।। 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 पदव्युत्तर 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 पदव्युत्तर 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. M.Sc.-II Year-Botany
2. M.Sc.-II Year-Herbal Medicine
3. M.Sc.-II Year-Analytical Chemistry
4. M.Sc.-II Year-Biochemistry
5. M.Sc.-II Year-Organic Chemistry
6. M.Sc.-II Year-Physical Chemistry
7. M.Sc.-II Year-Computer Management
8. M.Sc.-II Year-Computer Science
9. M.Sc.-II Year-Information Technology
10. M.C.A. (Master of Computer Applications)-II Year
11. M.Sc.-II Year-Software Engineering
12. M.Sc.-II Year-System Administration & Networking
13. M.Sc.-II Year-Dairy Science
14. M.Sc.-II Year-Environmental Science
15. M.Sc.-II Year-Applied Mathematics
16. M.Sc.-II Year-Mathematics
17. M.Sc.-II Year-Microbiology
18. M.Sc.-II Year-Physics
19. M.Sc.-II Year-Zoology
20. M.Sc.-II Year-Biotechnology
21. M.Sc.-II Year-Bioinformatics

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/२०२०–२१/**३३५**

दिनांक : १६.०७.२०२०.

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 M.Sc. BIOINFORMATICS

(For all affiliated colleges)

CHOICE BASED CREDIT SYSTEM (w.e.f. from June 2019-20 for II year June 2020)

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	4	DSE	4	75	25	100
		(II) Cell Biology and Genetics						
	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) Tools in Bioinformatics	4	DSE	4	75	25	100
		(II) Biodiversity and Phylogenetic Analysis						
	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. BI SY								
Semester	**Code**	**Title of the Course**	**Hr/Week**	**Type of Course**	**Credit**	**Marks**		**Total**
						ESA	**CIA**	
III	BI- IX	Biostatistics and R Programming	4	CC	4	75	25	100
	BI- X	Structural Biology	4	CC	4	75	25	100
	BI- XI	Programming in Java and Biojava	4	CC	4	75	25	100
	BI- XII	Research Methodology and IPR	2	SDC	2	40	10	50
	BI- XIII	Online certification course NPTEL/SWAYM/MOOC of equivalent credit	2	OE	2	50		50
	Lab course-V	Practicals based on course BI-IX and BI-X	4+4	PR	4	100		100
	Lab course-VI	Practicals based on course BI-XI and XII	4+4	PR	4	100		100
	Total for Sem-III				**24**	**515**	**85**	**600**
Semester	**Code**	**Title of the Course**	**Hr/Week**	**Type of Course**	**Credit**	**Marks**		**Total**
						ESA	**CIA**	
IV	BI- XIV	Chemoinformatics and Drug Designing	4	CC	4	75	25	100
	BI- XV	Biological Data Base Management	4	CC	4	75	25	100
	BI- XVI	Programming in Perl and Python	4	CC	4	75	25	100
	BI XVII	(I) Genomics, Transcriptomics and Proteomics	4	DSE	4	75	25	100
		(II) Systems Biology						
	Lab course-VII	Practicals based on course BI-XIV + BI-XV+ BI-XVI + BI-XVII	4+4	PR	4	100		100
	Lab course-VIII	Dissertation work / Review Writing	4	PR	4	100		100
	Total for Sem- IV				**24**	**500**	**100**	**600**

S.R.T.M. university, Nanded

Biostatistics and R programing – BI-XI

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

Objective: To seek knowledge about biostatistics and introduction to R programming.

Learning Outcome: This course will give students background of statistical view for program making and data analysis. And how programming is done using R.

Unit I:Introduction

Definition of statistics, population Concept of Data – Discrete and continuous data, Representation of data – Tabulation, Graph, Chart Diagrams, What Are Events? Complements. Entropy and Related Concepts: Information theory, Entropy Relative Entropy Scores and Support Inference

Unit II: Probability theory and Random variables

Probability, sample space mutually exclusive and exhaustive events. Probabilities of Events Conditional Probabilities Independence of Events, axiomatic definition of probability, addition theorem of probability, multiplication theorem of probability, conditional probability, byes theorem

Continuous random, variables, discrete random variables, pdf, pmf, mgf, problem. Design of experiment (ANOVA- One way, Two way) Introduction to Matrices: addition, multiplication.

