Sant Gadge Baba Amravati University, Amravati

Faculty of Science and Technology

Programme: B.Sc. Bioinformatics

POs:

At the time of graduation, Students would be able to

PO1.Critical Thinking: Take informed actions after identifying the assumptions that frame our thinking and actions, checking out the degree to which these assumptions are accurate and valid, and looking at our ideas and decisions (intellectual, organizational, and personal) from different perspectives.

PO2.Effective Communication: Speak, read, write and listen clearly in person and through electronic media in English and in one Indian language, and make meaning of the world by connecting people, ideas, books, media and technology.

PO3. Social Interaction: Elicit views of others, mediate disagreements and help reach conclusions in group settings.

PO4. Effective Citizenship: Demonstrate empathetic social concern and equity centred national development, and the ability to act with an informed awareness of issues and participate in civic life through volunteering.

PO5. Ethics: Recognize different value systems including your own, understand the moral dimensions of your decisions, and accept responsibility for them.

PO6. Environment and Sustainability: Understand the issues of environmental contexts and sustainable development.

PO7. Self-directed and Life-long Learning: Acquire the ability to engage in independent and life-long learning in the broadest context socio-technological changes

Programme Specific Outcomes (PSOs):

Upon completion of the programme successfully, students would be able to

1. enhance their career opportunities in industry, bioinformation industries or as a preparation for further higher education through in–house state of the art laboratory exposures and outbound dissertation activities fostering Global Competencies among Students.
2. Think critically about the Bioinformatics domain-based knowledge.
3. enhance skill based domain knowledge in the field of Bioinformatics engineering.

Employability Potential:

After successful completion of this course, students would able to act as a:

- Bioinformatics assistant.
- Pharmacogenomics analyst.
- As a Drug designing analysist.
- As Computational Biologist.
- Database Management.

Scheme of Teaching, Learning & Examination leading to the Degree in Master of Science in the Programme Bioinformatics
(Two year- Four Semester Degree Programme- C.B.C.S.)
(B.Sc. Part I) Semester I

S. No.	Subject	Subject Code	Teaching & Learning Scheme							Duration of Exam Hours	Examination & Evaluation Scheme						
			Teaching Periods Per Week				Credits				Theory		Practical		Total Marks	Minimum Passing	
			L	T	P	Total	L/T	Practical	Total		Theory+ MCQ External	Theory Internal	Internal	External		Marks	Grade
1	DSC-I Elementary Mathematics & Statistics		6	-	-	6	3	-	3	3	60 +20	20	-	-	100	40	P
2	AEC- I Biostatistics		-	1	-	1	1	-	1	1	-	-	25	-	25	10	P
3	AEC-I		--	-	-	--	-	-	-	Internal Assessment at College Level/ Institute							P
4	Lab- 1 Practical Based on DSC I		-	-	6	6	-	3	3	*	-	-	25	25	50	20	P
8	# Internship/ Field Work/ Work Experience @	150 hrs. during vacation															
9	**Open elective/ GIC/ Open skill/ MOOC***																
Total			6	1	6	13		3	7	4			50	25	175	70	

Total weekly hours (Equivalent to periods) Should not exceed 30 hours.
L: Lecture, T: Tutorial, P: Practical

Note: Internship/ Field work/ Work Experience will be conducted after I semester till Vth Semester in vacations for minimum 150 hrs. It's credits and grades will be reflected in final semester VI credit grade report.

DSE: The student can select any one of the following discipline specific courses 1. ---------- 2. ---------- 3. ----------.

-OEC (Optional) i.e. GIC/MOOC/Skill course can be studied during semester I to VI, Its credits and grades will be reflected in final semester VI credit grade report.

Scheme of Teaching, Learning & Examination leading to the Degree in Master of Science in the Programme Bioinformatics
(Two year- Four Semester Degree Programme- C.B.C.S.)
(B.Sc. Part I) Semester II

S. No.	Subject	Subject Code	Teaching & Learning Scheme							Duration of Exam Hours	Examination & Evaluation Scheme						
			Teaching Periods Per Week				Credits				Theory		Practical		Total Marks	Minimum Passing	
			L	T	P	Total	L/T	Practical	Total		Theory+ MCQ External	Theory Internal	Internal	External		Marks	Grade
1	DSC-II Computer Fundamentals and Operating Systems		6	-	-	6	3	-	3	3	60 +20	20	-	-	100	40	P
2	AEC- II Programming Language		-	1	-	1	1	-	1	1	-	-	25	-	25	10	P
3	AEC-I		--	-	-	--	-	-	-	Internal Assessment at College Level/ Institute							P
4	Lab- 2 Practical Based on DSC II		-	-	6	6	-	3	3	*	-	-	25	25	50	20	P
8	# Internship/ Field Work/ Work Experience @	150 hrs. during vacation															
9	**Open elective/ GIC/ Open skill/ MOOC***																
Total			6	1	6	13		3	7	4			50	25	175	70	

Total weekly hours (Equivalent to periods) Should not exceed 30 hours.
L: Lecture, T: Tutorial, P: Practical

Note: Internship/ Field work/ Work Experience will be conducted after I semester till Vth Semester in vacations for minimum 150 hrs. It's credits and grades will be reflected in final semester VI credit grade report.

