RAMA UNIVERSITY UTTAR PRADESH

Faculty of Sciences, Kanpur

EVALUATION SCHEME

[Effective from the Session 2016-17]

B. Sc. Bioinformatics

1st, 2nd & 3rd Year

RAMA UNIVERSITY UTTAR PRADESH, KANPUR

Faculty of Sciences

Rama University Uttar Pradesh, Kanpur

Course Detail and Evaluation Scheme
(Effective from the Session 2016-17)

B.Sc. Bioinformatics
First Year- 1st Semester

S.N.	Subject Code	Subject Name	Period			Evaluation Scheme			Subject Total	Credit
			L	T	P	CE	MTE	ETE		
Theory subjects										
1	BBI - 101	Applied Chemistry	3	1	0	20	20	60	100	4
2	BBI- 102	Elementary Mathematics	3	1	0	20	20	60	100	4
3	BBI - 103	Basic Biology	3	1	0	20	20	60	100	4
4	BBI - 104	Environmental Studies	3	1	0	20	20	60	100	4
5	BBI - 105	Introduction to Computers /MS Office	3	1	0	20	20	60	100	4
6	BBI - 001	*Communication Skills	2	0	0	0	0	50	0	0
Practicals										
1	BBI - 151	Applied Chemistry Laboratory	0	0	2	30	20	50	100	2
2	BBI - 152	Introduction to Computers Laboratory	0	0	2	30	20	50	100	2
		Total	**17**	**5**	**4**	**160**	**140**	**450**	**700**	**24**

*This is only qualifying paper & Marks of this paper is not added in the total of the semester

L-Lecture, T-Tutorial, P- Practical, CE- Continuous Evaluation, MTE-Mid Term Examination, ETE-End Term Examination

Evaluation Scheme:

- **Course without practical components**

For Continuous Evaluation (CE) is such as: 20 Marks

1. Attendance: 5 Marks
2. Assignments/Quiz / Seminar/Term paper /Project :15Marks

MTE - Mid Term Examination: 20 Marks

a. First Mid Term Examination: 10 marks
b. Second Mid Term Examination: 10 marks

ETE - End Term Examination: 60 Marks

- **Course with practical components only**

For Continuous Evaluation (CE) is such as: 30 Marks
Conduct / Perform/Execution /Practical File/ Viva-Voice
+
b. Second Mid Term Examination: 10 marks
ETE - End Term Examination: 50 Marks

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Course Detail and Evaluation Scheme
(Effective from the Session 2016-17)

B.Sc. Bioinformatics
First Year- 2nd Semester

S.N.	Subject Code	Subject Name	Period			Evaluation Scheme			Subject Total	Credit
			L	T	P	CE	MTE	ETE		
Theory subjects										
1	BBI - 201	Fundamental of Biological system	3	1	0	20	20	60	100	4
2	BBI - 202	Cell Biology	3	1	0	20	20	60	100	4
3	BBI - 203	Biochemistry	3	1	0	20	20	60	100	4
4	BBI - 204	Biostatistics	3	1	0	20	20	60	100	4
5	BBI - 205	Progrmming in C	3	1	0	20	20	60	100	4
Practicals										
6	BBI - 251	Biochemistry Laboratory	0	0	2	30	20	50	100	2
7	BBI - 252	Progrmming in C Laboratory	0	0	2	30	20	50	100	2
		Total	**15**	**5**	**4**	**160**	**140**	**400**	**700**	**24**

L-Lecture, T-Tutorial, P- Practical, CE- Continuous Evaluation, MTE-Mid Term Examination, ETE-End Term Examination

Evaluation Scheme:

- **Course without practical components**

For Continuous Evaluation (CE) is such as: 20 Marks
1. Attendance: 5 Marks
2. Assignments/Quiz / Seminar/Term paper /Project :15Marks

MTE - Mid Term Examination: 20 Marks
   a. First Mid Term Examination: 10 marks
   b. Second Mid Term Examination: 10 marks

ETE - End Term Examination: 60 Marks

- **Course with practical components only**

For Continuous Evaluation (CE) is such as: 30 Marks
Conduct / Perform/Execution /Practical File/ Viva-Voice
MTE - Mid Term Examination: 20 Marks
   a. First Mid Term Examination: 10 marks
   b. Second Mid Term Examination: 10 marks
ETE - End Term Examination: 50 Marks

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Course Detail and Evaluation Scheme
(Effective from the Session 2016-17)

B.Sc. Bioinformatics
Second Year- 3rd Semester

S.N.	Subject Code	Subject Name	Period			Evaluation Scheme			Subject Total	Credit
			L	T	P	CE	MTE	ETE		
Theory subjects										
3	BBI - 301	Structural Bioinformatics	3	1	0	20	20	60	100	4
4	BBI - 302	Database Management System	3	1	0	20	20	60	100	4
2	BBI - 303	Microbiology	3	1	0	20	20	60	100	4
5	BBI - 304	Computational Molecular Biology	3	1	0	20	20	60	100	4
1	BBI - 305	Bioinformatics I	3	1	0	20	20	60	100	4
Practicals										
6	BBI - 351	Microbiology & Molecular Laboratory	0	0	2	30	20	50	100	2
7	BBI - 352	Bioinformatics I Laboratory	0	0	2	30	20	50	100	2
		Total	**15**	**5**	**4**	**160**	**140**	**400**	**700**	**24**

L-Lecture, T-Tutorial, P- Practical, CE- Continuous Evaluation, MTE-Mid Term Examination, ETE-End Term Examination

Evaluation Scheme:

- **Course without practical components**

For Continuous Evaluation (CE) is such as: 20 Marks

1. Attendance: 5 Marks
2. Assignments/Quiz / Seminar/Term paper /Project :15Marks

MTE - Mid Term Examination: 20 Marks

a. First Mid Term Examination: 10 marks
b. Second Mid Term Examination: 10 marks

ETE - End Term Examination: 60 Marks

- **Course with practical components only**

For Continuous Evaluation (CE) is such as: 30 Marks
Conduct / Perform/Execution /Practical File/ Viva-Voice
MTE - Mid Term Examination: 20 Marks

a. First Mid Term Examination: 10 marks
b. Second Mid Term Examination: 10 marks

ETE - End Term Examination: 50 Marks

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Course Detail and Evaluation Scheme
(Effective from the Session 2016-17)

B.Sc. Bioinformatics
Second Year- 4th Semester

S.N.	Subject Code	Subject Name	Period			Evaluation Scheme			Subject Total	Credit
			L	T	P	CE	MTE	ETE		
Theory subjects										
1	BBI - 401	Molecular genetics	3	1	0	20	20	60	100	4
4	BBI - 402	Object oriented programming using Java	3	1	0	20	20	60	100	4
2	BBI - 403	Bioethics, Biosafety and IPR	3	1	0	20	20	60	100	4
5	BBI - 404	Chemoinformatics and Drug Design	3	1	0	20	20	60	100	4
3	BBI - 405	Bioinformatics II	3	1	0	20	20	60	100	4
Practicals / Project										
6	BBI - 451	Object oriented programming using java Laboratory	0	0	2	30	20	50	100	2
7	BBI - 452	Molecular Genetics Laboratory	0	0	2	30	20	50	100	2
Total			**15**	**5**	**4**	**160**	**140**	**400**	**700**	**24**

L-Lecture, T-Tutorial, P- Practical, CE- Continuous Evaluation, MTE-Mid Term Examination, ETE-End Term Examination

Evaluation Scheme:

- **Course without practical components**

For Continuous Evaluation (CE) is such as: 20 Marks

1. Attendance: 5 Marks
2. Assignments/Quiz / Seminar/Term paper /Project :15Marks

MTE - Mid Term Examination: 20 Marks

a. First Mid Term Examination: 10 marks
b. Second Mid Term Examination: 10 marks

ETE - End Term Examination: 60 Marks

- **Course with practical components only**

For Continuous Evaluation (CE) is such as: 30 Marks
Conduct / Perform/Execution /Practical File/ Viva-Voice
MTE - Mid Term Examination: 20 Marks

a. First Mid Term Examination: 10 marks
b. Second Mid Term Examination: 10 marks

ETE - End Term Examination: 50 Marks

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Course Detail and Evaluation Scheme
(Effective from the Session 2016-17)

B.Sc. Bioinformatics
Third Year- 5th Semester

S.N.	Subject Code	Subject Name	Period			Evaluation Scheme			Subject Total	Credit
			L	T	P	CE	MTE	ETE		
Theory subjects										
4	BBI - 501	Recombinant DNA Technology	3	1	0	20	20	60	100	4
2	BBI - 502	Immunology	3	1	0	20	20	60	100	4
3	BBI - 503	Molecular Biology	3	1	0	20	20	60	100	4
1	BBI - 504	Computational Genomics and Proteomics	3	1	0	20	20	60	100	4
5	BBI - 505	Biophysical basis for Bioinformatics	3	1	0	20	20	60	100	4
Practicals										
4	BBI - 551	Molecular Biology Laboratory	0	0	3	30	20	50	100	3
5	BBI - 552	Seminar on Emerging area of Bioinformatics	0	0	3	100	-	-	100	3
		Total	**15**	**5**	**6**	**230**	**120**	**350**	**700**	**26**