Unit III: Measure of central tendency, dispersion

Definition, formula, and computation for ungrouped and grouped data of Arithmetic Mean – Combine mean, weighted mean, GM, HM. Median, Mode. Quartiles – Definition, formula, and computation for ungrouped and grouped data. Range – Definition for ungrouped and grouped data. SD, MD, Mean deviation about (mean mode median), variance: real life examples. Correlation and regression.

Unit IV:Continuous and discrete distribution

Probability Distributions – Discrete and Continuous Discrete Probability Distributions – One Bernoulli trial, The Binomial, Distribution, The Hyper geometric Distribution, The Uniform Distribution, The Geometric Distribution, The Poisson distribution, Approximations Continuous Distributions – The Uniform Distribution, the Normal, Distribution, the Exponential Distribution, The Gamma Distribution, The Beta Distribution. Tests of statistics: z test, t test, f test, chi square test.

Unit V: Introduction to R programing:

R programming introduction, how to download and install R, R studio on Mac or Windows, R data type, Arithmetic and logical operation with example, Functions in R programming.

Reference Books:

1. Fundamentals of statistics- S.C. Gupta, V.K. Kapur- Himalaya
2. Statistics: concepts and applications by Frank, Harry & Althoen, S. C., Cambridge University Press,
3. Introduction to probability and statistics by Lipschutz, S. & Schiller, J. J., New York.
4. Statistical methods in bioinformatics: an introduction by Ewens, W. J. & Grant, G.Springer,
5. Handbook of computational statistics: concepts and methods by Gentle, Hardle,-Springer
6. Introduction of Mathematics for Life science- E. Batschelet - Springer
7. Discrete Mathematics- Semyour Lipschutz & Marc Lipson-McGraw Hill
8. Statistical Methods - Gupta-Himalaya
9. Biostatistics – P. Hanamantrao- Himalaya
10. Introduction to Biostatistics Dr. Pranabkumar Banerjee

Practical (Lab Course Work –V): Experiments based on given syllabus by using data from biological experiments.

S.R.T.M. university, Nanded

Structural Biology– BI-XII

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

Objective: To seek knowledge about protein modelling and few other macromolecules.

Learning Outcome: This course will give students background of how protein is made Insilco and hoe stable conformational structure is obtained.

Unit I:Macromolecular Structure Protein

Primary, Secondary, Super secondary, Tertiary and Quaternary structure Nucleic acid – DNA and RNA, Carbohydrates, 3D Viral structures Principles of protein folding and methods to study protein folding. Structure of Ribosome Macromolecular interactions –Protein – Protein, Protein – Nucleic acids, Protein - carbohydrates

Unit II: Macromolecular x-ray crystallography

Principles of crystallography, Methods to study 3D structure. Co-ordinate systems Fitting and refinement; Validation Analysis of 3D structures, Mass spectrometry and computational approaches in structural biology

Unit III:Molecular modeling An Overview. Introduction and challenges Molecular modelling methods – Conformational searching, Potential energy maps, Ramachandran maps, Ab-initio methods, Semi-empirical methods Empirical methods.

Unit IV:Conformational analysis

Introduction and Methods – Molecular fitting. Conformations: global vs. local Force fields: expressions for stretch, bond, torsion, etc. Energy Minimization – Non-derivative and derivative methods. Free energy calculations Global optimization (simulated annealing, Tabu search, genetic algorithms) Applications of energy minimization.