DSE: The student can select any one of the following discipline specific courses 1. ---------- 2. ---------- 3. ----------.

-OEC (Optional) i.e. GIC/MOOC/Skill course can be studied during semester I to VI, Its credits and grades will be reflected in final semester VI credit grade report.

Scheme of Teaching, Learning & Examination leading to the Degree in Master of Science in the Programme Bioinformatics
(Two year- Four Semester Degree Programme- C.B.C.S.)
(B.Sc. Part II) Semester III

S. No.	Subject	Subject Code	Teaching & Learning Scheme							Duration of Exam Hours	Examination & Evaluation Scheme						
			Teaching Periods Per Week				Credits				Theory		Practical		Total Marks	Minimum Passing	
			L	T	P	Total	L/T	Practical	Total		Theory+ MCQ External	Theory Internal	Internal	External		Marks	Grade
1	DSC-III Fundamentals of Bioinformatics		6	-	-	6	3	-	3	3	60 +20	20	-	-	100	40	P
2	AEC- III Protein Structural Predication		-	1	-	1	1	-	1	1	-	-	25	-	25	10	P
3	AEC-I		--	-	-	--	-	-	-	Internal Assessment at College Level/ Institute							P
4	Lab- 3 Practical Based on DSC III		-	-	6	6	-	3	3	*	-	-	25	25	50	20	P
8	# Internship/ Field Work/ Work Experience @	150 hrs. during vacation															
9	**Open elective/ GIC/ Open skill/ MOOC***																
Total			6	1	6	13		3	7	4			50	25	175	70	

Total weekly hours (Equivalent to periods) Should not exceed 30 hours.
L: Lecture, T: Tutorial, P: Practical

Note: Internship/ Field work/ Work Experience will be conducted after I semester till Vth Semester in vacations for minimum 150 hrs. It's credits and grades will be reflected in final semester VI credit grade report.

DSE: The student can select any one of the following discipline specific courses 1. ---------- 2. ---------- 3. ----------.

-OEC (Optional) i.e. GIC/MOOC/Skill course can be studied during semester I to VI, Its credits and grades will be reflected in final semester VI credit grade report.

Scheme of Teaching, Learning & Examination leading to the Degree in Master of Science in the Programme Bioinformatics
(Two year- Four Semester Degree Programme- C.B.C.S.)
(B.Sc. Part II) Semester IV

S. No.	Subject	Subject Code	Teaching & Learning Scheme							Duration of Exam Hours	Examination & Evaluation Scheme						
			Teaching Periods Per Week				Credits				Theory		Practical		Total Marks	Minimum Passing	
			L	T	P	Total	L/T	Practical	Total		Theory+ MCQ External	Theory Internal	Internal	External		Marks	Grade
1	DSC-IV Fundamentals of Molecular Biology and immune System		6	-	-	6	3	-	3	3	60 +20	20	-	-	100	40	P
2	AEC- IV Immunology		-	1	-	1	1	-	1	1	-	-	25	-	25	10	P
3	AEC-I		--	-	-	--	-	-	-	Internal Assessment at College Level/ Institute							P
4	Lab- 4 Practical Based on DSC IV		-	-	6	6	-	3	3	*	-	-	25	25	50	20	P
8	# Internship/ Field Work/ Work Experience @	150 hrs. during vacation															
9	**Open elective/ GIC/ Open skill/ MOOC***	**OEC I**															
Total			6	1	6	13		3	7	4			50	25	175	70	

Total weekly hours (Equivalent to periods) Should not exceed 30 hours.
L: Lecture, T: Tutorial, P: Practical

Note: Internship/ Field work/ Work Experience will be conducted after I semester till Vth Semester in vacations for minimum 150 hrs. It's credits and grades will be reflected in final semester VI credit grade report.

DSE: The student can select any one of the following discipline specific courses 1. ---------- 2. ---------- 3. ----------.

-OEC (Optional) i.e. GIC/MOOC/Skill course can be studied during semester I to VI, Its credits and grades will be reflected in final semester VI credit grade report.

CBCS B.Sc. Bio-informatics

Syllabus Prescribed for 2022 Year **UG. Programme**

Programme **B.Sc. Bioinformatics**

Semester I

Code of the Course Subject	**Title of the Couse/ Subject**	**No. of periods/ week**
DSC I	**Elementary Mathematics & Statistics**	**03**

COs :

Upon completion of the course successfully, students would be able to

1. Develop conceptual as well as applied knowledge and skills in the field of Mathematics & Statistics for bioinformatics and data science for sustainable approach in order to solve scientific problems.