L-Lecture, T-Tutorial, P- Practical, CE- Continuous Evaluation, MTE-Mid Term Examination, ETE-End Term Examination

Evaluation Scheme:

- **Course without practical components**

For Continuous Evaluation (CE) is such as: 20 Marks

3. Attendance: 5 Marks
4. Assignments/Quiz / Seminar/Term paper /Project :15Marks

MTE - Mid Term Examination: 20 Marks

a. First Mid Term Examination: 10 marks
b. Second Mid Term Examination: 10 marks

ETE - End Term Examination: 60 Marks

- **Course with practical components only**

For Continuous Evaluation (CE) is such as: 30 Marks
Conduct / Perform/Execution /Practical File/ Viva-Voice
MTE - Mid Term Examination: 20 Marks

a. First Mid Term Examination: 10 marks
b. Second Mid Term Examination: 10 marks

ETE - End Term Examination: 50 Marks

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Course Detail and Evaluation Scheme
(Effective from the Session 2016-17)

B.Sc. Bioinformatics
Third Year- 6th Semester

S.N.	Subject Code	Subject Name	Period			EVALUATION SCHEME			Subject Total	Credit
			L	T	P	CE	MTE	ETE		
Theory subjects										
1	BBI - 601	Data Structure & Algorithm	3	1	0	20	20	60	100	4
2	BBI - 602	Molecular Modeling	3	1	0	20	20	60	100	4
3	BBI - 603	Enzymes and Metabolism	3	1	0	20	20	60	100	4
4	BBI - 604	Introduction to Perl Language	3	1	0	20	20	60	100	4
Practicals / Project										
1	BBI- 651	Introduction to Perl Language Laboratory	0	0	2	30	20	50	100	2
2	BBI - 652	Major Project	0	0	12	100	-	250	350	12
Total			**12**	**4**	**14**	**230**	**100**	**540**	**850**	**30**

L-Lecture, T-Tutorial, P- Practical, CE- Continuous Evaluation, MTE-Mid Term Examination, ETE-End Term Examination

Evaluation Scheme:

- **Course without practical components**

For Continuous Evaluation (CE) is such as: 20 Marks

1. Attendance: 5 Marks
2. Assignments/Quiz / Seminar/Term paper /Project :15Marks

MTE - Mid Term Examination: 20 Marks

a. First Mid Term Examination: 10 marks
b. Second Mid Term Examination: 10 marks

ETE - End Term Examination: 60 Marks

- **Course with practical components only**

For Continuous Evaluation (CE) is such as: 30 Marks
Conduct / Perform/Execution /Practical File/ Viva-Voice
MTE - Mid Term Examination: 20 Marks

a. First Mid Term Examination: 10 marks
b. Second Mid Term Examination: 10 marks

ETE - End Term Examination: 50 Marks

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(Effective from the Session 2016-17)

	L	T	P	C
Subject: Applied Chemistry (BBI-101)	**3**	**1**	**0**	**4**

UNIT-I

Importance of Chemistry, physical quantities and their measurement in Chemistry, SI Units, uncertainty in measurements and use of significant figures, Unit and dimensional analysis, Matter and its nature, laws of chemical combinations, atomic, and molecular, masses mole concept, molar masses, percentage composition and molecular formula, chemical stoichiometry.

UNIT-II

Three states of matter, gaseous state, gas laws (Boyle's Law and Charles Law), Avogadro's Law, Grahams'Law of diffusion, Dalton's law of partial pressure, ideal gas equation, Kinetic theory of gases, real gases and deviation from ideal behaviour, van der Waals' equation, liquefaction of gases and critical points, Intermolecular forces; liquids and solids.

UNIT-III

Earlier atomic models (Thomson's and Rutherford) , emission spectrum of hydrogen atom, Bohr's model, of hydrogen atom, Limitations of Bohr's model, dual nature of matter and radiation, Heisenberg uncertainty principle, quantum mechanical model of atom (quantum designation of atomic orbitals and electron energy in terms of principal, angular momentum and magnetic quantum numbers), electronic spin and spin quantum numbers, Pauli's exclusion principle, general idea of screening (constants) of outer electrons by inner electrons in an atom, *Aufbau* principle, Hund's rule, atomic orbitals and their pictorial representation, electronic configurations of elements.

UNIT-IV

Some basic concepts in thermodynamics, first law of thermodynamics, heat capacity, measurement of U and H, calorimetry, standard enthalpy changes, thermochemical equations, enthalpy changes during phase transformations, Hess's Law, standard enthalpies of formation, bond enthalpies and calculations based on them.Kossel -Lewis approach to chemical bond formation, ionic bonds, covalent bonds, polarity of bonds and concept of electronegativity, valence shell electron pair repulsion (VSEPR) theory , shapes of simple molecules, valence bond theory, hybridization involving s, p and d orbitals and shapes of molecules and bonds; Molecular orbital theory involving homounclear diatomic molecules; Hydrogen-bonding.

UNIT-V

Classification of solids based on different binding forces: molecular, ionic, covalent and metallic solids, amorphous and crystalline solids; unit cells in two dimensional and three dimensional lattices, calculation of density of a unit cell, packing in solids, voids, number of atoms per unit cell in a cubic unit cell, point defects, electrical and magnetic properties.Kohlraus's law, Measurement of Conductance. pH determination, Conduct metric titrations. Hydrolysis of Salts. pH and buffer in living system.

Recommended Books:

1. Lee, J.D. 2001 Inorganic chemistry. Blackwell science,
2. Negi A.S and Anand. 2001. A text book of physical chemistry. Taj press.
3. Sony, P.L 2000. A text book inorganic chemistry, Sultan Chand and Sons.
4. Mathews, P.1996 Advanced chemistry, Cambridge University Press
5. Voet, D. and Voet, JG.2004 Biochemistry, 4thEdition, John Willey & Sons, Inc

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(Effective from the Session 2016-17)

	L	T	P	C
Subject: Elementary Mathematics (BBI-102)	**3**	**1**	**0**	**4**

UNIT-I

Sets, Relations, functions, complex numbers, square root of a complex number and cube root of unity, sequences, AP, GP and HP series; AM, GM and HM; Exponential and Logarithmic series and their sum. Permutation and combination. Bionomial Theorem and its applications. Matrices and Determinants; Inverse of a matrix and its applications for solving linear equations in two or three variables.

UNIT-II

Limit of a function, continuity of a function. Differentiation of a function and its physical significance. Derivative of polynomial, trigonometric exponential, logarithrmic, inverse trigonometric and implicit functions. Integration of a function, Integration by substitution, partial fraction and their use in rational functions.

UNIT-III

Definite integrals and its properties. Applications of definite integrals in finding areas bounded by a curve and area between two curves.Order and degree of a differential equation, General and particular solutions, solution of homogenous differential equation of first order, solution of a linear differential equation.

UNIT-IV

Cartesian system of coordinates in a plane, distance and section formulae, area of a triangle, condition of collinearity of three points in a plane, slope of a line, parallel and perpendicular lines, two point form; intercept, normal and general forms of a line, angle between two lines. Equations of circles, Parabola, Ellipse and Hyperbola; equations of their tangents.

UNIT-V

Coordinates of a point in three-dimensional space. Section formula. Direction ratios and cosines of a line joining two points, angle between two lines, condition for intersection of two lines, collinearity of three points, shortest distance between two lines. Equation of plane, condition of co-planarity of two lines, Angle between tow planes. Equation of a sphere - its centre and radius. Diameter form of equation of a sphere

Recommended Books:

1. Binmore, "Mathematical Analysis". Cambridge University. Press.
2. NCERT, New Delhi (Books related to above cited topics)

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(Effective from the Session 2016-17)

	L	T	P	C
Subject: Basic Biology (BBI-103)	**3**	**1**	**0**	**4**

UNIT-I

The cell concept, structure of prokaryotic, eukaryotic cells, plant cells and animal cells, Structure and function of cell membrane, cell organelles and their function. Structure and use of compound microscope, Macro and micro molecules, Basic chemical constituents of living body. Tissues in animal and plants, Morphology, anatomy and functions of different parts of plants: Root, stem, leaf, inflorescence, flower, fruit and seed, Concepts of botanical garden, herbaria, zoological park and museums.

UNIT-II

Classification of living organisms (Five kingdom classification, major groups and principles of classification in each kingdom), Systematic and binomial system of nomenclature, Concept of animal and plant classification. Concepts of alleles and genes, Mendelian Experiments, Cell cycle (Elementary Idea), mitosis and meiosis, techniques to study mitosis and meiosis. Plant Physiology: Concepts of diffusion, osmosis, imbibitions, Movement of water, food, nutrients and gases, Photosynthesis, plant growth and development.

UNIT-III

Brief history of microbiology, Types of microorganisms, Basic idea of domain bacteria, proteobacteria, nonproteobacteria Gram –ve and Gram +ve bacteria, lichens, algae, protozoa, helminthes, viral structures, Viral multiplication, Role of microorganisms in the production of industrial chemicals and pharmaceuticals. Functional Anatomy of Prokaryotic and Eukaryotic Cells: Size, shape, and arrangement of bacterial cells. Structure and function of cells.

