

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

Paper Code: US06CBNF21	Total Credit: 4 (4 lectures/wk)
Python Programming	

Unit	Description
I Introduction to Python	Installing and Working with Python. Features of Python, Python Variables, Data Types, and Operators, Conditional Statements, Iteration Statements, Control structures: Break, Continue, Pass. Build in Functions.
II Python Data Structures and Manipulation	Understanding Strings, Lists, Tuples, Sets and Dictionaries, Data Structure Manipulation using loops
III Functions, File Management, Exception Handling and Debugging	Functions- Defining Functions, Testing Functions, Name Scopes, Inline Functions, Using global names inside function, Recursive Functions, Modules, File Handling – Introduction , Creating files, Read and Write files, Delete files, Exception handling, Debugging
IV Object-Orientated Concepts, Regular Expression, Python MySQL	Class, Object, Instances, Inheritance, Encapsulation, Polymorphism, Method Overriding, Object Overloading, Packages, Regular Expression, Python MYSQL – Create Database, Create Table, Insert, Select, Where, Order By, Delete, Drop Table, Update, and Join.

Basic Text and Reference Books:

1. Paul A. DeBarry: Head First Python, 2010, O'Reilly Media, Inc.
2. Martin C. Brown: The Complete Reference Python, McGraw Hill
3. David M. Beazley: Python Essential Reference, Pearson Addison-Wesley Professional.
4. Allen Downey, Jeffrey Elkner, Chris Meyers : How to think like a computer scientist learning with Python , Freely available online.2012
5. Exploring Python, Timothy A. Budd ,McGraw Hill

Online Reading / Support material:

1. <http://docs.python.org/3/tutorial/index.html>
2. <http://interactivepython.org/courselib/static/pythonds>
3. <http://www.ibiblio.org/g2swap/byteofpython/read/>
4. Python Tutorial/Documentation : www.python.org

The learning objectives of this course are:

- To understand why Python is a useful scripting language for developers.
- To learn how to design and program Python applications.
- To learn how to use lists, tuples, and dictionaries in Python programs.
- To learn how to identify Python object types.

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Syllabus with effect from: June – 2020

PaperCode: US06CBNF22	TotalCredit: 4
R Programming	(4 lectures/wk)

Unit	Description in detail
I Introduction to R	History of R, Features of R, How to install R, How to run R, Comments in R, Reserved words, Identifiers, Constants, Variables Operators: Arithmetic, Relational, Logical, Assignment, Miscellaneous, Basic Data Types: Numeric, Integer, Complex, Logical, Character Vectors: Creating Vectors, Combining Vectors, Accessing Vector Elements, Modifying Vectors, Deleting Vectors, Vector Arithmetic & Recycling, Vector Element Sorting, Reading Vectors
II Data Structure in R	Matrices: Creating Matrices, Accessing Matrix Elements, Matrix Manipulation, Matrix Operations Arrays: Creating Arrays, Accessing Array Elements, Array Element Manipulation, Array Arithmetic Lists: Creating Lists, Accessing List Elements, Updating List Elements, Merging Lists, List to Vector Conversion Factors: Creating Factors, Accessing Factor Components, Merging Factors Data Frames: Creating Data Frames, Accessing Data Frame Components, Modifying Data Frames, Aggregating Data, Sorting Data, Merging Data, Reshaping Data, Subsetting Data
III Flow Control & Functions in R	Decision Making: if statement, if..else statement, Nested if..else statement, switch statement, Loops: for Loop, while Loop, repeat Loop, Loop Control Statements: break Statement, next Statement Built-in Functions: Mathematical Functions, Character Functions, Statistical Functions, Date and Time Functions Functions Definition, Function Calling: Function without arguments, Functions with named arguments, Function with default arguments.
IV Connecting R to External interfaces	Packages: Installing a Package, Loading a Package Charts and Graphs: Bar Charts, Line Graph, Pie Chart, Scatter Plots, Dot Plots CSV Files: Reading from a CSV File, Writing to a CSV File Microsoft Excel: Reading from a xlsx File, Writing to xlsx File Databases: Connecting R to MySQL, Creating Tables, Inserting Rows, Updating Rows, Deleting Rows, Querying Tables, Dropping Table