UNIT I :	Types of functions, d-neighbourhood of point, Limit of function, Continuity of function, Theorems on Limits and Continuity of functions. Differentiation of function. Its physical significance. Differentiation of Sum, Difference, Product, Ratio of Functions. Derivative of Trigonometric, Exponential, Logarithmic, Inverse trigonometric, Polynomial, Implicit functions. Increasing and Decreasing functions. Maxima and Minima. Derivative as a rate of change.
UNIT II :	Integration of a function , Finding a function from its derivative, Integration of Sum, Difference and Product of two Functions . Integration by substitution. Integration by partial Fractions . Definite integral . Definite integral as limit of sum. Calculating Areas and Volumes of bounded regions.
UNIT III :	Differential equation, its Formation. Its general solution and particular solution. Order and degree of differential equation. First order differential equation. Variable separable method.
UNIT IV:	Representation of data. Discrete data, continues data, Histogram, PolyGram's Frequency curves, Mean, Variability of data- the standard deviation, Median, quartiles, percentile, Skiwness, Box and Whisker diagrams. Regression and Correlation, Scatter diagrams, Regression function, Linear correlation and regression lines, Product moment correlation coefficient.
UNIT V :	Probability : Experimental probability, probability when outcomes are equally likely, subjective probabilities, Probabilities law. Probability rules for combined events, conditional probability and independent events, Probability trees. Bayes theorem.
UNIT VI :	Random Variables and Distributions : Discrete and Continuous Random Variables, Cumulative distribution function, Probability mass function and Probability density function, Expectation of random variables – Experimental Approach and theoretical.

Suggested Reading:

1. Binmore : "Mathematical Analysis", Cambridge University Press.
2. Edward Batschelet : " Introduction to Mathematics for Life Sciences"3rd Edition(1992).
3. Edwards , J:"Differential Calculas for Beginners", MacMilan and Co.ltd (1963).
4. Edwards , J:" Integral Calculas for Beginners ", AITBS Publishers & Distributors(1994).
5. Gorakh Prasad :" Differential Calculas ", Pothishala Pvt Ltd, Allahabad
6. Gorakh Prasad :" Integral Calculas ", Pothishala Pvt Ltd, Allahabad.
7. S.Dobbs and J.Miller, (2002), 'Statistics (Advanced Level Mathematics) : Cambridge.
8. Narayanan, S. and Manicavachaagam Pillai, T.S. (1993) "Calculus, Vol. I and II"; Vishwanathan Printers and Publishers.
9. Veerarajan, T. (2003) "Engineering mathematics"; Third Edition, Tata
10. McGraw Hill Publishing Co. Ltd, New Delhi.
11. Veerarajan, T. (2003) "Trignometry, Algebra and Calculus"; Third Edition, Tata McGraw Hill Publishing Co. Ltd, New Delhi.
12. Sharma, A.K. (2005) "Text Book of Integral Calculus", Discovery Publishing House.
13. Grewal, B.S. (2000) "Higher Engineering Mathematics"; Thirty seventh edition, Khanna Publishers, New Delhi.
14. E. Horowitz and S. Sahani, "Fundamentals of Data structures", Galgotia Booksource Pvt. Ltd., (1999)
15. Ellis Horwitz, Sartaz Sahani and Sanguthevar Rajasekaran, (1999), "Computer Algorithms", Galgotia Publications
16. T .H. Cormen, C. E. Leiserson, R .L. Rivest (2001) "Introduction to Algorithms", 3rd Ed PHI.

Learning Outcome:

Upon completion of the course successfully, students would be able to

1. Understand utility of Mathematics & Statistics in order to perform Bioinformatics.

Syllabus Prescribed for 2022 Year		**UG. Programme**
Programme		**B.Sc. Bioinformatics**
Semester I		
Code of the Course Subject	**Title of the Couse/ Subject**	**No. of periods/ week**
AEC I	**Biostatistics**	**01**

Cos :

Upon completion of the course successfully, students would be able to

acquire knowledge of Mathematics & Statistics.

Unit I Introduction to Python	Numerical description of data: Tabular, Graphical and Diagrammatic representation of data. Measures of Central tendency and Dispersion. Linear regression, Least square method, Karl Pearson correlation coefficient. Probability Theory: Concept and definitions of Probability, addition and multiplication theorems, conditional probability, independent events, Statement of Bayes' theorem. Random variables: Discrete and continuous random variables, cumulative density function, Probability density and mass functions, Joint, Marginal and Conditional distributions, mathematical expectation Distributions: Binomial, Poisson, Normal distributions (Basic concepts and applications)

Suggested Reading:

1. Ewens, W.J. and Grant, 2001. Statistical Methods in Bioinformatics: An Introduction, Springer-Verlag
2. Devore, J.L. 2002. Probability and Statistics 5th edition, Thomson Asia
3. Miller & Freund 2004 Probability and Statistics for Engineers, 7th Edition, Pearson's Education.
4. Chung, Kai Lai 2003 Elementary Probability Theory with Statistical Processes (Student Edition) Springer International
5. Feller, W. 2007 An Introduction to Probability Theory and its Applications, Wiley Eastern Limited.
6. Larson, H.J. 1982 Introduction to Probability Theory and Statistical Inference, John Wiley & Sons.
7. Goon, A.M., Gupta, M.K. and Dasgupta B. 1998 Fundamental of Statistics – Vol. 1, The World Press Pvt. Ltd.
8. Prasad, G.: Differential Calculus, Pothisala Publication
9. Boas: Mathematical methods in the Physical Sciences, Wiley Publication.
10. Yule, G.U and Kendall, M.G.: An Introduction to the Theory of Statistics, Universal Book Stall (New Delhi).
11. Shanti Narayan, A text book of Vector Calculus, S Chand & company, New Delhi
12. D T Finbeiner, Introduction to Matrices and linear transformations, CBS publishers, Delhi