Unit V: Methods for 3D structure prediction Knowledge based & Fold recognition Advance techniques in Prediction of 3D Structure – Hidden Markov Model, Neural networks, Rosetta Stone, Genetic algorithms. Designing of molecules like drug, inhibitors using – Structure based &ligand-based docking methods. Different Scoring schemes

Reference Books:

1. Principles of protein X-ray Crystallography by Jan Drenth, Springer-Verlag.
2. Computational Molecular Biology-Pavel A. Pevzner-PHI
3. DNA Protein Interactions-Andrew Travers and Malcolm Buckle- Oxford
4. Handbook of Hidden Markov models in Bioinformatics-Martin Gollery- CRC Press
5. Microarrays for an Integrative Genomics-I.S. Kohane, Kho, Butte-

6. Structural Bioinformatics - Methods of biochemical Analysis Philip E. Bourne (Ed), H. Weissig Wiley-Liss,
7. Introduction to Protein Structure by Branden, Carl & Tooze, John, Garland Publishing.
8. Molecular Modeling: Principles and Applications by Andrew Leach, Prentice Hall.
9. Prediction of protein structure and the principles of protein conformation by Fasman, G.D. Plenum Press
10. Protein Bioinformatics-Eidhammer, Jonassen, Taylor-Wiley

Practical (Lab Course Work –VII): Experiments based on syllabus

S.R.T.M. university, Nanded

Programming in JAVA and Bio-JAVA– BI-XI

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

Objective: To seek knowledge about what is JAVA and how it can be used in biology.

Learning Outcome: This course will give students background of how JAVA programing can be used to make databases and what are components of JAVA and Bio-JAVA.

Unit I:An Introduction and overview of Java

A Short History of Java, Features of Java, Comparison of Java and C++, Java Tools And Editors (Appletviewer,Jar,Jdb). BuiltIn Data Types, Variables and Constants(Final Keyword Related to variables), Operators, Output using println method, Control Statements, Arrays, Simple Java Program.

Unit II:Objects and Classes

Defining Your Own Classes, methods and objects, using this keyword, constructors, types of constructors, constructor overloading, static variables and methods, access specifiers, packages-creating, accessing and using packages, Garbage collection, finalizemethod.

Unit III: Inheritance and Interfaces

Inheritance Basics and Types of Inheritance, use extends keyword, Super class, Subclass and use of Super Keyword, Method Overriding, Use of final keyword related to method and class, Use of Abstract class, Defining and Implementing Interfaces, interface variables and interface methods.

Unit IV: Exception Handling, Strings, Streams and Files

Dealing Errors, types of exception, exceptions handling using try and catch, using throws keyword, uses finally block. String class and String Buffer Class, Stream classes, Byte Stream classes, Character Stream Classes, Using the File class, Creation of files, Reading/Writing characters and bytes, Handling primitive data types.

Unit V:Applet Programming with Graphical User Interface and Bio-Java

Applet Life Cycle, Applet HTML Tags, Passing parameters to Apple, User Interface Components with AWT in applet, Buttons and Labels, Checkboxes and Radio Buttons, Lists and Combo Boxes, Dialogs (Message, confirmation, input (like file selection).

Introduction to Bio-Java, Installation, symbols, basic sequence manipulation (DNA to RNA and reverse compliment, motif as regular expression), Translation (DNA to Protein, six frame translation), Proteomics (to calculate mass and PI of a peptide), FASTA and BLAST for parser.

Reference Books:

1. Complete reference Java by Herbert Schildt(5th edition)
2. Java 2 programming black books, Steven Horlzner
3. Programming with Java , A primer ,Forth edition , By E. Balagurusamy
4. Java servlet Programming by Jason Hunter, O'Reilly

5. Core Java Volume-I-Fundamentals, Eighth Edition, Cay S. Horstmann, Gary Cornell

Practical: (Lab Course Work –VI): Programs based on the syllabus

S.R.T.M. university, Nanded

Research methodology and IPR– BI-XII

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

Objective: To seek knowledge about hoe research occurs and what is IPR.

Learning Outcome: This course will give students background on how to patent their research, how to write and prepare research paper.