Basic Text and Reference Books:

- R Programming for Data Science, Roger D. Peng (2015), Leanpub publisher
- Statistics Using R Purohit, G.S., Gore, S.D. and Deshmikh, S.R. (2008), Narosa Publishing House
- Data Analysis and Graphics Using R: An example-based approach, Maindonald J. and Braum, J. (2007) Second Edition, Cambridge Series in Statistical and Probabilistic Mathematics.
- An R Companion to Linear Statistical Models, Hey-Jahans, C.(2012), CRC Press

The learning objectives of this course are:How to program in R and how to use R for effective data analysis.

- Install and configure software necessary for a statistical programming environment.
- Reading data into R, accessing R packages, writing R functions, debugging, profiling R code, and organizing and commenting R code.

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

Syllabus with effect from: June – 2020

Paper Code: US06CBNF23	Total Credit: 4 (4 lectures/wk)
Title of Paper: Immunotechnology	

Unit - I: Introduction to Immunology, Types of Immunity-Innate & Acquired, Humoral & cell mediated, Active & passive immunity, Antigens- Antigenic determinants, Haptens, Components of Innate & acquired immunity. Primary and secondary Immune response, Cells of the immune system,

Unit - II: Primary and secondary lymphoid organs -Bone Marrow, Thymus, Lymph nodes, Spleen, MALT & GALT. Antibodies-structure, types & function. Monoclonal antibodies-Hybridoma technology (HAT selection), Applications of Monoclonal Antibodies.

Unit-III: Antigen–Antibody interactions – Agglutination and precipitations reactions, variants and applications, ELISA- principle, variants (Indirect, sandwich & competitive) and applications. MHC-structure, types & function,

Unit-IV: Cytokines-Introduction & types, Role of cytokines in immune response, Classical, Alternative & lectin pathway, Disorders of the immune system: Autoimmunity, Hypersensitivity and Immunodeficiency (Introduction and examples), Role of Bioinformatics in Immunology & vaccine development.

References

1. Judy Owen, Jenni Punt, Sharon Stranford 2013 Kuby Immunology: International Edition W. H. Freeman
2. Abbas AK, 2011, Cellular and Molecular Immunology 7th Ed. Elsevier Health Sciences – India.
3. Murphy K, 2011 Janeway's Immunobiology. 8th Ed. Garland Science Publishers, New York.

learning outcome:

This course will provide students with knowledge on how the immune system and able to articulate the roles of innate recognition receptors (i.e. Toll-Like Receptors) in immune responses and to compare and contrast humoral versus cell-mediated immune responses.

The students will be able to describe the roles of the immune system in both maintaining health and contributing to disease.

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

Syllabus with effect from: June – 2020

Paper Code: US06CBNF24	Total Credit: 4 (4 lectures/wk)
Title of Paper: Structural Bioinformatics	

Unit 1:- Macromolecular Structures: DNA: Types of Double helices (A,B,Z).RNA: Secondary structures, Tertiary structures. Amino acid: Structure and Properties of Amino acids, Structure of proteins: Hierarchical organization of protein structure- Primary, Secondary, Supersecondary, Tertiary, Quaternary structure. Ramachandran Plot and its importance

Unit 2:- Protein folding: Principle of Protein folding & Unfolding: Levinthal Paradox, Anfinsen's experiment, thermodynamics of protein folding, Protein misfolding, Disorders/Diseases of Protein Misfolding (Alzheimer's disease, Cystic fibrosis, Mad Cow disease, Prions). Protein – protein interaction and protein DNA interaction, methods and significance.

Unit 3 :- Structure Prediction & Comparison : RNA secondary structure prediction methods and its application (mfold method of Zuker), Methods for protein secondary and tertiary structure prediction-Algorithms of Chou Fasman, GOR, PSI-PRED and Artificial Neural network, Steps involved in Homology Modeling, Concepts in 3D structure comparison

Unit 4:- Drug design & discovery : Definition of drugs, steps in development of new drugs, chemical & physiochemical parameters in drug-designing, drug metabolism, Interaction energy calculations, structure based drug designing, Combinatorial chemistry, virtual & high throughput screening, Docking and its importance, Introduction to Molecular Dynamics.