Learning Outcome:

Upon completion of the course successfully, students would be able to

1. Explain basic principles of Mathematics & Statistics applicable to Bioinformatics.

Syllabus Prescribed for 2022 Year **UG Programme**
Programme: B. Sc. Bioinformatics

Semester I Code of the Course/Subject	**Title of the Course/Subject** (Laboratory/Practical/practicum/hands-on/Activity)	**(No. of Periods/Week)**
- Practical – I	Practical based on DSC I	06

CO:

Upon completion of the course successfully, students would be able to

1. Adapt and apply basic knowledge on various techniques and areas of Mathematics & Statistics applications in bioinformatics.

Practical-I : Elementary Mathematics and Statistics :-

1. Measures of dispersion- Range, Quartile deviation and mean deviation.
2. Computation of rank correlation coefficient.
3. Simple problems on probability- Law of addition, Law of multiplication.
4. Large sample test.

5. Application of Chi-square distribution.
6. Random Sampling- SRSWOR and SRSWR.
7. Fitting of binomial distribution. 8. Fitting of normal distribution.
8. Problems on Mean and Mode.
9. Problems on order and degree of differential equation.
10. Standard deviation and coefficient of correlation.

Learning Outcome:

Student would be able to apply the laws and equations of Mathematics & Statistics to bioinformatics.

Syllabus Prescribed for 2022 Year	**UG. Programme**
Programme	**B.Sc. Bioinformatics**
Semester II	
Code of the Course Subject	**Title of the Couse/ Subject** **No. of periods/ week**
DSC II	**Computer Fundamentals and Operating Systems 03**
Cos : Upon completion of the course successfully, students would be able to 1. Develop conceptual as well as applied knowledge and skills in the field of Computer Fundamentals and Operating Systems for bioinformatics.	
UNIT I :	Introduction to Computers: Characteristics, classification of computer block Diagram of computer, Memory: Types of memory, RAM, ROM, PROM, EPROM, I/O devices: keyboard, mouse, floppy disk, monitor, compact disk. Printers: Impact, Non-Impact, dot matrix, inkjet, laser Interpreter, compiler, Assembler. Introduction to Number System: Decimal, binary, octal, hexadecimal codes ASCII, EBCDIC.
UNIT II :	Windows: Introduction, features, desktop: Background screensaver, Customizing desktop, creating, moving, deleting Icons. Windows Explorer Copying, renaming, moving, deleting, operations on files and folders. My computer, My documents, control panel : Mouse, printer, date and time. MS-Word: Introduction to word, features, page setup, views, text formatting, Auto correct, spell check, grammar, table, tabs, indentation mail merge, print Preview, printing of document, hyperlink.
UNIT III :	MS- EXCEL: Introduction, features, creating and formatting worksheet, Inserting data, entering mathematical formulas and functions, autofill, Graphs: Type of charts, creating, moving charts, (column, bar, & pie) Introduction to Internet: Types of Internet connection: Direct, dial-up, Protocol : TCP / IP, FTP, HTTP. Domain name, Electronic mail address, word Wide web, search engines, browser: Internet Explorer.
UNIT IV:	Based on Unix operating system: Overview of unix O.S., Unix file system, Data structure for process and memory management, process states and state Transition diagram, process scheduling, memory management, Executing and Terminating program in unix. Unix commands: pwd, cd, ls, mv, ln, cp, mkdir, rm, rmdir, du
UNIT V :	Based on Linux operating system : Design principal, kernel modules, Process management, scheduling, memory management, file system, Inter Process communication, security
UNIT VI :	Networking : Needs and objectives, LAN- Introduction, classification, topology. Topologies – Bus, Tree, Ring, Star, Hybrid, WAN, MAN. Communication Protocols – Purpose, OSI model, Client Server Architecture
Suggested Reading:	
17. Computer fundamentals: B. Ram, Nas Age publication. 18. A first course in computer: Sanjay saxena 19. PC Software: Taxali R.K. 20. Fundamentals of computer: V.Rajaraman, PHI Publication. 21. Information Technology: Alexie and Mathews, Vijay Nikole Publication. 22. IT Tool and Application: Alexie and Mathews, Vijay Niklole publication. 23. Operating system by: Achut S. Godbole Tata megrow Hill publication. 24. Operating system concept, sixth edition by silberschutz, Galvin, Gagne Wiley publication. 157 158 25. Computer Fundamentals, Pradeep K. Sinha. BPB Publication. 26. ABC of LAN – Michel Doprtech (BPB) 27. Local Area Network – Keiser - TMH	
Learning Outcome: Upon completion of the course successfully, students would be able to 1. Understand utility of Computer Fundamentals and Operating Systems in order to perform Bioinformatics.	