Unit – I: Introduction to research

Research Definition, Characteristics, Objectives, Research and Scientific method, and Types of Research

UNIT – II: Data collection and statistical analysis

Literature Review, Review Concepts and Theories, Formulation of Hypothesis
Sources of Hypothesis, Characteristics of Hypothesis, Role of Hypothesis and
Tests of Hypothesis Threats and Challenges to Good Research

UNIT-III: Protocol writing format

Writing an article, Essay, Research Paper, Research Project, Thesis, dissertation, Book Research Ethics, Citation Methods, Bibliography, Citation Rules.

UNIT IV: IPR

What is Intellectual property? Importance of prospecting scientific discoveries, Bioprospecting, IPR policy of government of India, how is patent filed and granted? Qualification of patent: Novel, commercial and non-obvious, other types of IPR.

UNIT V: IPR in Agriculture:

Plant breeder's rights, Farmers right, Patenting of plant species

S.R.T.M. university, Nanded

Chemo Informatics and Drug Designing– BI-XIV

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

Objective: To seek knowledge about drug designing using cheminformatics.

Learning Outcome: This course will give students background of how macromolecules are modeled Insilco and how to develop drugs.

Unit I:Introduction

Chemoinformatic definition, scope of cheminformatics, history of cheminformatics, why to use informatics methods in chemistry?

Unit II: Representations of chemical compounds

Introduction, Computer Representations of Chemical Structures: Graph Theoretic Representations, Linear Notations, Connection Tables, Canonical Representations of Molecular Structures. 2D structure databases, Reaction Databases, The Representation of Patents and Patent Databases. Representations of 3D molecular structures: Experimental 3D Databases, 3D Database Searching. Theoretical 3D Databases: Structure-Generation Programs,

Unit III:Molecular Descriptors

Introduction, Descriptors Calculated from the 2D Structure: Simple Counts, Physicochemical Properties, Molar Refractivity. Structure Searching: Substructure Searching, Screening Methods, Similarity searching, Conformational Search and Analysis: Systematic and Random Conformational Search.

Unit IV: Drug and Drug-Targets

Drug: definition, "Drug-Likeness" and Compound Filters, rule of five. Lead Compound: definition, natural and synthetic resources of lead compounds. Drug targets: Enzymes, receptors, carrier proteins, structural proteins, nucleic acids, etc.

Unit V: Drug designing

Combinatorial Synthesis and Combinatorial Library, QSAR, 3D Pharmacophores. Screening Methods: High-throughput screening, Virtual Screening. Protein–Ligand Docking. The Prediction of ADMET Properties, Toxicity Prediction.

Reference Books:

1. Handbook of Chemoinformatics, volume 1, by John Gastiger, Thomas Engel, WILEY-VCH
2. Guidebook on Molecular Modelling in Drug Designing-Ed. N Claude Cohen-Elsevier
3. An Introduction to Chemoinformatics, by Andrew R. Leach & Valerie j. Gillet, Springer
4. Instant Notes in Medicinal Chemistry, by G. Patrick, BIOS Scientific
5. Discovering Genomics, Proteomics, & bioinformatics- Campbell & Heyer-Pearson

Practical (Lab Course Work –V): Experiments based on syllabus.

S.R.T.M. university, Nanded

Biological Database Management– BI-XV

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

Objective: To seek knowledge about Database management and SQL.

Learning Outcome: This course will give students background on how data is analysed and distributed usding DBMS.

Unit I:Introduction

Database designing, data capturing; Data Abstraction, Data Models, Instances & Schemes; Textual Databases; Introduction to Distributed Database Processing. Basic concepts and applications of Network Data Model, Hierarchical Data Model, Multimedia Databases E-R Model – E-R diagrams; Entity and entity sets; Relations and relationship sets; Reducing E-R Diagrams to tables. Basic concepts of – Indexing and Hashing; ISAM; B+ Tree indexed files; Static Hash functions; Dynamic Hash functions.

