

**SARDAR PATEL UNIVERSITY**  
**Programme & Subject: B.Sc. (Bioinformatics)**  
**Syllabus with effect from: June – 2020**

**BSc Bioinformatics Programme Outcomes**

After successful completion of B.Sc Bioinformatics Course the graduates

- Eligible for pursuing higher education, M.Sc. programmes in the different field of life science, IT and computer science.
  
- Eligible for doing jobs in pharmaceutical and IT Industry.
  
- Understand the potentials, and impact of bioinformatics outcome on environment and to find out the sustainable solutions to problems regarding web designing, drug designing, software development, medical, and agriculture sector, etc.
  
- Can work individually as well as in team to thrive in multidisciplinary environment.
  
- Both oral and written communication skills

**SARDAR PATEL UNIVERSITY**

**Programme& Subject: B.Sc. (Bioinformatics) Semester: V**

**Syllabus with effect from: June – 2020**

<b>PaperCode:US05CBNF21</b>	<b>TotalCredit: 4 (4 lectures/wk)</b>
<b>PERL programming Language</b>	

**UNIT Getting started with Scripting Language**

**I** A Low and Long Learning Curve, Perl's Benefits, How to Install PERL, How to run PERL Program, Text editors, Representing Sequence data, A Program to store DNA sequence  
Concatating DNA fragments, DNA to RNA :Transcription,Calculate Reverse Complement

**Protein Files and Arrays**

Files, Arrays, Proteins Reading Proteins in File, Arrays, Scalar and list Context

**II Motifs and Loops**

Flow Control, Code Layout, Finding Motifs, Counting Nucleotides, Exploding String into Array  
Operating on String, Writing to Files

**III Subroutines and Bugs**

Subroutines, Scoping and Subroutines, Command Line Argument and Array, Passing Data to  
Subroutine, Modules and Libraries of Subroutine, Fixing Bugs in Your Code

**IV Mutations and Randomization**

Random Number Generator, A Program Using Randomization

A Program to Simulate DNA Mutation

Generating Random DNA

Analyzing DNA

**The Genetic Code**

Hashes, Genetic Code, Translate DNA to Protein

**Basic Text and Reference Books:**

1. Beginning of PERL for bio Informatics by James D. Tisdall

**Learning outcome:**

- proficient programming in the Perl language and programming in general
- design and revision of Perl scripts
- debugging techniques appropriate for the Perl language

## SARDAR PATEL UNIVERSITY

Programme & Subject: B.Sc. (Bioinformatics) Semester : V

Syllabus with effect from: June – 2020

<b>PaperCode: US05CBNF22</b>	<b>TotalCredit: 4</b>
<b>Relational Database Management Systems</b>	<b>(4 lectures/wk)</b>

### Unit

#### I Introduction to DBMS, RDBMS and Data Modeling

DBMS : Meaning, Advantages, Disadvantage, The three-schema architecture for a Database Management System (DBMS), Codd Rules, Entity-relationship modeling (different types of entities, attributes, relationships and their representation in the E-R diagram), Case studies of data modeling using E-R modeling  
Consequences of poor Data base Design, Normalization, 1<sup>st</sup> Normal Form, 2<sup>nd</sup> Normal Form, 3<sup>rd</sup> Normal Form, Boyce-Codd Normal Form, Examples of normalization

#### II Introduction to SQL

SQL - introduction , advantages and disadvantages, Data types – built-in (number, char, varchar2, date, raw, long raw), Types of SQL Statements : DDL (Data Definition Language),  
DML (Data Manipulation Language), DCL (Data Control Language), TCL (Transaction Control Language)  
Working with SQL\*Plus – overview and basic commands like ed, start, get, save, exit, connect, set linesize, set pagesize and host, Creating table and inserting data - CREATE TABLE, INSERT, retrieving data using query – SELECT , manipulating data – DELETE and UPDATE , modifying and removing table – ALTER TABLE and DROP TABLE.