Syllabus Prescribed for 2022 Year		**UG. Programme**
Programme		**B.Sc. Bioinformatics**
Semester II		
Code of the Course Subject	**Title of the Couse/ Subject**	**No. of periods/ week**
AEC II	**Programming Language**	**01**

Cos :

Upon completion of the course successfully, students would be able to

Acquire knowledge of Programming Language.

Unit I Introduction to Programming Language	C, Data Type, Operators and Expressions in C, Control and Repetitive Statements: IF-THEN-ELSE, SWITCH, WHILE, FOR, DO; Break and Continue Statements, Input and Output functions, Function and Program Structure in C, Parameter passing, Pointers, Arrays, Structures, C-Library.

Suggested Reading:

13. Sethi, R., 1996, Programming Languages, Addison-Wesley.
14. Appleby, D. and Vandkopple, J.J., 1991, Programming Languages, Tata McGraw-Hill.
15. Kernighan, B.W. and Ritchie, D.M., 2002 The C Programming Language, Prentice-Hall, India.
16. Gottfried, B.S., 1998 Schaum's Outline of Theory and Problems of Programming with C, McGraw-Hill
17. Schildt, H., 1987 C: The Complete Reference, Osborne/ TMH.
18. Tisdall, J.D. 2001 Beginning Perl for Bioinformatics. O'Reilly & Associates.
19. Schwartz R.L. and Phoenix T. 2011 Learning Perl 6th edition, O'Reilly SPD, Mumbai.
20. Siever 2000 Perl in a nutshell O'Reilly SPD, Mumbai
21. Model M.L. 2009 Bioinformatics Programming using Python: Practical Programming for Biological Data, O'Reilly.
22. Kinser J. 2008 Python for Bioinformatics, Series in Biomedical Informatics, Jones & Bartlett.

Learning Outcome:

Upon completion of the course successfully, students would be able to

1. understand Programming Language, Operating Systems and its utility for Bioinformatics.

Syllabus Prescribed for 2022 Year **UG Programme**
Programme: B. Sc. Bioinformatics

Semester II Code of the Course/Subject	**Title of the Course/Subject** (Laboratory/Practical/practicum/hands-on/Activity)	**(No. of Periods/Week)**
- Practical – II	Practical based on DSC II	06

CO:

Upon completion of the course successfully, students would be able to

1. Adapt basic knowledge on Computer Fundamentals and Operating Systems applications in bioinformatics.

Practical-II : Computer Fundamentals and Operating Systems :-

Learning Outcome:

Upon completion of the course successfully, students would be able to

apply the Computer Fundamentals and Operating Systems in order to solve problems in bioinformatics.

1. Use of Windows operating system (Notepad, WordPad, Calculator, Paint)
2. Use of Linux (basic commands)
3. Creating word file by using paragraphs, alignments
4. Create and print file using mail merge.
5. Working with spread sheet (all operations on cell like merging.)
6. Using function wizard.
7. Calculate regression and correlation use excel.
8. Using different distribution.

9. Creation of presentation.
10. Practicals on Unix basic commands.
11. Practicals based on internet..

Syllabus Prescribed for 2022 Year	**UG. Programme**
Programme	**B.Sc. Bioinformatics**
Semester III	
Code of the Course Subject **Title of the Couse/ Subject**	**No. of periods/ week**
DSC III **Fundamentals of Bioinformatics**	**03**
Cos : Upon completion of the course successfully, students would be able to 1. learn about the chemical structures of carbohydrate, and their structural and metabolic role in cellular system	
UNIT I :	Water as a biological solvent, Structure of water and polarity, Concept of osmolarity, ionization of water, weak acids and bases, Terminologies like, pH, Buffer solution, Morality, Normality, Normality, equivalent weight and their function in cell.
UNIT II :	Carbohydrates, Definition and classification of carbohydrates, structure, occurrence, and biological importance of Monosaccharide, disaccharides, oligosaccharides, polysaccharides, and Mucopolysaccharides. Proteoglycanns and glycoprotein.
UNIT III :	Lipids and fatty acids, Classification, nomenclature , structures and properties of saturated and unsaturated fatty acid, Simple and Compound lipids, Triglycerides, glycerophospholipids, Glycolipids, Isoprenoids, and Steroids, Biological functions of lipids.
UNIT IV:	Proteins, Introduction, Structure, Basic Building Blocks of Proteins, Protein structure, Primary, Secondary, tertiary and Quaternary structures. Denaturation and renaturation of proteins, Biological function of proteins.
UNIT V :	Enzymes, General characters and properties of enzymes, Nomenclature of enzymes, Holoenzymes, apoenzymes, active sites of enzymes, isoenzymes, Mechanism of enzymes action, factors affecting rate of enzyme catalyzed reaction, Enzyme kinetics. Km value.
UNIT VI :	Metabolism, Definition, Bioenergetics, ATP, structure and biological role, EMP pathway, TCA cycle, Beta hydrolysis, Lipid Biosynthesis, Protein synthesis.
Suggested Reading:	
1. Voet, D.J., Voet, J.G., Pratt, C.W., Principles of Biochemistry, John Wiley, (2008). 2. Berg, J.M., and Tymoczko, J.L., Stryer, L., Biochemistry, W.H. Freeman (2007). 3. Garrett, R.H., Grisham, C.M., Biochemistry, Brooks/Cole, Cengage Learning,(2010.) 4. Conn, E.E., and Stump, F., Outlines of Biochemistry, John Wiley (2006).	
Learning Outcome: Upon completion of the course successfully, students would be able to 2. interpret molecular structure and interactions present in proteins, nucleic acids, carbohydrates and lipids 3. explain organization and working principles of various components present in living cell.	