UNIT-IV

Catabolic & anabolic reactions: enzymes, energy production and carbohydrate metabolism. Lipid & protein catabolism, Energy production mechanism, metabolic diversity & pathways of energy use. Integration of metabolism. Energy Utilization: Structure of mitochondria, cellular respiration, relationship of carbohydrate metabolism to other compounds, Glycolysis, formation of acetyl co-A, Kreb cycle, Electron Transport System and Oxidative Phosphorylation, ATP, factors affecting respiration.

UNIT-V

Reproductive health and human welfare: Population and birth control, sexually transmitted diseases, infertility, Cancer and AIDS, Basic concepts of immunology, vaccines.

Recommended Books:

1. Biology-Textbook of Class XI, NCERT Publication
2. Biology-Textbook of Class XII, NCERT Publication
3. Biology by Peter H Raven, Georgeb Johnson, Kenneth A., Mason, Jonathan Losos, Susan Singer (MacGraw Hill Publication)

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(Effective from the Session 2016-17)

	L	T	P	C
Subject: Environmental Studies (BBI - 104)	**3**	**1**	**0**	**4**

UNIT-I

Environmental Sciences - Relevance - Significance - Public awareness - Forest resources - Water resources - Mineral resources - Food resources - conflicts over resource sharing - Exploitation - Land use pattern - Environmental impact - fertilizer - Pesticide Problems - case studies.

UNIT-II

Ecosystem - concept - structure and function - producers, consumers and decomposers - Food chain - Food web - Ecological pyramids - Energy flow - Forest, Grassland, desert and aquatic ecosystem. Biodiversity - Definition - genetic, species and ecosystem diversity - Values and uses of biodiversity - biodiversity at global, national (India) and local levels - Hotspots, threats to biodiversity - conservation of biodiversity - Insitu & Exsitu.

UNIT-III

Environmental Pollution - Causes - Effects and control measures of Air, Water, Marine, soil, solid waste, Thermal, Nuclear pollution and Disaster Management - Floods, Earth quake, Cyclone and Land slides. Role of individuals in prevention of pollution - pollution case studies.

UNIT-IV

Urban issues - Energy - water conservation - Environmental Ethics - Global warming - Resettlement and Rehabilitation issues - Environmental legislations - Environmental production Act. 1986 - Air, Water, Wildlife and forest conservation Act - Population growth and Explosion - Human rights and Value Education - Environmental Health - HIV/AIDS - Role of IT in Environment and Human Health - Women and child welfare - Public awareness - Case studies.

UNIT-V

Visit to a local area / local polluted site / local simple ecosystem - Report submission

Recommended Books:

1. Environment and Ecology, R K Khandal, 978-81-265-4277-2, Wiley India.
2. Environmental Science, 8thEd ISV, Botkin and Keller, 9788126534142,Wiley India.
3. Environmental Studies, R Rajagopalan, 978-0195673937, Oxford University Press
4. Textbook of Environmental Science and Technology, M.Anjireddy, BS Publications
5. Environmental Studies, Soli. J Arceivala, Shyam, R Asolekar,9781259006050, McGrawHill India, 2012.

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(Effective from the Session 2016-17)

	L	T	P	C
Subject: Introduction to Computers /MS Office (BBI - 105)	**3**	**1**	**0**	**4**

UNIT-I

Hands-On experience and regular usage: Tutorials (Typing, Windows 98/XP, Internet, UNIX, etc), applications. And utilities of Windows 98/XP, Browsers (I.E., Netscape), surfing the Internet, Search Engines, using E-Mail/Web mail, ftp

UNIT-II

Downloading and installing software/plug-ins on Windows 98/XP (Acrobat Reader, Post Scripts Viewer, etc) Pine, telnet, basic Unix commands Searching/Surfing on the WWW.

UNIT-III

Word Processing (Microsoft Word): Creating, Saving & Opening a document, Editing, Inserting, Deleting, Formatting, Moving & Copying Text, Find & Replace, Spell Checker & Grammar Checker (Thesaurus), Document Enhancement (Borders, Shading, Header, Footer), Printing document (page layout, Margins), Introduction to the use of Wizards & Templates, Working with Graphics (Word Art),

UNIT-IV

Working with Tables & Charts, Inserting Files (pictures, Databases, Spreadsheets) Spreadsheet Applications (Microsoft Excel): Worksheet Basics (Entering information in a worksheet, Saving & Opening a worksheet, Editing, Copying & Moving data, Inserting, Deleting & Moving Columns & Rows, Clearing Cells & Formatting cells), Working with workbooks, Working with formulae and functions, Printing worksheets, An introduction to the use of advanced spreadsheet concepts, Database "Management (Sorting records, Finding records, Adding & Deleting records, Filtering records in a worksheet), Working with Macros, Creating and using multiple worksheets

UNIT-V

Database Applications (Microsoft Access): Fields, Records, Files, Organization of Files, Access Modes; Database, Relational Database; Primary and Secondary Key, Working with databases & tables, Creating a Database, Appending, Updating Records Querying, Reports, Forms and sub forms, Sorting, Filters, An introduction to use of Macros, Modules, Wizards with database applications. Creation of Computer Presentations with graphics (Microsoft Power Point): Creation of slides, Rapid Presentation design using wizards, Inserting graphs & charts Action buttons, Transitions, Build and Animation effects Introduction to Multimedia Tools & Devices Searches on Medline, bibliographic databases, etc.

Recommended Books:

1. Programming in ANSI C, 4th edition Author: Balagurusamy E Publisher: Tata McGraw-Hill Publishing Company limited
2. Object oriented programming with C++, 3rd edition Author: Balagurusamy E Publisher: Tata McGraw-Hill Publishing Company limited

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	L	T	P	C
Subject: Communication Skills (BBI - 001)	**2**	**0**	**0**	**2**

UNIT-I
Programme of writing: Thinking and planning, information, ideas. Topic outline, order of paragraph writing, revising. Use of vocabulary: meaning of words, precise usages synonym, technical terms, nomenclature, context, superfluous words.

UNIT-II
Use of Good English: Noun, pronoun, verb adverb, objective, Conjunction, article tense spelling etcCompilation of experimental records, weiting progress reports.

UNIT-III
Communication skill: Letters and memoranda communication as a part of science. Reading ; How to read, making notes as you read, writing a book review

UNIT-IV
Helping the reader: Easy reading (how to begin, control, explain, sentence length, rhythm, style) capture and hold readers interest-effective communication. The art of illustrations, figures.

UNIT-V The art of thesis and report writing Editing and correcting

Recommended Books:

1. ”Written communication in English" Sarah Freeman
2. "English for students of science", A.Roy,P,L. Sharma
3. Mcmillan Grammer ; A Handbook of "Augustione and Joseph", Orient Longman
4. A new guide to precis writing R.W. Jepson (O,L)

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	L	T	P	C
Subject: Applied Chemistry Laboratory (BBI - 151)	**0**	**0**	**2**	**2**

1. Estimation of sodium hydroxide using standard sodium carbonate.
2. Estimation of hydrochloric acid- standard oxalic acid.
3. Estimation of oxalic acid- standard sulphuric acid.
4. Estimation of ferrous sulphate- standard Mohr salt solution.
5. Estimation of oxalic acid- standard ferrous sulphate.
6. Estimation of potassium permanganate- standard sodium hydroxide

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	L	T	P	C
Subject: Introduction to Computers Laboratory (BBI - 152)	**0**	**0**	**2**	**2**

1. Creating a Presentation Using a Template
2. Entering and Editing Text
3. Inserting Word Table or an Excel Worksheet;
4. Adding Clip Art Pictures and Other Objects
5. Resizing and Scaling an Object Presentation of Slides
6. Transition and Slide Timings
7. Using shortcut keys
8. Manipulation of Cells
9. Entering Text, Numbers and Dates
10. Creating Text, Number and Date Series
11. Editing Worksheet Data
12. Formatting Cells

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(Effective from the Session 2016-17)

	L	T	P	C
Subject: Fundamental of Biological system (BBI - 201)	**3**	**1**	**0**	**4**

UNIT-I

The cell concept, structure of prokaryotic and eukaryotic cells. Structural and Functional relationship of cell membrane and cell organelles. Structural and functional aspects of compound microscope.

UNIT-II

Tissues in animal and plants, Morphology, anatomy and functions of different parts of plants: Root, stem, leaf, flower, fruit and seed, Concepts of botanical garden, herbarium, zoological park and museums.

UNIT-III

Classification of living organisms (Five kingdom classification, major groups and principles of of each kingdom), Systematic and binomial system of nomenclature, Concept of animal and plant classification.

UNIT-IV

Concepts of alleles and genes, Mendelian genetics, Cell cycle (Elementary Idea), mitosis and meiosis, techniques to study mitosis and meiosis.

UNIT-V

Concepts of diffusion, osmosis, imbibitions, Movement of water, food, nutrients and gases, Photosynthesis, plant growth and development.

Recommended Books:

1. Biology-Textbook of Class XI, NCERT Publication
2. Biology-Textbook of Class XII, NCERT Publication

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(Effective from the Session 2016-17)

	L	T	P	C
Subject: Cell Biology (BBI - 202)	**3**	**1**	**0**	**4**

UNIT-I

Basic Structure and function of cell, types of cell, cell theory, difference between prokaryotic and eukaryotic cell, different types of cell organelles, their structure and functions. Extra cellular matrix, Cytoskeleton.