#### III Data Constraints and Functions

Pseudo columns – ROWID, ROWNUM, USER, UID, SYSDATE  
Null values, TAB table, DUAL table, Operators – arithmetic, relational, logical, range searching, pattern matching and set, Data constraints – Introduction, advantages and disadvantages  
Type of data constraints – NOT NULL, UNIQUE, PRIMARY KEY, FOREIGN KEY and CHECK  
Modifying constraints, working with data dictionary and use of USER\_CONSTRAINTS  
Functions – introduction, merits and demerits, types of functions (scalar and aggregate)  
Scalar : Numeric functions (FLOOR, MOD, POWER, ROUND, SQRT and TRUNC), Character functions (CHR, ASCII, CONCAT, INITCAP, LOWER, SUBSTR, TRIM, UPPER), Date functions (ADD\_MONTHS, LAST\_DAY, NEXT\_DAY, MONTHS\_BETWEEN), Conversion functions (TO\_NUMBER, TO\_CHAR and TO\_DATE) Aggregate fun : AVG, COUNT, MAX, MIN, SUM

#### IV Query, Subquery, Joins, Transaction Management , Basics of PL/SQL

Query and subquery, types of subquery  
Creation and manipulation of database objects – indexes, views, sequences.  
Joining tables – ANSI Style, types of joins (cross join, natural join, equijoin, outer joins, self join)  
Data control language statements – GRANT and REVOKE  
Transaction control language statements – COMMIT, ROLLBACK and SAVEPOINT  
PL/SQL - Introduction and advantages  
Understanding PL/SQL Block structure

### Basic Text and Reference Books:

1. An introduction to Database Systems : Bipin C. Desai, Galgotia Publications Pvt. Ltd.
2. Ivan Bayross : SQL, PL/SQL The programming language of Oracle, 3<sup>rd</sup> revised edition, BPB Publications
3. SQL/PLSQL for Oracle9i, P. S. Deshpande, dreamtech press, reprint edition 2009
4. Understanding Database Management Systems : S. Parthasarthy and B.W. Khalkar, First edition – 2007, Master Academy
5. Oracle9i The Complete Reference , Kevin Loney, George Koch, Oracle Press

**Learning outcome:** Demonstrate an understanding of the elementary & advanced features of DBMS & RDBMS Prepare various database tables and joins them using SQL commands. Understand the basic concept how storage techniques are used to backup data and maintain data access performance in peak hours. Evaluate options to make informed decisions that meet data storage, processing, and retrieval needs.

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**Programme & Subject: B.Sc. (Bioinformatics) Semester : V**

**Syllabus with effect from: June – 2020**

<b>Paper Code:US05CBNF23</b>	<b>TotalCredit: 4 (4 lectures/wk)</b>
<b>Genetic engineering</b>	

**UNIT-I Recombinant DNA technology:**Introduction to r DNA, Cutting and Joining DNA – Restriction Endonucleases, Nucleic acid modifying enzymes (Polymerase, Alkaline phosphatase, Exonuclease, DnaseI and RNase ) Ligation, How to clone a gene - What is clone, Overview and steps of the procedure.

**UNIT-II Vectors:** Vectors – Plasmid vectors, Vectors based on the lambda Bacteriophage, Cosmids, M13 vectors, Expression vectors, Vectors for cloning and expression in Eukaryotic cells, retroviral vector, Super vectors : YACs and BACs. Application of vector in construction of genomic and cDNA library

**UNIT-III Hybridization:** Nucleic Acid Hybridization : Principle and application - Preparation of nucleic probes, Principle of Nucleic acid hybridization, Nucleic acid hybridization assays, and microarrays. Molecular Mapping – RFLP, RAPD , AFLP , repetitive DNA. DNA finger printing and its application.

**UNIT-IV Stem cell technology:** Potential, Classes and application of stem cell (tissue engineering, Gene and cancer therapy). Methods to create transgenic animals (Microinjection and retrovirus). Application of transgenic animals.