Unit II:ORACLE, SQL

Oracle Architecture, Oracle objects - Tables, Views, Indexes, Sequences, Synonyms, Snapshots, Clusters. Database ,Tablespace, Data files, Data Blocks, Extents, Segments, Rollback Segments; Oracle Background Processes, control file, Redo log file, Archive log file; Security, Users, Grants, Roles. Backup & Recovery (Archiving); Physical Storage & Logical Storage. User Defined Columns; PL/SQL Interface/ Triggers; Packaged Procedure; Calling Report from a Form. Menu - Default Menus; PL/SQL in Menu Modules, Menu Security. Select Statements, Data Definition Statements, Data Manipulation Statements, Data Control Statements.

Unit III:More on SQL

SQL commands used to create table, modify table structure, drop table, rename table. SQL commands used to change the data within the database – inserting of records in the tables, updation of all or specific set of records in tables, viewing the attributes of table's column. Querying data – Selecting the data from table using Arithmetic and logical Operators, Range searching and pattern matching, Function, group function, scalar function. Defining Constraints – Types: I/O constraints like Primary Key, Foreign key, Null and Unique constraints. Business constraints like check constraints. Levels: Table level constraints, column level constraints, creating and deletion of constraints using the Alter Table clause. Joining multiple tables, joining a table to itself. Security Management using SQL – Granting rights on user objects such as Tables, Views, and Sequences; Revoking rights on user objects such as Tables, Views, and Sequences.

Unit IV: PL/SQL

PL/SQL blocks exception handling, triggers handling with cursors in PL/SQL blocks; Types of cursors: Implicit and Explicit cursors.

Unit V: Introduction to Front-end application development Introduction to Front-end application development, working with code and forms, variables, procedures and controlling program executor, standard controls, data access. Establishing connection to various databases. Need of metadata standards & ontology.

Reference Books:

1. SQL, PL/SQL: the programming language of oracle by I. Bayross, BPB Publications.
2. DBMS by Bipin Desai-
3. Oracle SQL & PL/SQL Handbook: a guide for data administrators, developers, and business analysis by J. Palinski, Delhi, Pearson Education, 2003.
4. Database System Concepts by Hanery Korth and Abraham Silberschatz, TMH
5. An Introduction to Database Systems by C.J. Date, Addison-Wesley.
6. ORACLE: Power Objects Handbook by Bruce Kolste, David Peterson.

Practical ((Lab Course Work –VII): Experiments based on syllabus

S.R.T.M. university, Nanded

Programming using Perl and Python– BI-XVI

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

Objective: To seek knowledge about Perl components and programing along with introduction to Python.

Learning Outcome: This course will give students background onprograming using Perl and Python

Unit I:Introduction and art of Programming

Introduction, computer program & programming language, Perl's benefits, portability, speed & program maintenance, Installing perl on your computer, how to run perl Program, text editor, finding help. Individual approaches to programming, bio programming strategies, the programming process.

Unit II: Sequence & Strings, Basic Operators

General introductions to DNA & protein sequence, Standard IUB/IUPAC nucleic acid codes, Standard IUB/IUPAC amino acid codes, A program to store a DNA sequence, Concatenating DNA fragments. Introduction to genetics code & codon table, translating codons to amino acids (using hashes), translating DNA into proteins, sequence file formats, FASTA format, Transcription: DNA & RNA. Scalar variables, Arithmetic operators, comparison operators, logical operators, assignment operators, auto increment & auto decrement operators, Concatenating & repeating string operators.

Unit III:File Handling, Lists & Arrays, Pattern Matching

Opening a file, reading a file, writing a file, closing a file, determining a status of a file. Introduction to lists, storing lists in array variables, more about lists & arrays, Array library function. How pattern matching works, pattern matching operators, anchoring the patterns, patterns matching function, program to calculate the reverse complement.

Unit IV:Control Flow & Looping Statements, Subroutines & Hashes

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. 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 variables.