UNIT-II

Cell cycle and different phases of cell cycle, cell division (mitosis and meiosis), Various type of cell-cell junction, bacterial cell signaling. Cell division in bacteria.

UNIT-III

Physiochemical properties of plasma membrane and their functions, transport through plasma membrane, uniport, symport and antiport, diffusion, facilitated diffusion and active transport.

UNIT IV

Building blocks of DNA, RNA, protein, and lipids, their structure and function, denaturation of DNA and proteins. Hyperchromacity, double helical model of DNA. Different types of mutation in DNA, renaturation of DNA and proteins.

UNIT V

Various types of microscopes used to visualize the cells. Cell viability and toxicity. Cell counting, Cell proliferation, cell culture techniques, angiogenesis.

Recommended Books:

1. Molecular Biology of the Cell, 4th edition by Bruce Albert's, Alexander Johnson, Julian Lewis, Martin Raff, Keith Roberts, and Peter Walter. New York: Garland Science; 2002.
2. Cell and Molecular Biology: Concepts and Experiments, Fourth Edition by Gerald Karp-2004
3. Molecular Cell Biology (Lodish, Molecular Cell Biology) by Harvey Lodish, Arnold Berk, Chris A. Kaiser and Monty Krieger - 2007
4. The World of the Cell, 7th Edition by Wayne M. Becker, Lewis J. Kleinsmith, Jeff Hardin and Gregory Paul Bertoni (Feb 29, 2008)

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(Effective from the Session 2016-17)

	L	T	P	C
Subject: Biochemistry (BBI - 203)	**3**	**1**	**0**	**4**

UNIT -I

Carbohydrate: Classification & properties of mono, di, oligo and polysaccharides. Mutarotation, Anomer, Epimer, Structure of Glucose, Fructose, Sucrose, Maltose, Lactose. Structure and role of polysaccharides - Starch, Chitin, Heparin, Cellulose and Glycogen. pH and buffer solution.

UNIT- II

Carbohydrate metabolism- Glycolysis and its regulation, Gluconeogenecis, Krebs cycle and its regulation, Electron transport system and its regulation, Pentose Phosphate pathway and Glyoxylate cycle.

UNIT-III

Amino acids- Classification and properties, Classification and properties proteins, Co-enzymes, Peptide bond conformation. Isoelectric point. Structure of Protein - primary, secondary, tertiary and quaternary. Ramachandran plot and its significance. Urea cycle and its role in human body.

UNIT-IV

Lipids - Classification, properties and functions, Fatty acids- nomenclature, structures, Biosynthesis of Fatty acids – saturated and unsaturated, Beta oxidation of saturated fatty acids, Comparison between fatty acid biosynthesis and Beta oxidation.

UNIT-V

Vitamins - Classification and role of Water soluble and fat-soluble vitamins. Animal hormones and Phytohormones roles.

Recommended Books:

1. Harper's Illustrated Biochemistry, (26th Edition) – R.K. Murray, D.K. Garner, P.A. Mayers & V.W. Rockwell, Pub: McGraw Hill International Edition.
2. Principles of Biochemistry (4th Edition) – Lehninger, Nelson & Cox. Pub: Macmillan
3. Biochemistry (3rd Edition) – G. Zubay., Pub: Wm. C. Brown Pub.
4. General Biochemistry (5th Edition, 1996) – Weil, Pub: New Age Intl. Ltd.
5. Biochemistry (5th Edition) – Lubert Stryer. Pub: W.H. Freeman & Com., NY.
6. Biochemistry – D. Voet and J.G. Voet Pub: John Willy & Sons

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(Effective from the Session 2016-17)

	L	T	P	C
Subject: Biostatistics (BBI - 204)	**3**	**1**	**0**	**4**

UNIT-I

Biostatistics - definition - statistical methods - basic principles. Variables - measurements, functions, limitations and uses of statistics.

UNIT-II

Collection of data primary and secondary - types and methods of data collection procedures - merits and demerits. Classification - tabulation and presentation of data - sampling methods.

UNIT-III

Measures of central tendency - mean, median, mode, geometric mean - merits & demerits. Measures of dispersion - range, standard deviation, mean deviation, quartile deviation - merits and demerits; Co-efficient of variations.

UNIT-IV

Correlation - types and methods of correlation, regression, simple regression equation, fitting prediction, similarities and dissimilarities of correlation and regression.

UNIT-V

Statistical inference - hypothesis - simple hypothesis - student 't' test - chi square test.

Recommended Books:

1. Biostatistic, Danniel, W.W., 1987. New York, John Wiley Sons.
2. An introduction to Biostatistics, 3rd edition, Sundarrao, P.S.S and Richards, J. Christian Medical College, Vellore
3. Statistical Analysis of epidemiological data, Selvin, S., 1991. New York University Press.
4. Statistics for Biology, Boston, Bishop, O.N. Houghton, Mifflin.

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(Effective from the Session 2016-17)

	L	T	P	C
Subject: Progrmming in C (BBI - 205)	**3**	**1**	**0**	**4**

UNIT–I

Overview of C, Feature of C, Structure of program, Variables, Expression, Identifiers, Keywords, Data types, Constants. Operator: Arithmetic, Logical, Relational, Conditional and Bitwise operators, Precedence and associatively of operators, Types conversion in expression Basic input/output and library functions Single Character Input/Output i.e. getch(), getchar(), getche(), putchar(), Formatted input/output i.e. printf() And scanf(), Library Functions – concepts mathematical and character functions. Control structures- If Statement, If…….Else Statement, Nesting Of If ……..Else Statement, Else If Ladder, ? : Operator, Switch Statement, Compound Statement, Loop Controls – For, While, Do-While Loops, Break Continue, Exit, Goto Statement .

UNIT–II

The Need of a Function, User Defined and Library Function, Prototype of a Function, Function Argument, Return Values and Nesting of Function, main(),Command Line Argument, Recursion, Calling of Functions, Array as Function Argument, Scope and Life of Variables - Local and Global Variable, Storage Class specifier – Auto, Extern, Static, Register, Preprocessor Directive.

UNIT–III

Arrays-Single And Multidimensional Arrays, Array Declaration And Initialization Of Arrays, String : Declaration, Initialization, String Functions Structure and union-Defining Structure, Declaration Of Structure Variable, Accessing Structure Members, Nested Structures, Array Of Structures, Structure Assignment , Structure As Function Argument, Function That Return Structure, Union.

UNIT-IV

Pointers- The & And * Operators, Pointers expressions, Pointers V/s Arrays, Pointer to functions, Functioning returning pointers. Dynamic memory allocation Introduction, Malloc, Calloc, Sizeof, Free, Relloc Functions Bitwise operator

UNIT–V

File management-Defining, Opening a File & Closing a File, Text file, Binary file, Functions for File Handling: fopen, fclose, gets, puts, fprint, fscanf, getw, putw, fputs, fgets,fread, fwrite, Random access to files : fseek, ftell, rewind, file name as Command Line Argument. Graphics on your PC, Initialize Graphics Mode, Functions used In Graphics - Drawing a Point on The Screen, Drawing – lines, rectangle, ovals, circles, arcs, polygon, filling colors, Using Text in Graphics Display.

Recommended Books:

1 Programming in C by e. Balaguruswami, TMH Publications
2. Programming with C by Gottfried, Schaums outlie series, TMH publications
3. Thinking in C by Mahapatra, PHI publications
4. Graphics programming in C by Stevens, BPB publication
5. Programming in C by R Subburaj, Vikas publishing

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	L	T	P	C
Subject: Biochemistry Lab (BBB – 251)	**0**	**0**	**2**	**2**

List of experiments:

1. Estimation of blood sugar.
2. Estimation of blood urea.
3. Estimation of hemoglobin content of human blood.
4. Determine the number of RBC count in the human blood.
5. Determine the number of WBC count in the human blood.
6. Determine erythrocyte sedimentation rate (ESR) of human blood.
7. Estimate SGPT/SGOT activity.

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	L	T	P	C
Subject: Progrmming in C Laboratory (BBI – 252)	**0**	**0**	**2**	**2**

List of experiments:

All assignments based on theory.

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	L	T	P	C
Subject: Structural Bioinformatics (BBI - 301)	**3**	**1**	**0**	**4**

UNIT-I

Fundamentals of X-ray diffraction, NMR spectroscopy of macromolecules Protein Structure: Primary, Secondary, Super Secondary, Domains, Tertiary, Quaternary, Ramachandran plot.

UNIT-II

Protein secondary structure classification databases: HSSP, FSSP, CATH, SCOP. Protein secondary structure prediction methods: GOR, Chou-Fasman, PHD, PSI- PRED, J-Pred.

UNIT-III

Protein Tertiary structure prediction methods: Homology Modeling, Fold Recognition, ab-intio Method. Protein folding, Molecular Dynamics of Protein, Molecular Docking of Protein, Small molecule and Nucleotide, Concepts of Force Field.