**Basic Text and Reference Books:**

1. Principle of Genetic Manipulation by Old and Primrose
2. Genomes by T. A. Brown
3. Gene Cloning T.A.Brown
4. An introduction to Genetic Analysis – Griffith Miller , Suzuki Levonting

**Learning Outcome:**

- The objective of the course is to familiarize the students with the basic concepts in genetic engineering; to acquaint the students to versatile tools and techniques employed in genetic engineering and recombinant DNA technology; and to appraise them about applications genetic engineering.
- Student will able to understand general techniques used by genetic engineers to modify DNA.
- Analyze the benefits and drawbacks of manipulating an organism's DNA.

## SARDAR PATEL UNIVERSITY

Programme&Subject : B.Sc. (Bioinformatics) Semester : V

Syllabus with effect from: June – 2020

<b>PaperCode:US05CBNF24</b>	<b>TotalCredit: 4 (4 lectures/wk)</b>
<b>TitleofPaper: Bioinformatics Applications</b>	

**Unit 1: Genomics:** Introduction to genomics and type. Organization of the Human genome, Nuclear genome and Mitochondrial genome, Repeats, coding regions, non-coding regions. Organization of Prokaryotic genome, Comparative genomics. Genome sequencing: Basic concept, Shot gun method and Clone contig method and their importance. Tools for genome analysis. Human Genome Project – Overview, Goals & Applications.

**Unit 2: Introduction to Genome Informatics:** First Generation of Sequencing techniques: – manual & automated: Maxam and Gilbert and Sangers method. Chain termination method, Pyrosequencing  
Second Generation of Sequencing techniques: Roche/454 sequencing, Ion torrent sequencing, Illumina/Solexa sequencing  
Third Generation of Sequencing technique: Pacific Biosciences SMRT sequencing, nanopore sequencing  
Comparison of Next generation sequencing techniques, Significance and Drawbacks of NGS, NGS File formats, Softwares for NGS data analysis.

**Unit 3:Gene Prediction and Expression analysis:** Gene structure in Prokaryotic and Eukaryotic. Gene prediction methods: Prediction of promoters, splice sites and regulatory regions, detecting of Open Reading Frames in sequences. Microarray analysis definition, types of microarray, microarray analysis life cycle (sample preparation and labeling, hybridization, washing and image acquisition), microarray data analysis.

**Unit 4: Phylogenetic & molecular evolution:** molecular basis of evolution, Phylogenetic trees & different methods for phylogenetic inference, Construction- Maximum Parsimony Method, Maximum likelihood method and Distance Methods Phylogenetic Tree Evaluation: Bootstrapping & significance of phylogenetic tree. Tools for phylogenetics analysis.

### Reference Readings

1. Claverie, J.M. and Notredame C. 2003 Bioinformatics for Dummies. Wiley Editor.
2. Letovsky, S.I. 1999 Bioinformatics. Kluwer Academic Publishers.
3. Baldi, P. and Brunak, S. 1998 Bioinformatics. The MIT Press.
4. Setubal, J. and Meidanis, J. 1996 Introduction to Computational Molecular Biology. PWS Publishing Co., Boston.
5. Lesk, A.M. 2002 Introduction to Bioinformatics. Oxford University Press.
6. Fogel, G.B. and Corne, D.W., Evolutionary Computation in Bioinformatics.
7. Genetic Library Construction and Screening: Advanced Techniques and Applications: Lab Manual
8. Patterson, B.K., Techniques in Quantification and Localization of Gene Expression.
9. Mont, D.W., Bioinformatics: Sequence and Genome Analysis.
10. Evens, W.J. and Grant, G.R., Statistical Methods in Bioinformatics: An Introduction.

### Learning outcome:

The course aims to appraise the students to basic and high throughput techniques in Genomics and Proteomics and their applications.

Suggest and outline solution to theoretical and experimental problems in Genomics and Proteomics fields.