Syllabus Prescribed for 2022 Year	**UG. Programme**
Programme	**B.Sc. Bioinformatics**
Semester III	
Code of the Course Subject **Title of the Couse/ Subject**	**No. of periods/ week**
AEC III **Protein Structural Predication**	**01**
Cos : Upon completion of the course successfully, students would be able to acquire knowledge of Protein structure, analysis, and its interaction.	
Unit I Protein structure, function and bioinformatics	Protein structure, function and bioinformatics: Folding. Structure determination by X-ray crystallography and NMR spectroscopy. Structure modelling and analysis using molecular graphics. Protein-ligand, protein-DNA and protein-protein interactions. Kinetic and thermodynamic characterization of interactions. Examples for proteins: Enzymes, membrane proteins, structural proteins, regulatory proteins. Structure-function relationships. Introduction to databases for protein sequences, structures and functions and to protein bioinformatics tools and methods.
Suggested Reading:	
2. Sethi, R., 1996, Programming Languages, Addison-Wesley.	

3. Appleby, D. and Vandkopple, J.J., 1991, Programming Languages, Tata McGraw-Hill.
4. Kernighan, B.W. and Ritchie, D.M., 2002 The C Programming Language, Prentice-Hall, India.
5. Gottfried, B.S., 1998 Schaum's Outline of Theory and Problems of Programming with C, McGraw-Hill
6. Schildt, H., 1987 C: The Complete Reference, Osborne/ TMH.
7. Tisdall, J.D. 2001 Beginning Perl for Bioinformatics. O'Reilly & Associates.
8. Schwartz R.L. and Phoenix T. 2011 Learning Perl 6th edition, O'Reilly SPD, Mumbai.
9. Siever 2000 Perl in a nutshell O'Reilly SPD, Mumbai
10. Model M.L. 2009 Bioinformatics Programming using Python: Practical Programming for Biological Data, O'Reilly.
11. Kinser J. 2008 Python for Bioinformatics, Series in Biomedical Informatics, Jones & Bartlett.

Learning Outcome:

Upon completion of the course successfully, students would be able to

1. comprehend the importance of chemical foundation in living organisms.
2. analyze the various types of weak interactions between the biomolecules and water.
3. correlate how the large biomolecules such as proteins, carbohydrates, lipids, nucleic acids are made from the simple precursors.

Syllabus Prescribed for 2022 Year **UG Programme**
Programme: B. Sc. Bioinformatics

Semester III Code of the Course/Subject	**Title of the Course/Subject** (Laboratory/Practical/practicum/hands-on/Activity)	**(No. of Periods/Week)**
- Practical – III	Practical based on DSC III	06

CO:

Upon completion of the course successfully, students would be able to

Demonstrate knowledge of methods and techniques for biomolecules separation and purification.

Practical-III :

Section I: Qualitative test and Biochemical Preparations

1. Qualitative analysis of Carbohydrates

2. Qualitative tests for proteins, lipids and aminoacids

3. Preparation of buffers of different pH.

4. Measurement of pH of given sample by universal indicator solutions, pH strip and pH meter.

Section II: Quantitative analysis

1. Paper chromatography of amino acids.

2. Paper chromatography of Sugars .

3. TLC

4. Estimation of glucose by Benedict's method

5. Estimation of glycine

6. Saponification value of oils.

7. Estimation of proteins by Biurate method.

Suggested Readings:

1. Wilson, E., Walker, J., Practical Biochemistry-Principles and techniques, Cambridge University press (2010).

2. Boyer, R.F., Modern Experimental Biochemistry. Nenjamin/Cummings publishing company Inc. Redwoodcity, California (2012).
3. Scopes, R.K., Protein Purification Principles and Practice, Narosa Pub. House (1994).
4. Cantor C.R., Schimmel P.R. Biophysical Chemistry, W. A. Fremman and Company (1980).

Learning Outcome:

Upon completion of the course successfully, students would be able to demonstrate

1. Quantification of various biomolecules
2. Characterization of some physical properties of various biomolecules
3. the effect of temperature and pH on protein structure