UNIT-IV

Motif and Domain: Motif databases and analysis tools. Domain databases (CDD, SMART, ProDom) and Analysis tools. HMM (Hidden Markov Model): Introduction to HMM, its application in Sequence alignment and Structure prediction, HMM based Softwares (HMMER and HMMSTR)

UNIT-V

Structural features of RNA: Primary, Secondary, Tertiary. Introduction to RNA Secondary structure prediction, Methods for RNA Secondary structure prediction, Limitation of RNA Secondary structure prediction

Recommended Books:

1. Structural Bioinformatics by Graham Kemp and Per-Georg Nyholm
2. Structural Bioinformatics, 2nd Edition, Jenny Gu (Editor), Philip E. Bourne ISBN: 978-0-470-18105-8, 1096 pages, February 2009, Wiley-Blackwell

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(Effective from the Session 2016-17)

	L	T	P	C
Subject: Database Management System (BBI - 302)	**3**	**1**	**0**	**4**

UNIT-I

Purpose of database, data abstraction, data models, instances & schemas, data independence, data definition language, data manipulation language, database manager, database administration

UNIT-II

Entity & Entity sets, relationship sets, mapping constraints, candidate & primary key, entity relationship diagram, reducing ER diagram to tables.

UNIT-III

Concepts of relational model, integrity constraints, extension & intension, relational algebra, relational calculus, commercial query language, modifying the database, comments on relational model.

UNIT-IV

Introduction, the mapping operation, data manipulation facility, data definition facility, data control facility.

UNIT-V

Introduction to functional dependence, normalization1NF, 2NF, 3NF, BCNF, 4NF, 5NF, **Oracle Ingress or Sybase:** Creation of tables, modification of tables, DDL command for RDBMS, SQL command for RDBMS, Command language

Recommended Books:

1. Date C J, " An Introduction to Database Systems", Addision Wesley
2. Korth, Silbertz, Sudarshan," Database Concepts", McGraw Hill
3. Elmasri, Navathe, "Fudamentals of Database Systems", Addision Wesley O'Neil, Databases, Elsevier Pub.
4. Leon & Leon, "Database Management Systems", Vikas Publishing House
5. Bipin C. Desai, " An Introduction to Database Systems", Gagotia Publications

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(Effective from the Session 2016-17)

	L	T	P	C
Subject: Microbiology (BBI - 303)	**3**	**1**	**0**	**4**

UNIT-I

History, scope and development of Microbiology; Applications of Microbiology in human welfare. Contribution in microbiology: Antony van Leeuwenhoek, Alexander Fleming, Edward Jenner, Louis Pasteur, Robert Koch, Selman Waksman, Joseph Lister, A M Chakrrobarti etc

UNIT-II

Definition of growth, mathematical expression of growth. Growth curve, Growth yield, Effect of nutrient concentration on growth. Factors affecting growth: nutrients, temperature, oxygen, pH, osmotic pressure. Measurement of growth; general introduction of synchronous culture, continuous culture and batch culture

UNIT-III

Classification, structural and functional relation of Bacteria-(eubacteria & archaebacteria), Cyanobacteria, Actinomycetes, Mycoplasma, Rickettsia & Chlamydia.

UNIT-IV

Classification, general characteristics and structure of Viruses (Prions, Virions, Virusoids & Viroids) Virus host, General features of virus reproduction. DNA & RNA Viruses with the example of retrovirus, TMV & Pox Virus. lytic and lysogenic phages.

UNIT-V

Classification, general characteristics, structure with emphasis on *Mucor, Rhizopus, Puccinia, Aspergillus, Penicillium, Alternaria,* and *Agaricus* function of each part & components of cell. Reproduction & economic importance of fungi.

Recommended Books:

1. Microbiology by Pelczar (W C Brown publication)
2. Genral Microbiology by stainer (Mac Millan Publication)
3. Microbiology by Pawar and Dagniwala (Himalaya publishing House)

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	L	T	P	C
Subject: Computational Molecular Biology (BBI - 304)	**3**	**1**	**0**	**4**

UNIT-I

Introduction to Algorithm: History, Principles, types, development and its complexity. Algorithms Issues and Problems, algorithms: NP complete problem, polynomial-Reducibility, Travelling sales man problem, sorting problem and Fibonacci Problem.

UNIT- II

Pairwise Sequence Alignment: Introduction, Global Alignment, Semi-global Alignment, Local Alignment Banded Alignment, Gap penalty function.

UNIT-III

Substitution Matrix, Local alignment database search, Similarity and distance measure, Normalized Local alignment.

UNIT-IV

Dynamic Programming, Dynamic programming Principles and its uses. Heuristics second generation alignment tool (Blast, FASTA, ClustalW). Probalitics and statiscs method- concepts and its significance.

UNIT -V

Algorithms for partial digest, double digest problem, graph algorithm for DNA sequence assembly (CASP3, Phrap, Phred).

Recommended Books:

1. Neil C.Jones and Pavel .A Pevzner An introduction to Bioinformatics. Algorthims.(computational Molecular Biology) (2004) MIT press. ISBN-10: 0262101068
2. R. Durbin, S.Eddy, A.Krogh, G.Mitchison Biological sequence analysis : Probabilistic models of Proteins and Nucleic acids (1998) Cambridge University Press 0-521-62971-3
3. Michael.S.Waterman Introduction to Computational Biology : Maps, Sequences and Genomes . Waterman. (1995) Chapman and Hall/ CRC Press ISBN-10: 0412993910
4. Dan Gusfield Algorthims on Strings, Trees and Sequences : Computer Science and Computational Biology (1997) Cambridge University Press. ISBN-10: 0521585198
5. Srinivas Aluru, Handbook of Computational Molecular Biology, Chapman

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(Effective from the Session 2016-17)

	L	T	P	C
Subject: Bioinformatics I (BBI - 305)	**3**	**1**	**0**	**4**

UNIT-I

What is bioinformatics ,- Scope of bioinformatics - Elementary commands and Protocols FTP - Telnet - HTTP - Primer on information theory. Sequencing alignment local alignment, multiple alignments - common alignment methods.

UNIT-II

Sequence databases and their use - Introduction to databases - database search Algorithms issues in databases - search sequence database search - FASTA - BLAST

UNIT-III

Evolutionary trees and phylogeny, Phylogenetic trees - parsimony - Multiple sequence alignment and phylogenetic tree construction and analysis.

UNIT-IV

Special topics in bioinformatics, DNA Mapping -and sequencing - Map alignment - Large scale sequencing and alignment - Shotgun - DNA sequencing - Sequence assembly - Gene predictions

UNIT-V

Introduction to Biological databases; Organization and management of databases; Searching and retrieval of information from the World Wide Web; Structure databases-PDB (Protein Data Bank),Molecular Modeling Databases (MMDB); Primary Databases (NCBL, EMBL, DDBJ) ; Introduction to Secondary Databases Organization and management of databases (Swissprot, PIR, KEGG); Introduction to BioChemical databases-organization and Management of databases.

Recommended Books:

1. Mount D. W. Bioinformatics & Genome Analysis. Cold Spring Harbor Laboratory Press.
2. C.Braden and C.Tooze: Introduction to Protein Structure" Garland Publishing Inc., New York.
3. S.C.Rastogi, N.Mendiratla and P.Rastogi: Bioinformatics methods and applications-Genomics, Proteomics and Drug Discovery, Prentice Hall (India).
4. Dov Stekal (2003) Microarray Bioinformatics, Cambridge University Press, Cambridge.
5. Brown TA. (2002) Genomes. John Wiley & Sons (Asia) Pvt. Ltd. Singapore.
6. P.Clate & R.Backofen :Computational Molecular Biology, Willy Publication.
7. T.K.Atwood and D.J. Parry Smith, Introduction to Bioinformatics. Biological databases.

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	L	T	P	C
Subject: Microbiology & Molecular Laboratory (BBI - 351)	**0**	**0**	**3**	**3**

List of Experiments

1. Estimation of DNA content in the given sample by diphenylamine method.
2. Estimation of RNA content by the Orcinol method.
3. Isolation of Plasmid DNA.
4. Isolation of bacterial genomic DNA.
5. Isolation of plant DNA.
6. Isolation of fungal genomic DNA.

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	L	T	P	C
Subject: Bioinformatics-I Laboratory (BBI - 352)	**0**	**0**	**2**	**2**

List of Experiments

1. Construction of data Bases for specific class of proteins/enzymes, genes/ ORF/ EST/Promoter sequences/ DNA motifs or protein motifs using oracle.
2. Access and use of different online protein and gene alignment softwares
3. Gene finding related search for a given nucleotide sequence in order to predict the gene
4. ORF prediction for different proteins out of some given nucleotide sequences.
5. Exon identification using available softwares for a given nucleotide sequences
6. Secondary structure prediction for amino acid sequences of a given protein.

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	L	T	P	C
Subject: Molecular genetics (BBI - 401)	**3**	**1**	**0**	**4**

UNIT-I

Organization of bacterial genome, Structure of eukaryotic chromosomes. Role of nuclear matrix in chromosome organization and function, matrix binding proteins, heterochromatin and euchromatin, molecular components. Satellite DNA, DNA melting and buoyant density, packing and organization of chromatin, nucleosome phasing, Mutation:- Nonsense, missense and point mutations, intragenic and intergenic suppression, frameshift mutations, physical, chemical and biological mutagens.