**SARDAR PATEL UNIVERSITY**  
**Vallabh Vidyanagar**  
**Programme & Subject :B.Sc. BIONFORMATICS**  
**Semester – V**  
**US05CBNF25 :Practicals**  
(Syllabus Effective from June 2020)

**Credits : 2 External : 15 Marks**  
**Contact Hrs per Week : 4 Internal : 35 Marks**  
**All units carry equal weightage University Examination Duration: 2 Hrs**

	Description	Weightage
	<b>Practicals Based on US05CBNF21 and US05CBNF22</b>	<b>50%</b>

1. Problems based on reagent preparations: Molarity, Molality.
2. Isolation of genomic DNA from plant cells.
3. Isolation of genomic DNA from *E.coli* cells.
4. Isolation of Plasmid DNA.
5. Gel electrophoresis- Agarose (for separation of above isolated genomic DNA)
6. Competent cells preparation and transformation
7. SDS PAGE. (Demo)
8. Radial Immunodiffusion,
9. ELISA.
10. Separation and identification of amino acid by paper chromatography.

1. Multiple alignment using tool M-Coffee.
2. To perform Sequence analysis by using EMBOSS.
3. To study the phylogentic relationships of nucleotide and protein sequence(s) by using PHYLIP Package and PhyML.
4. To model a protein sequence using swiss model.
5. To model a protein sequence using modeler software.
6. To study physiochemical properties of protein using Protparam.
7. To perform secondary structure analysis using GOR.
8. Gene identification using ORF Finder at NCBI.
9. To study protein structure using RASMOL.
10. Use Finger PRINTScan program to get information about protein functions.
11. To study conserved region in the sequence using Sequence logo.

**SARDAR PATEL UNIVERSITY**

**Discipline specific**

**Programme & Subject : B.Sc. (Bioinformatics) Semester : V**

**Syllabus with effect from: June – 2020**

<b>Paper Code:US05DBNF26</b>	<b>TotalCredit: 2 (2 lectures/wk)</b>
<b>Title of Paper: Biological Chemistry and Metabolism</b>	

**UNIT I: VITAMINS**

Vitamins: Definition, Overview of General characteristics, Properties, Metabolism , Effects of deficiencies of water soluble & fat soluble vitamins, Vitamin related co-enzymes and chemical reactions. Structure and Hydrolysis of ATP & introduction to energy rich compounds- Biological oxidation-reduction reactions and Redox potential.

**UNIT II: ENZYMES**

Definition, Nomenclature and Classification of enzymes, Introduction to Allosteric enzymes, Inhibitors, Active site (lock and key theory, induced fit theory). Enzyme kinetics- Derivation of Michaelis-Menten equation, Km and its significance, line-weaver Burk plot and its limitations and solutions(Eadie Hofstee and Hannes Woolf's curve and equations).

**UNIT III: LIPIDS**

Lipids: Definition, Overview of [Importance, Nomenclature, General Structure of Fatty acids (Saturated, Unsaturated, Hydroxy and Cyclic)], Biological Roles of Lipids, Lipid metabolism ( $\beta$  ,  $\alpha$  ,  $\omega$  oxidation, lipolysis, , fatty acid synthesis)

**UNIT IV: METABOLISM**

Carbohydrate metabolism (Glycolysis,Kreb's cycle) . Nucleic acid metabolism: *de novo* synthesis and degradation of purines and pyrimidines Proteins: General features of Trans-amination, Trans-deamination and Urea cycle.

**REFERENCES:**

1. Biochemistry – J. M. Berg, John L. Tymoczko, Lubert Stryer W. H. Freeman & Co.
2. Essentials of Biochemistry- David Lee Nelson, Albert L. Lehninger, Michael M. Cox . W. H. Freeman & Co.
3. Principles and Techniques of practical biochemistry - Keith Wilson, Cambridge University Press.
4. Principles of Anatomy and Physiology- Gerard J. Tortora & B. H. Derrickson, John Wiley & Sons.
5. Outlines of biochemistry-Conn & Stumpf 5th Ed, John Wiley & Sons,
6. Biochemistry - U. Satyanarayana. 2nd Ed, New Central Book Agency (p) Ltd.
7. Medical Biochemistry - Chhaterjee and Ranashinde.7th Ed, Jaypee Publishers
8. Fundamentals of Biochemistry: Life at the Molecular level- Voet Donald , John Wiley & Sons.

**Learning outcome:** Students will be able to know about Vitamins, enzymes, lipids and metabolism