Reference Readings

1. Liebler, D. 2002 Introduction to Proteomics: Tools for New Biology. Human Press Totowa.
2. Campbell, A.M. & Heyer, L.J. 2002 Discovering Genomics, Proteomics and Bioinformatics. Benjamin/Cummings.
3. Structural Bioinformatics by Philip E. Bourne and Helge Weissing, Wiley.
4. Introduction to Protein structure by Brandel C. and Tooze, J.
5. Structure and Mechanism in Protein science – Fersht WH freeman & Co
6. Protein folding – Creighton TE (ed) WH Freeman & Co.
7. Structural Bioinformatics by Philip E. Bourne and Helge Weissing, Wiley

Learning outcome: Student at the end of course will be able-

- To estimate the validity of information in macromolecular structure databases, and use computer programs to visualise and analyse macromolecular structures from a functional perspective
- use bioinformatics tools for sequence alignment, sequence motif identification and prediction of secondary and tertiary structures
- account for the purpose, theoretical background, and limitations of the above mentioned bioinformatics methods and use this knowledge to interpret relevant results.

SARDAR PATEL UNIVERSITY
Vallabh Vidyanagar
Programme & Subject :B.Sc. BIONFORMATICS
Semester – VI
US06CBNF25 :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
	Practicals Based on US06CBNF21 and US06CBNF22	50%

PRACTICAL VI SEM

1. Separation and identification of Amino Acids by Thin Layer Chromatography
2. Quantitative estimation of carbohydrates by Nelson-Somogyi method.
3. Quantitative estimation of reducing sugar by DNS method (Dinitro salicylic acid)
4. Quantitative estimation of fats by Dichromate method.
5. Enzyme assay: effect of pH, temperature and incubation time on enzymatic activity.
6. Restriction digestion and ligation
7. RAPD analysis of plant DNA.
8. Effect of UV Radiation on Bacterial Growth.
9. Determination of total protein by Biuret method.
10. Study of chromosomal Abberations using colchicine.

A mini Project in Bioinformatics.

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Discipline specific

Subject: B.Sc. (Bioinformatics) Semester : VI

Syllabus with effect from: June – 2020

Paper Code: US06DBNF26	Total Credit: 2 (2 lectures/wk)
Title of Paper: Instrumental Methods of Analysis	

UNIT I: MICROSCOPY

Microscope: Definition. Properties of Light (Def. of Wavelength, Frequency, Amplitude, Polarization, Diffraction, Refraction, Magnification, Resolution) Compound microscope, Phase contrast microscope, Fluorescent microscope and Electron microscope (SEM & TEM), Tissue processing for electron microscope.

UNIT II: CENTRIFUGATION AND SPECTROSCOPY

Basic principle of sedimentation – Relative centrifugal force (RCF), Sedimentation rate, Svedberg unit or Sedimentation coefficient, Types of Centrifugation: Analytical and Preparative, Differential, Density gradient, Types of Centrifuge & rotors.
Overview of Electromagnetic radiation, Laws relating to absorption of radiation. Principle, Instrumentation and Applications of Colorimeters, Spectrophotometers – Ultraviolet and Visible Absorption Spectroscopy.

UNIT III: CHROMATOGRAPHY

Principles of Chromatography (Distribution Coefficient), Types of Chromatography: Principles, Instrumentation and applications of - Thin Layer Chromatography (TLC), Column Chromatography, Ion-Exchange Chromatography, Affinity Chromatography, Gel permeation Chromatography, GLC, High Performance Liquid Chromatography (HPLC)

UNIT IV: ELECTROPHORESIS

Gel Electrophoresis: General Principles, Agarose gel electrophoresis, SDS-PAGE, Pulse Field Gel Electrophoresis (PFGE), Iso electric Focusing, Capillary Electrophoresis.

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,

Learning outcome: Students will be able to know techniques and instrumentation microscopy, centrifugation, chromatography, electrophoresis