UNIT-II

Concepts of replication initiation, elongation and termination in prokaryotes and eukaryotes, enzymes and accessory proteinsinvolved in DNA replication, Fidelity in replication, replication of single stranded circular DNA.DNA repair, DNA repair enzymes, photoreactivation, nucleotide excision repair, mismatch correction, SOS repair. Recombination:- homologous and non-homologous recombination, site specific recombination, Holliday structure, resolution.

UNIT-III

Prokaryotic Transcription & Regulation: Promoters, Regulatory elements, Transcription unit, constitutive and inducible promoter, operators, Initiation, Attenuation, Termination, Rho-dependent and independent termination, Anti-termination, Transcriptional regulation, positive and negative regulation, Operon concept, Regulation of transcription of lac, and trp, operons. Processing of tRNA and rRNA. Eucaryotic transcription and regulation: RNA polymerase structure and assembly, RNA polymerase I, II, III, Eukaryotic promoters and enhancers, General Transcription factors, TATA binding proteins (TBP) and TBP associated factors (TAF), Activators and repressors, transcription initiation, elongation and termination.

UNIT-IV

The translation machinery, ribosomes, composition and assembly. Universal genetic code, degeneracy of codons, termination codons, isoaccepting tRNA, wobble hypothesis. Mechanism of initiation, elongation and termination, Co- and post-translational modifications, Protein synthesis. Transport of proteins and molecular chaperones. Protein stability, protein turnover and degradation.

UNIT-V

Introduction, Basic steps for gene expression. Microarray:- Concept of microarrays; spotted arrays, oligonucleotide arrays, designing the experiment, Two-color microarray experiments. Tools for microarray analysis; soft-finder, xCluster, MADAM, SAGE, ClustalW, BLASTn. Microarray design, microarray experimentation, fabrication computational analysis of Microarray data, Applications of microarray technology.

Recommended Books:

1. Principles of Biochemistry (4th Edition) – Lehninger, Nelson & Cox. Pub: Macmillan
2. Biochemistry (3rd Edition) – G. Zubay., Pub: Wm. C. Brown Pub.
3. Biochemistry (5th Edition) – Lubert Stryer. Pub: W.H. Freeman & Com., NY.
4. Biochemistry – D. Voet and J.G. Voet Pub: John Willy & Sons.

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	L	T	P	C
Subject: Object Oriented Programming Using JAVA (BBI - 402)	**3**	**1**	**0**	**4**

UNIT-I
Introduction, the Java platform, a development cycle for java applications, basic data types, variables, literals, constants, expressions, arithmetic operators, relational operators, bit level operator, logical operators, string operator, casting, control structures, selection control statements, iteration control statements, break and continue, switch control statements, array, command line arguments.

UNIT-II
Classes, Constructors, Methods, Equality and equivalence, Static fields, Static Methods, A static application, Data members initialization, the keyword "this", an example: the complex number class.

UNIT-III
Constructors, Methods, Instance of and class methods, Packages Access control, final and abstract, polymorphism, Interfaces, Exceptions.

UNIT-IV
Input output, Byte oriented streams, Buffered byte oriented streams, Data buffered byte oriented streams, Character oriented stream, Standard input, Threads, The Producer & Consumer example, synchronized methods, Wait & Notify, JAR files.

UNIT-V
Java Native Interface, The definition of native methods, Numeric parameters and return values, Using Strings,Using non static methods and non static fields, Assessing static fields, Calling non static methods from C, Using arrays, Exceptions, Ant, A first example, Projects, targets, task elements and properties, A more complicated example.

Recommended Books:

1. Eckel B, Thinking in Java (3rd Edition) Prentice Hall.2002. Available on-line at http://jamesthornton.com/eckel/
2. Flanagan D, Java in a Nustshell: A Desktop quick reference (3rd Edition), O'Reilly,1999.
3. Holzner S, Java2, The Coriolis Group, 2000.
4. Horstmann C, Computing concepts with java 2, essentials (2nd Edition), Wiley 2000.
5. Horstmann C and Cornell G, Core Java, Volume II – Advanced Features, The sun Microsystems press, 2000.
6. Horstmann C and Cornell G, Core Java, Volume I – Advanced Features, The sun Microsystems press, 2001.

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	L	T	P	C
Subject: Bioethics, Biosafety and IPR (BBI - 403)	**3**	**1**	**0**	**4**

UNIT-I

Bioethics - legal and socioeconomic impacts of biotechnology- ethical concerns of biotechnology research and innovation, Bioethics commitees

UNIT-II

Intellectual property rights-patent, copyright, trade mark, TRIP- GATT and PBR, WTO

UNIT-III

Patent system – patenting laws-Legal development-Patentable subjects and protection in biotechnology-The patenting living organisms.

UNIT-IV

GLP - Containment facilities – Biosafety levels - Genetically modified organisms and its release - Genetically modified foods, Biosafety guidelines in India - International guidelines

UNIT-V

Basic concepts of Biodiversity - Elements of Biodiversity - Ecosystem Diversity, Genetic Diversity, Species Abundance & Diversity

Recommended Books:

1. Singh K, *Intellectual Property rights on Biotechnology*, BCIL, New Delhi, 2010
2. Shaleesha A. Stanley, Bioethics, Wisdom educational service, 2008, Wisdom Educational Service
3. Beier, F.K., Crespi, R.S. and Straus, T. *Biotechnology and Patent protection*-Oxford and IBH Publishing Co. New Delhi, 1985
4. Biotechnology by U.Sathyanarayana, 2009 , Books and allied (p) Ltd
5. Biotechnology by B.D.Singh, kalyani publishers,2009

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	L	T	P	C
Subject: Chemoinformatics & Drug Design (BBI - 404)	**3**	**1**	**0**	**4**

UNIT-I
Structure representation systems, 2D and 3D structures; General introduction to chemical structure-hybridization, tetrahedron geometry etc. Reaction transformations notation like SMIRKS, Introduction to graph theory, vertex partitioning algorithms- CANGEN algorithm, Internal co-ordinates and introduction to calculation of Z matrix of simple small organic molecules.

UNIT-II
Chemical Databases – Design, Storage and Retrieval methods; Introduction to database filters, property based & (drug-like)-Lipinski Rule of Five, In silico ADMET; QSAR approach, Knowledge-based approach.

UNIT-III
Modeling of small molecules and methods for interaction mapping; Chemical properties 2D and 3D; Introduction to adjacency, distance matrix and use of these matrices for calculating Weiner Index, Hosoya Index, Balban Index, Shultz Index, Randic Index. Introduction to shape indices- Kappa Shape index and calculation of molecular shape.

UNIT-IV
Role of Chemoinformatics in pharmaceutical/chemical research; Integrated databases; HTS analysis; Ligand based design of compounds; Structure based design of compounds, Chemoinformatics tools for drug discovery; Integration of active drugs; Optimization techniques; Filtering chemicals

UNIT-V
Drug Design: Role of Bioinformatics in drug design - Drug discovery cycle - Physicochemical principles of drug action - lead discovery - lead modification - optimization – Molecular Docking, AUTODOCK & HEX –docking algorithms - Structure Based De Novo Ligand Design -Rational Design - pharmacophores - QSAR

Recommended Books:

1. Leach A.R. , “Molecular Modelling - Principles and Applications”, 2nd Edition, Prentice Hall, 2001.
2. Prasad R.K., “Quantum Chemistry”, Halsted Press, 1992.
3. Ramachandran K. I., Deepa G., Namboori K., “Computational Chemistry and Molecular Modeling: Principles and Applications”, Springer, 2008.
4. McCammon, J.A. and Harvey, S.C., “Dynamics of Proteins and Nucleic Acids”, Cambridge University Press, Cambridge, 1987.
5. Young, D.C., “Computational Chemistry: A Practical Guide for Applying Techniques to Real-World Problems”, Wiley-Interscience, 2001

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(Effective from the Session 2016-17)

	L	T	P	C
Subject: Bioinformatics II (BBI - 405)	**3**	**1**	**0**	**4**

UNIT-I

Introduction and applications of Bioinformatics,Biological Data Bases. Primary and secondary data Bases. Specialized sequence data Bases of EST, TFB Sites, SNP's, gene expression. Pfam, PROSITE, BLOCK (Secondary data Bases). Data retrieval with ENTREZ, SRS, DBGET.

UNIT-II

Principles of DNA sequencing (chemical chain termination, Dideoxy chain termination method, Automatic sequencer). RNA sequencing. Protein sequencing (Edmand degradation method).

UNIT-III

Sequence alignment (pairwise and multiple, global and local). Sequence alignment algorithm (FAST, BLAST, Needleman and Wunsch, Smith Waterman). Data Bases similarity searches (BLAST, FASTA and PSI BLAST). Amino acid substitution matrices (PAM BLOSUM).

UNIT-IV

Protein structure prediction (Chou Fasman method): Secondary and tertiary structures. Homology Modelling, ORF prediction, Gene prediction, Micro array data analysis. Profiles and motifs.

UNIT-V

Structure visualization methods (RASMOL, CHIME etc.). Protein Structure alignment and analysis. Application of Bioinformatics in drug discovery and drug designing.

