of entry of pathogens (through stomata, wounds, root hairs and buds), Factors affecting disease development- Temperature, moisture, wind and soil pH, Dispersal of plant pathogens (by air, water, insects and animals), chemical weapons of pathogen: enzymes, toxins and growth regulators.

Unit 3: Plant disease
Symptoms, causal organisms, disease cycle and control measures of some common plant diseases: Bacterial blight of Pomegranate, Powdery mildew of pea, Tikka disease of groundnut, Grassy shoot of Sugarcane, etc.

Unit 4: Plant Pathology and Bioinformatics:
Databases: Blast2GO, SSR locator, PPNEMA, MaizeGDB, PathoPlant, PhytoPath, applications of bioinformatics in plant pathology.

References:

1. Introduction to Principles of Plant Pathology – R.S.Singh
2. Plant Dieases – R.S.Singh
3. Plant Pathaology – B.P.Pandey
4. Plant physiology – Dubey B.P.
5. Plant physiology – Shrivastava H.

Practical's:
1. Isolate *Citrus canker* from infected lemon plant.
2. Isolate any plant pathogen from infected plant field soil.
3. Maintain pure culture of Citrus Canker.

4. Study different symptoms of plant infected by different pathogen.
5. Study effect on plant growth due to pathogen infection.
6. Browse above databases to study about different plant pathogens.