Syllabus Prescribed for 2022 Year	**UG. Programme**
Programme	**B.Sc. Bioinformatics**
Semester IV	
Code of the Course Subject	**Title of the Couse/ Subject** **No. of periods/ week**
DSC IV	**Fundamentals of Molecular Biology and immune System 03**
Cos : Upon completion of the course successfully, students would be able to 1. learn about the immune system including organs, cells and receptors.	
UNIT I :	Unit I : Structure of DNA, forms of DNA-A,B,C,D and Z DNA. Secondary structure of RNA, Replication in prokaryotes and Eukaryotes. Structural organization of Eukaryotic and Prokaryotic genomes. Organelle genome organization and Transposable genetic elements.
UNIT II :	Fundamentals of Structural, Comparative and Functional Genomics and its applications. Genome sequencing methods. Introduction to Genome analysis. Structural organization of Eukaryotic and Prokaryotic genes. Regulation of gene expression in Eukaryotes and Prokaryotes.
UNIT III :	Process of Translation in Eukaryotes and Prokaryotes: Translational factors, Initiation, Elongation and Termination. Regulation of translation in Eukaryotes and Prokaryotes. Structure of Eukaryotic and Prokaryotic Ribosomes.
UNIT IV:	Organs and cells of immune System and their function. Various types of Antibodies, their structure and function. Antigen Antibody Reaction. Antigen, Hapten.
UNIT V :	Humoral and Cell mediated immunity, MHC and immunity to infectious dieses, Vaccins, Lymphocytes trafficking, Tlymphocytes, B-lymphocytes, Macrophages, Dendritic cells, natural killers, Lymphokines, Activated killer cells, Eosinophiles, Nuetrophiles and mast Cells.
UNIT VI :	Molecular Basis of immunity: Theories of Antigen Antibody reactions. T Lymphatic and B Lymphatic responses. Different Classes of immunoglobulins and their differentiation. Interferons and Interleukins and its applications.

Suggested Reading:

5. J De Robertis, EDP and De Robertis EMF. (2006) Cell and Molecular Biology. 8th edition. Lipincott Williams and Wilkins, Philadelphia.
6. Cooper, G.M. and Hausman, R.E. (2009). The Cell: A Molecular Approach. 5th
7. Edition. ASM Press & Sunderland, Washington, D.C.; Sinauer Associates, MA.
8. Tymoczko JL, Berg JM and Stryer L (2012) Biochemistry: A short course, 2nd ed., W.H.Freeman
9. Nelson D. L. and Cox M.M. (2008) Lehninger Principles of Biochemistry, 5th Edition., W.H. Freeman and Company
10. Voet, D. and Voet J.G. (2004) Biochemistry 3rd edition, John Wiley and Son
11. Sharma, V. K. (1991) Techniques in microscopy and cell biology. Tata McGraw Hill
12. Reimer, L. and Kohl, H. (2008) Transmission electron microscopy. Springer. udy Owen, Jenni Punt, Sharon Stranford 2013
13. Abbas AK, 2011, Cellular and Molecular Immunology 7th Ed. Elsevier Health Sciences – India.
14. Delves P, Martin S, Burton D, Roitt IM 2011 Roitt's Essential Immunology. 12th Ed. Wiley- Blackwell Scientific Publication, Oxford.
15. Murphy K, 2011 Janeway's Immunobiology. 8th Ed. Garland Science Publishers, New York.
16. Peakman M, and Vergani D. (2009). Basic and Clinical Immunology. 2nd edition Churchill Livingstone Publishers, Edinberg.
17. Richard Coico, Geoffrey Sunshine 2008 Immunology: A Short Course, 6th Edition Wiley- Blackwell
18. Sudha Gangal 2013 Textbook of Basic and Clinical Immunology Orient Blackswan Private Limited - New Delhi

Learning Outcome:

Upon completion of the course successfully, students would be able to

1. Discuss the immune system including organs, cells and receptors
2. learn about molecular basis of antigen recognition, hypersensitivity reaction, antigen-antibody reactions
3. use the principles of immunology and its applications in treating human diseases.

Syllabus Prescribed for 2022 Year		**UG. Programme**
Programme		**B.Sc. Bioinformatics**
Semester IV		
Code of the Course Subject	**Title of the Couse/ Subject**	**No. of periods/ week**
AEC IV	**Immunity**	**01**

Cos :

Upon completion of the course successfully, students would be able to

understand antigen and describe how antigens affect the adaptive defenses.

Unit I Immunology	Immunity to pathogens, How pathogens avoid immunity, AIDS and immunity, Cancer and Immunity. Autoimmune diseases.

Suggested Reading:

12. Roilt, I. Essential immunology. 9th Edition. USA. Blackwell Science Ltd. 1997. 114
13. Lydyard, P., Whelan, Al and Fasger, MlW. Instant notes in immunology. 2nd Edition. USA. Garland Science/ BIOS Scientific Publishers Ltd.2004.

Learning Outcome:

Upon completion of the course successfully, students would be able to

1. Acquire knowledge and understanding of the immunological concepts as applicable to diverse areas such as medical, industrial, environment, genetics, agriculture, food and others.

Syllabus Prescribed for 2022 Year		**UG. Programme**
Programme		**B.Sc. Bioinformatics**
Semester IV		
Code of the Course Subject	**Title of the Couse/ Subject**	**No. of periods/ week**
OEC I	**Protein Structural Predication**	**03**

Cos :

Upon completion of the course successfully, students would be able to

gain knowledge about immunological against infections; humoral and cell mediated immunity; autoimmunity mechanisms and damage; immunodiagnostic tests and assays; Vaccines- preparations and use.