Recommended Books:

1. Bioinformatics: Principles and applications by Ghosh and Mallick (oxford) university press)
2. Bioinformatics by Andreas D Boxevanis (Wiley Interscience)
3. Fundamental concept of bioinformatics by Dan e. krane
4. Introduction to bioinformatics by Attwood and Parry Smith (Pierson education Publication)
5. Instant notes in Bioinformatics by Westhead, parish and Tweman (Bios scientific publishers)

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	L	T	P	C
Subject: Object Oriented Programming Using JAVA Laboratory (BBI - 451)	**0**	**0**	**2**	**2**

All assignments based on theory.

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	L	T	P	C
Subject: Molecular Genetics Laboratory (BBI - 452)	**0**	**0**	**3**	**3**

List of Experiments

1. Isolation of DNA from the given sample.
2. Isolation of plasmid DNA from the given bacteria.
3. Estimation of nucleic acids.
4. Separation of DNA from the agrose gel electrophoresis.
5. Purification of DNA through columns.
6. Estimation of RNA content by the Orcinol method.

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	L	T	P	C
Subject: Recombinant DNA Technology (BBI - 501)	**3**	**1**	**0**	**4**

UNIT-I
Gene cloning -concept and basic steps; application of bacteria and viruses in genetic engineering; Molecular biology of E. coli and bacteriophages in the context of their use in genetic engineering.

UNIT -II
Restriction modification enzymes used in recombinant DNA technology, endonucleases, ligases and other enzymes useful in gene cloning, Vectors: plasmid, bacteriophage and other viral vectors, cosmids, linkers and adapters. Ti plasmid, yeast artificial chromosome, Bacterial Artificial Chromosome

Unit III
DNA hybridization, DNA labeling, Southern and northern blotting; In-situ hybridization immunological assay and protein activity, Gene expression in prokaryotes & eukaryotes, Strong and regulatable promoters.

UNIT-IV
Gene isolation; Gene cloning, Expression of cloned gene Single cell nuclear transfer (SCNT) procedures and the cloning of sheep (Dolly), applications in conservation; therapeutic vs. reproductive cloning; ethical issues and the prospects for human cloning, Gene therapy

UNIT-V
Use of *Agrobacterium* for genetic engineering in plants, PCR technology for gene/DNA detection, cDNA and genomic DNA library, DNA sequencing methods Molecular markers: RAPD; RFLP; AFLP, SNP. Site directed mutagenesis, transposons.

Recommended Books:

1. Molecular Cloning, A laboratory Manual. Sambrook, J., Fritsch, E.F., Mariatis.3rd edition. 2001. Cold Spring Harbor Laboratory, USA.
2. Recombinant DNA. Watson, 1992.

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(Effective from the Session 2016-17)

	L	T	P	C
Subject: Immunology (BBI - 502)	**3**	**1**	**0**	**4**

UNIT-I

Introduction to immunity, Characteristics of innate and adaptive immunity, Humoral and Cell mediated immune response, Hematopoiesis, Cells and Molecules of the immune system, Primary and Secondary lymphoid organs, Inflammation.

UNIT-II

Characteristics and types of Antigens, Factors affecting the immunogenicity, Haptens and adjuvants, ABO blood group antigens, Epitopes, Structure, functions and characteristics of different classes of antibodies, Antigenic Determinants on Immunoglobulins.

UNIT-III

Structure and Function of MHC molecules, Exogenous and Endogenous pathways of antigen processing and presentation, Complement system, Structure, function and application of cytokines.

UNIT-IV

Antigen and antibody interactions, cross reactivity, precipitation reactions, serological techniques – ELISA, RIA and western blotting Production and application of monoclonal antibodies.

UNIT-V

Hyper-sensitivity, Autoimmunity, Cancer, AIDS and Transplantation immunology.

Recommended Books:

1. Immunology and immunotechnology by Ashim k. Chakravarty (Oxford university Press)
2. Immunology by C. Fatima 3. Immunology by Kuby (Free man publication)

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	L	T	P	C
Subject: Molecular Biology (BBI - 503)	**3**	**1**	**0**	**4**

UNIT- I

DNA as the genetic material- Griffiths and Hershey-Chase experiment, Central Dogma of molecular biology, structure of A, B and Z-DNA, structure of RNA : t-RNA, m-RNA and r-RNA, DNA denaturation and renaturation.

UNIT -II

DNA Replication -Prokaryotic and Eukaryotic (Modes, Components of cellular replisomes and their functions), The replicon, types and activities associated with prokaryotic DNA polymerases, eukaryotic DNA polymerases and their functions. Origin of replication in prokaryotes and eukaryotes. Okazaki fragments, Replication of Telomeric DNA.

UNIT- III

Transcription: Introduction, promoter architecture in prokaryotes and eukaryotes. Subunit structure of prokaryotic RNA polymerase. Types of eukaryotic RNA polymerases and their roles, Stages of transcription, sequence of events in initiation of transcription in prokaryotes and eukaryotes. Elongation and termination of transcription. Post transcriptional modification process- 5' cap, poly A tail , RNA splicing, RNA editing.

UNIT -IV

Genetic code- Properties of genetic code, Second genetic code, Second half of the genetic code, wobble hypothesis, cracking of genetic code, Open reading frame, Translation- Eukaryotic & prokaryotic, translation machinery, mechanism of initiation, elongation and termination.

UNIT -V

Housekeeping gene, luxury gene, Regulation of gene expression in prokaryotes. Operon concept. The lac operons- Negative control of lac operon, positive control of lac operon. Eukaryotic gene regulation.

Recommended Books:

1. Albert B, Bray Denis et al.: Molecular Biology of The Cell, latest ed.
2. Watson, Hopkin, Roberts et al.: Molecular Biology of the Gene, 4th ed.
3. Genetics- Strickberger, 2 nd.
4. Microbial Genetics – D. Frifielder.
5. Baltimore- Molecular Biology of the Cell.
6. Benjamin Levin – Genes VIII, 8 th ed.
7. Advance Genetics by G.S. Miglani, Narosa Publishing House.

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	L	T	P	C
Subject: Computational Genomics and Proteomics (BBI - 504)	**3**	**1**	**0**	**4**

UNIT-I

Genomic and c DNA sequence: gene prediction rules – gene prediction softwares – human and Arabidopsis genome projects – mutations

UNIT-II

Gene therapy - applications of genome – transgenic animals and plants – Pathway regulatory networks

UNIT- III

Introduction, Serial Analysis of Gene Expression, Microarray, Types of Microarrays, Microarray Fabrication, Microarray hybridization and detection, Microarray Image Processing and analysis, Expression ratios, Transformations of the Expression ratio, Data Normalization

UNIT -IV

Proteomics – protein separation - 2DE, protein identification – mass spectrometry. Protein chips. Applications of proteomics – Medical proteomics in disease diagnosis, pharmaceutical proteomics in drug development.

UNIT -V

Discovering a drug - target identification and validation - identifying the lead compound - optimization of lead compound - chemical libraries.

Recommended Books:

1. Bioinformatics: A Practical Guide to the Analysis of Genes and Proteins by Andreas D. Baxevanis and B. F. Francis Ouellette, 2004-Wiley Interscience
2. Discovering Genomics, Proteomics and Bioinformatics (2nd Edition) by A. Malcolm Campbell and Laurie J. Heyer , 2009, Pearson Education.
3. Principles of Proteomics by R.M.Twyman, Taylor & Francis group , 2004 BIOS Scientific Publishers.
4. Introduction to Bioinformatics by Arthur M. Lesk ,2008, Oxford University

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	L	T	P	C
Subject: Biophysical basis for Bioinformatics (BBI - 505)	**3**	**1**	**0**	**4**

UNIT-I
Physicochemical concepts in Biomolecular Studies: Definition and scope of biophysics, water as an unusual solvent, molecular structure and physicochemical properties of water. Acid and bases, concept of pH, measurement and calculation of pH, buffers and stability of their pH, buffer capacity, titration behavior and ionization equilibria of biomolecules, pK and pI values, stereoisomerism and optical activity in amino acids and sugars.

UNIT-II
Biophysical Aspects of Structural Organization of Biomolecules: Structural levels and physical configuration of proteins, Ramchandran plot and its significance, stabilizing forces and conformational properties of proteins, characteristics of protein folding, conformational properties and stabilizing forces of nucleic acids and their constituents, structural hierarchy in carbohydrates and lipid structures, concept and significance of macromolecular interactions in defining structure-function relationships, architecture of protein and nucleic acid assemblies.

UNIT- III
Biomembrane organization and transport: Principles of membrane organization and stability, various membrane models, components of cell membrane, membrane fluidity, mobility of membrane proteins, specialization of plasma membrane, transport across membrane, concepts and mechanisms of simple and facilitated diffusion, electrodiffusion, osmosis, osmotic pressure, osmotic equilibrium, electro osmosis, mechanism of active transport, selectivity and iron specificity of biomembranes, role valinomysin and gramicidin in iron transport, exocytosis and endocytosis.