Unit V:Introduction to Python and R programming

Introduction to BioPerl. Brief introduction of Python; comparison with Perl R Programming

Reference Books:-

1.) James Tisdall 2001 “Beginning Perl For Bioinformatics” O’reily & Associates.

1. 2. R. Schwartz , Foy and Phoenix, “Learning Perl” –O’Reilly
2. 3) Learning Perl- Larry Wall
3. 4) Kernel Methods in Computational Biology-Ed. Scholkopt, Tsuda, Vert-
4. 5) Bioinformatics Technologies- Yi Ping Chen-Springer
5. 6) Mastering Perl for Bioinformatics-James D. Tisdall- Oreally
6. 7) Algorithms in Bioinformatics-Ed. Gary Benson, Roderic Page- Springer
7. 8) Building Bioinformatics Solutions –Cornod Bessant, I Shadforth, Oakley-oxford

Practical (Lab Course Work –VI): Experiments based on syllabus

S.R.T.M. university, Nanded

Genomics, Transcriptomics and Proteomics– BI-XVII

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

Objective: To seek knowledge about terms related to gene, its transcription and translation..

Learning Outcome: This course will give students will learn methods of genomics and proteomics and how their interaction could help in different fields.

Unit I: Methods in Genomics

Chemical synthesis and Sequencing of DNA. Polymerase chain reaction and its applications Introduction sequencing strategies for whole genome analysis, sequence data analysis. Gene function by sequence comparison Global expression profiling: whole genome analysis of mRNA and protein expression, microarray analysis, types of microarrays and their applications

Unit II:Methods in Proteomics

Methods of protein sequencing: Edman degradation, Tryptic and/or Chymotryptic Peptide Mapping. Chemical and Physical Considerations in Protein and Peptide Stability, Different methods for protein engineering, Site-directed mutagenesis, gene shuffling, and direct evolution. Isolation and purification of proteins, Stability and activity-based approaches of protein engineering.

Unit III:Genome Alignments and Comparative Genomics

BLAST2, MUMmer PipMaker VISTA. Comparison of Gene Order- GeneOrder Viruses, Microbes, Pathogens Eukaryotes. COG, VirGen, CORG, HOBACGEN, Homophila, XREFdb, Gramene, Single Nucleotide Polymorphism, dbSNP and other SNP-related databases

Unit IV:Protein-Protein Interaction

Networks, databases and software DIP (Database of Interacting Proteins), PPI Server, BIND - Biomolecular Interaction Network Database PIM –Hybrigenics, PathCalling Yeast Interaction Database, MINT - a Molecular Interactions Database\ GRID - The General Repository for Interaction Datasets, InterPreTS - protein interaction prediction through tertiary structure

Unit V:Genomics & Proteomics Mapping of protein interactions

Two hybrid, phage display etc. Experimental Techniques: 2 D PAGE, Mass spectrometry, Bioinformatics Approaches. Concept of Functional genomics, Toxicogenomics, Pharmacogenomics, Metagenomics

Reference Books:

1. Principles of Genome analysis and Genomics-Primrose and Twyman-Blackwell Publishing
2. Principles of Proteomics-R.M Twyman-BIOS advanced text
3. Functional Genomics-Stephen Hunt, Livesey- Oxford
4. Genetic Programming-W. Banzhaf, Nordin, Keller, Francone- Elsevier
5. Protein Science-Arthur M. Lesk- Oxford
6. Comparative Genomics-Nicholas H Bergman-Humana Press
7. Bioinformatics of Genome Regulations and StructureEd. Nikolay Kolchanov-Ralf Hofestaedt-Springer
8. Bioinformatics: sequence and genome analysis by David Mount, cold springer harbour press.
9. Introduction to proteomics: tools for the new biology by Liebler, D.C. & Yates, J.R.III, Humana Press
10. Proteomics: from protein sequence to function by Pennington, S. R. & Dunn, M. J.: Viva Books