Unit I MOLECULAR BASIS	Microbial pathogens – Bacterial, Viral and Fungal Pathogens and Parasitic diseases. Immune response vs infection. Immunity against bacterial infections – Innate and Acquired Immune responses – cellular involvement – Macrophages, Neutrophils, NK cells, Defensins, Humoral and Cell mediated Immune responses, Intracellular infections.
Unit II INFECTION AND IMMUNITY	Immunity against bacterial and viral infections – Innate and Acquired immune responses – Effector mechanisms of HI and CMI – cytokine involvement. Immunodeficiency. Immunity to fungal and parasitic infections – overview of Humoral and Cell mediated immune responses against the pathogens. Immunomodulation in infections
Unit III CLINICAL IMMUNOLOGY	Clinical Immunology - Disease caused by immune response – hypersensitivity, immune tolerance and autoimmunity, mechanism of autoimmunity, therapy for immunological diseases - Immune complex disease, immunosuppression and immunomodulation.
Unit IV IMMUNODIAGNOSIS	Diagnostic Immunology - Methods based on precipitation; ODD, CIE, IEP, immunofixation and immunoblotting, RIA, RE, Immunonephlometry. Methods based on Agglutination - agglutination of whole cells, agglutination of inert particles coated with Ag/Ab. Hemagglutination – Direct, indirect, passive; CFT, labelled assays – ELISA, RIA, FISH, IFTin vivo reactions- skin tests, immune complex demonstration. Diagnostic evaluation of lymphocytic hemagglutination inhibition, lymphocytic function and CMI, phagocytosis.
Unit V VACCINES	Introduction to Vaccines and Adjuvants - Types of vaccines – Whole cell - Killed and Live Attenuated vaccines. Sub–unit vaccines – polysaccharides, proteins, Toxoids. Recombinant vector vaccines, DNA vaccines, Development of vaccines and antibodies in plants.

Unit V VACCINES	Vaccines against AIDS and Tropical Infectious Diseases – Leprosy, malaria and TB. Vaccines for control of fertility , Anti – HCG Vaccines and Anti – sperm antigen vaccine. Immunization – Active and Passive. Therapy for immunological diseases. Immune therapy for cancer. Strategies of vaccine production. Gene silencing.

Suggested Reading:

1. Talwar GP, Rao KVS and Chauhan VS, Recombinant and Synthetic Vaccines; Narosa, New Delhi. 1994.
2. Benjamini E, Coico R and Sunskise G,;Immunology – A short course, Wiley – Liss Publication, NY. Ed.4; 2000.
3. Kuby J, Immunology, WH Freeman and Co. NY. Ed.4; 1997.
4. Clark WR, The Experimental Foundations of Modern Immunology; John Wiley and Sons Inc. New York. 1991.
5. Leslie Hudson and Frank C. Hay., Practical Immunology. Wiley. Ed.3; 1989.
6. Noel R. Rose, Herman Friedman, John L. Fahey., Manual of Clinical Laboratory Immunology. ASM. Ed.3; 1986.

Learning Outcome:

Upon completion of the course successfully, students would be able to

1. Learn the molecular basis of microbial pathogens.
2. Understand the Innate and Acquired immune responses against microbial pathogens
3. Learn various disease caused by immune response.
4. Learn immune diagnostic tests and assays against pathogens.
5. Understand the vaccines preparations and its clinical uses.

Syllabus Prescribed for 2022 Year **UG Programme**
Programme: B. Sc. Bioinformatics

Semester III Code of the Course/Subject	**Title of the Course/Subject** (Laboratory/Practical/practicum/hands-on/Activity)	**(No. of Periods/Week)**
- Practical – IV	Practical based on DSC IV	06

CO:

Upon completion of the course successfully, students would be able to

1. gain hands-on knowledge
2. acquire adequate skills required to perform molecular Biology and Immunology.

Practical-IV:

Section I : Molecular Biology

1. Isolation of plant DNA by CETAB Method.
2. Isolation of organism DNA by Modified CETAB method.
3. Isolation of Chloroplast.
4. Isolation of Mitochondria.
5. Amplification of DNA by RAPD method.
6. Introduction to Instrumentations: Laminar Air Flow, PCR, Gel Documentation System, Hi-speed centrifuges, Bench top Centrifuges, UV-Spectrophotometer.
7. Separation of Proteins by using SDS-PAGE.
8. Preparation of different percent of Agarose Gel.
9. Isolation of RNA.
10. Quantification of RNA and DNA by UV-Spectrophotometer.

Section II: Quantitative analysis

1. ELISA- test
2. Test for Salmonella strain by using Widal Kit.
3. VDRL- test.
4. Identification of Blood Groups.
5. Identification of RH factor.
6. To perform Antibiotic sensitivity test by Multiple disc method.

Suggested Readings:

5. Peter J. Delves, Seamus J. Martin, Dennis R. Burton, Ivan M. Roitt . Roitt's Essential Immunology (Essentials). Willy Blackwell publication.
6. Frank C. Hay and Westwood MR. Practice Immunology John Wiley and Sons Ltd. 4th Edition. ISBN: 9780865429611, 9780865429611

Learning Outcome:

Upon completion of the course successfully, students would be able to demonstrate

1. Antigen-antibody interactions in gels and to visualize the bands
2. Isolation of genomic DNA