UNIT- IV
Methods for Biophysical Characterization of Macromolecules: Production and properties of X-rays, principles of X-ray diffraction, Bragg's law, derivation of Bragg's equation, X-ray spectrometer, unit cell, reciprocal lattice concepts, Miller indicies and determination of crystal structure, crystallographic elucidation of Biomolecular structure, nature and significance of X-ray data for polypeptide and DNA. Principles of NMR spectrum, NMR spectrometer, chemical shift, spin-spin coupling, interpretation of NMR spectra, application of NMR in biomolecular characterization, ultracentrifugal analysis, sedimentation velocity, sedimentation equilibrium and density gradient centrifugal methods, principles and utility of UV-VIS, IR, Raman, CD and ORD spectra in biomolecular analysis, viscometric analysis of biomolecules.

UNIT- V
Methods for Biophysical Characterization of Cellular Systems: Principle and utility of compound, phase constrast, interference, fluorescence, polarizing, and transmission and scanning electron microscopes, CCD camera, flow cytometry, radioisotope tracer techniques, computer assisted semen analysis, NP completeness, polynomial time, polynomial time verification, NP completeness and reducibility, NP completeness proof, NP complete problems.

Recommended Books:

1. Introduction to algorithms by Thomas Coreman, Leisersons, Rivest.
2. Data structures using C and C++ by Andrew Tanenbum.
3. Computer Algorithms by Horowitz and Sahani.

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	L	T	P	C
Subject: Molecular Biology Laboratory (BBI - 551)	**0**	**0**	**2**	**2**

List of experiments:

1. Estimation of DNA content in the given sample by diphenylamine method.
2. Estimation of RNA content by the Orcinol method.
3. Isolation of Plasmid DNA.
4. Isolation of bacterial genomic DNA.
5. Isolation of plant DNA.
6. Isolation of fungal genomic DNA.

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	L	T	P	C
Subject: Data Structure & Algorithm (BBI - 601)	**3**	**1**	**0**	**4**

UNIT-I

Introduction to data structures, Abstract data types, Stacks - Introduction to stack & primitive operation on stack, Stack as an abstract data type, Stack's applications - Infix, post fix & Prefix expressions, Recursion, Multiple stacks Queues -Introduction to queues, Primitive Operations on the Queues, Queue as an abstract data type, Circular queue, Dequeue, Priority queue.

UNIT-II

Linked List - Introduction to the Linked List, Operation on Linked List, Linked List representation of stack and Queue,Header nodes. Types of Linked List - Doubly Linked List, Circular Linked List, Application of Linked List.

UNIT-III

Trees -Basic Terminology of Trees, Binary Trees, Tree Representations as Array & Linked List Binary tree representation, Traversal of binary trees - In order, Preorder & post order, Application of Binary tree, Threaded binary tree Balanced tree, AVL tree, B-tree, B+ & B* trees, Conversion of General Tree to Binary Tree, Counting Binary Trees, 2-3 Trees, algorithm for manipulating 2-3 Trees.

UNIT-IV

Searching - Sequential Searching, Binary search and their Comparison. Sorting - External & Internal sorting, Insertion sort, Selection sort, Quick sort, Bubble sort, Heap sort, Merge sort, Comparison of sorting methods Algorithms of sorting and searching in Linked list and Arrays.

UNIT–V

Tables - Hash table,Collision resolution Techniques. Graphs - Introduction to graphs, Basic Terminology, Directed, Undirected & Weighted graph, Representation of graphs, Warshall's algorithem for path matrix and shortest path Graph Traversals-Depth first & Breadth first search. Spanning Trees, minimum spanning Tree, The basic Greedy Strategy for computing Algorithm of Kruskal, and Prim Applications of Graphs : Shortest path and Longest Path Problems.

Recommended Books:

1. Fundamentals of data structure by *s. sawhney & e. horowitch*
2. Data structure by *tremblay & sorrenson*
3. Data structure *schaum's outline series, mcgraw hill publication*

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	L	T	P	C
Subject: Molecular Modeling (BBI - 602)	**3**	**1**	**0**	**4**

UNIT-I
Introduction to the concept of molecular modeling: Molecular structure and internal energy. Coordinate systems, Potential energy surfaces, local and global energy minima, Homology modeling, fold recognition and ab-initio approaches.

UNIT-II
Molecular Mechanics: general features, bond stretching, angle bending, improper torsions, out of plane bending, cross terms, non-bonded interactions, Ramachandran diagram point charges, calculation of atomic charges, polarization, van der waals interactions, hydrogen bond interactions, Water models, Force field, all atoms force field and united atom force field.

UNIT-III
Energy minimization: Steepest descent, conjugate gradient, Derivatives: First order steepest decent and conjugate gradients. Second order derivatives: Newton-Raphson, Minima, maxima, saddle points and convergence criteria. Non derivatives minimization methods: simplex and sequential univariative.

UNIT-IV
Simulation methods: Newton's equation of motion, equilibrium point, radial distribution function, pair correlation functions,

UNIT-V
MD methodology, periodic box, Solvent access, Equilibration, cutoffs, algorithm for time dependence; leapfrog algorithm, Verlet algorithm, Boltzmann velocity, time steps, duration of the MD run.

Recommended Books:

1. Andrew R.Leach Molecular Modelling Principles and applications. (2001) II ed . Prentice Hall.
2. Fenniri, H. "Combinatorial Chemistry –A practical approach",(2000) Oxford University Press, .
3. Lednicer, D. "Strategies for Organic Drug Discovery Synthesis and Design"; (1998) Wiley International Publishers.
4. Gordon, E.M. and Kerwin, J.F "Combinatorial chemistry and molecular diversity in drug discovery" (1998) Wiley-Liss Publishers.
5. Carl Branden and John Tooze and Carl Brandon Introduction to Protein Structure, (1991) John Garland, Publication Inc.

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	L	T	P	C
Subject: Enzymes and Metabolism (BBI - 603)	**3**	**1**	**0**	**4**

UNIT-I

An Introduction to enzymes, Enzymes and their classification, effect of enzyme on rate of reaction, Enzyme cofactors, prosthetic groups, coenzyme, holoenzyme, apoenzyme. Active site of enzyme.

UNIT-II

Different types of interactions between enzymes and substrate, enzyme substrate complex. Different types of enzyme catalysis e.g. Acid-Base catalysis, Covalent catalysis, Metal Ion catalysis.

UNIT-III

Mechalis-menten equation, turn over number, maximum velocity, steady state kinetics, different parameters for enzyme activities, specificity constant, transition state, Lineweaver-Burk equation.

UNIT-IV

Enzyme inhibition, study of reaction mechanism of chymotripsin and hexokinase, allosteric regulation of enzymes. Effect of temperature and pH on enzyme activity.

UNIT-V

Enzyme degradation, Allosteric enzymes, cooperativity activity of enzymes, difference between activity and specific activity. Various enzymes used in recombinant DNA technology. Various techniques used for measuring enzyme activity.

Recommended Books:

1. Enzyme Kinetics (1995) – Palmer, London: Portland Press
2. Enzyme Kinetics - Dixon , 1972, wiley publishers
3. Fundamental of Enzymology – Price & Steven , 1999-Bowker company
4. Enzyme Structure & Mechanism – Alan Fersht, 1985, W.H. Freeman
5. Enzyme Biotechnology – Tripathi, G, 2009- ABD Publishers.
6. .Industrial Enzyme & their Application (1998) –Uhlig, H.
7. Enzyme 3rd Ed. (1979) – Dixon M. & Webb, E.C.

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	L	T	P	C
Subject: Introduction to Perl Language (BBI - 604)	**3**	**1**	**0**	**4**

UNIT-I

Introduction to linux -Linux OS-Working Environment- editors-Navigation commands, File handling - creating and manipulating sequence files-text processing, System administration commands, Archival commands, process management networking and advanced commands.

UNIT-II

Introduction to perl - Data types, variables, operators, formatting of input/output, Array operations, Hashes, @ARGV, control structures and file handling, Debugging

UNIT-III

Perl subroutines and regular expressions - Builtin functions, subroutines, scoping of variables, Regular expressions-metacharacters and special operators, translation and substitution operators, pattern matching

UNIT-IV

Perl modules - OOP concepts in Perl, Packages, libraries and modules- basic modules - getopt::long, LWP, CWD, file::basename.

UNIT-V

Bioperl - Bioperl installation and applications, Bioperl modules- Databases, sequence retrieval & alignment, phylogentic tree construction, restriction enzyme analysis, mutation studies.

Recommended Books:

1. Programming Perl, (3rd ed), L. Wall, T. Christiansen, and J. Orwant, O'Reilly, 2000. The classic introduction to Perl.
2. Harshawardhan P Bal, "Perl Programming for Bioinformatics", Tata McGraw Hill, 2003. 2. James Lee, "Beginning Perl", Apress, 2004.
3. D. Curtis Jamison, "Perl Programming for Bioinformatics & Biologists", John Wiley & Sons, INC., 2004.
4. Michael Moorhouse, Paul Barry, "Bioinformatics Biocomputing and Perl", Wiley, 2004.

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	L	T	P	C
Subject: Introduction to Perl Language Laboratory (BBI - 651)	**0**	**0**	**2**	**2**

List of experiments:

1. Translate DNA to protein by using PERL module
2. Program to perform file handling, concatenation & string length
3. To perform matrix addition and multiplication
4. Generate Fibonacci series
5. To find greatest of 3 numbers
6. To check whether a number is a prime number or not
7. To perform GC count, chop, chomp & reverse compliment