Practical (Lab Course Work –VII): Experiments based on syllabus

S.R.T.M. university, Nanded

System Biology– BI-XIII

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

Objective: To seek knowledge about enzymes and their role in metabolic pathway

Learning Outcome: This course will give students background on hoe metabolic pathways occurs in organism and how enzymes and involved in it, also they will learn hoe bioinformatics could help in analyzing the metabolic pathway which would help to know root cause of any malfunctioning

Unit I: Enzymology

Enzyme general characteristics, nomenclature and classification. Methods of isolation, purification and characterization of enzymes. Concept of enzyme assay, enzyme activity, coenzymes and isoenzymes. Enzyme kinetics: Michaelis - Menten Equation - form and derivation, steady state enzyme kinetics. Significance of Vmax and Km.

Unit II:Enzymology

Enzyme inhibition - types of inhibitors - competitive, non-competitive and uncompetitive, their mode of action and experimental determination. Immobilized Enzymes: Relative practical and economic advantage for industrial use, Various methods of immobilization ionic bonding, adsorption, covalent bonding (based on R groups of amino acids), microencapsulation and gel entrapment.

Unit III:Metabolic Pathways

Photosynthesis - Light harvesting complexes; mechanisms of electron transport; photoprotective mechanisms; CO2 fixation-C3, C4 and CAM pathways. Respiration– Glycolysis, Citric acid cycle; mitochondrial electron transport and ATP synthesis; alternate oxidase; photorespiratory pathway. Nitrogen metabolism - Nitrate and ammonium assimilation; amino acid biosynthesis, Nucleotide biosynthesis- de novo and salvage.

Unit IV:More on Metabolic Pathways Databases

KEGG, PathDB, EcoCyc and MetaCyc, EMP, Malaria Parasite Metabolic Pathways Boehringer Mannheim - Biochemical Pathways. LIGAND - Biochemical Compounds and Reactions. ENZYME – Enzymes; BRENDA - Comprehensive Enzyme Information System. Full Genome Annotation through knowledge of Metabolic Pathways Organism Specific Metabolic Pathways. Comparison of Metabolic Pathways

Unit V:Metabolic Pathway Engineering

Mathematical modeling of metabolic pathways. Engineering of Metabolic Pathways Representation of Metabolic Pathways. Generation and Dynamic Representation of Metabolic Pathways Deriving Common Principles from the Metabolic Pathways Knowledge - E.g. deriving sets of enzymes specific for various reactions (e.g. oxidation), Alternative paths for synthesis of metabolites etc.

Reference Books:

1. Enzymes- Palmer & Bonner - Woodhead Publishing
2. Cohn and stumpt- Outline of Biochemistry- Wiley India
3. Gene Regulation and Metabolism-Ed. Collado Vides and Hofestad-
4. Fundamentals of Enzymology- Price and Stevens-Oxford
5. Fundamentals of Biochemistry- D., Voet, Voet, J.G. & Pratt, C. W. John Wiley & Sons.
6. Lehninger Principles of Biochemistry - D. L. Nelson & M. M. Cox, W. H. Freeman & Co.
7. The Enzyme Reference- D. L. Purich & R. D. Allison- Academic Press.
8. Metabolic Engineering -G.N. Stephanopoulos, A. A. Aristidou & J. Nielsen Academic Press.
9. Gene regulation and metabolism: postgenomic computational approaches. Collado-Vides, J. & Hofestadt, R. Cambridge, The MIT Press.

Practical (Lab Course Work –VI): Experiments based on syllabus.

S.R.T.M. university, Nanded

Project/Review writing– Lab course VII
(Dissertation/ Elective Lab Course Work)

Guidelines for Dissertation work

1. The dissertation will be allotted during III semester
2. Students will design experiment of dissertation under guidance of supervisor
3. Selection of topic relevant to priority to areas of biotechnology/Bioinformatics
4. Collection of literature from various sources
5. Planning of research experiments
6. Performing the experiments with scientific and statistical analysis
7. Writing and compilation of dissertation report
8. Presentation of experimental data in schedule of practical examination
9. Dissertation to be carried out individually by each student