Kalinga University Atal Nagar (C.G.)

SCHEME OF EXAMINATION
& SYLLABUS

of

B.S.C Bioinformatics

UNDER

Faculty of Science

w.e.f. Session 2021-22

Kalinga University, Naya Raipur
BSC.(Bioinformatics)
Scheme of Semester System Examination

Paper Code	SUBJECTS	Credit	Internal Marks	External Marks	Total
	First Semester				
	(Choose Any One) 101A/101B	2	15	35	50
BBI101A	English				
BBI101B	NCC				
BBI102	Basics of Biological Sciences	3	30	70	100
BBI103	Microbiology	3	30	70	100
BBI104	Introduction to Bioinformatics	3	30	70	100
BBI105	Fundamental of Information Technology	3	30	70	100
BBI106P	Basics of Biological Sciences-Lab	1	20	30	50
BBI107P	Microbiology-Lab	1	20	30	50
BBI108P	Introduction to Bioinformatics-Lab	1	20	30	50
BBI109P	Fundamental of IT-Lab	1	20	30	50
	Total	**18**	**215**	**435**	**650**

Paper Code	SUBJECTS	Credit	Internal Marks	External Marks	Total
	Second Semester				
	(Choose Any One) 201A/201B	2	15	35	50
BBI201A	Environmental Science				
BBI201B	NCC				
BBI202	Basics of Biochemistry	3	30	70	100
BBI203	Basics of Cell Biology	3	30	70	100
BBI204	Basics of Genetics	3	30	70	100
BBI205	Bio-programming using C Language	3	30	70	100
BBI206P	Basics of Biochemistry-Lab	1	20	30	50
BBI207P	Basics of Cell Biology-Lab	1	20	30	50
BBI208P	Basics of Genetics-Lab	1	20	30	50
BBI209P	Bio-programming using C Language-Lab	1	20	30	50
	Total	**18**	**215**	**435**	**650**

Third Semester					
Paper Code	**SUBJECTS**	**Credit**	**Internal Marks**	**External Marks**	**Total**
BBI301	Molecular Biology	3	30	70	100
BBI302	Soft Skills and Personality Enhancement	3	30	70	100
BBI302	Biodiversity and Phylogenetics	3	30	70	100
BBI304	Programming in Perl	3	30	70	100
	SEC Elective-I (Any One)	3	30	70	100
BBI305A	Metagenomics				
BBI305B	Advance Bioprogramming				
BBI306P	Molecular Biology-Lab	1	20	30	50
BBI307P	Biodiversity and Phylogenetics-Lab	1	20	30	50
BBI308P	Programming in Perl-Lab	1	20	30	50
Total		**18**	**210**	**440**	**650**

Fourth Semester					
Paper Code	**SUBJECTS**	**Credit**	**Internal Marks**	**External Marks**	**Total**
BBI401	Basics of Immunology	3	30	70	100
BBI402	Biochemical Techniques	3	30	70	100
BBI403	Biological Database Management	3	30	70	100
BBI404	Object oriented Programming	3	30	70	100
	SEC Elective-II (Any One)	3	30	70	100
BBI405A	Analytical Techniques for Bioinformatics				
BBI405B	Immuno informatics				
BBI406P	Basics of Immunology-Lab	1	20	30	50
BBI407P	Biochemical Techniques-Lab	1	20	30	50
BBI408P	Biological Database Management-Lab	1	20	30	50
BBI409P	Object oriented Programming-Lab	1	20	30	50
Total		**19**	**230**	**470**	**700**

* Student has to undergo for Internship Assessment completion of 4th Semester which is to be evaluated in 5th Semester

Fifth Semester					
Paper Code	SUBJECTS	Credit	Internal Marks	External Marks	Total
BBI501	Genetic Engineering	3	30	70	100
BBI502	Computational Structural Biology	3	30	70	100
BBI503	Chemo informatics	3	30	70	100
BBI504	Programming in JAVA	3	30	70	100
	SEC Elective-III (Any One)	3	30	70	100
BBI505A	Molecular Interactions				
BBI505B	Introduction to Biosensor				
BBI506P	Genetic Engineering-Lab	2	20	30	50
BBI507P	Computational Structural Biology-Lab	2	20	30	50
BBI508P	Chemo informatics-Lab	2	20	30	50
BBI509P	Programming in JAVA-Lab	2	20	30	50
BBI510P	Industrial Training Evaluation	2	30	70	100
	Total	**25**	**260**	**540**	**800**

Sixth Semester					
Paper Code	SUBJECTS	Credit	Internal Marks	External Marks	Total
BBI601	Concept of Genomics	3	30	70	100
BBI602	Concept of Proteomics	3	30	70	100
BBI603	Metabolomics	3	30	70	100
	SEC Elective-IV (Any One)	3	30	70	100
BBI604A	Microbial Informatics				
BBI604B	Scientific writing and Statistics				
	Departmental Elective (Any One)	3	30	70	100
BBI605A	Drug and Molecular Modelling				
BBI605B	Advanced Techniques in Bioinformatics				
BBI605C	Visual Basic and PHP				
BBI605D	Biochemical and Molecular Biology Methods				
BBI605E	Biodiversity, Agriculture, Ecosystem and Environment				
BBI606P	Concept of Genomics-Lab	1	20	30	50
BBI607P	Concept of Proteomics-Lab	1	20	30	50
BBI608P	Metabolomics-Lab	1	20	30	50
BBI609P	Project Work	4	50	150	200
	Total	**22**	**260**	**590**	**850**

BSC(Bioinformatics)
Semester-I

English
(BBI101A)

Course Objective

The purpose of this course is to introduce students to the theory, fundamentals and tools of communication and to develop in them vital communication skills which should be integral to personal, social and professional interactions. One of the critical links among human beings and an important thread that binds society together is the ability to share thoughts, emotions and ideas through various means of communication: both verbal and non-verbal. In the context of rapid globalization and increasing recognition of social and cultural pluralities, the significance of clear and effective communication has substantially enhanced.

CONTENTS

Unit I: Introduction: 06

Theory of Communication, Types and modes of Communication, *Mediums and channels of communication, barriers to* communication, English as a Global language, the Lingua Franca, Social influences on English

Unit II: Language of Communication: 06

Verbal and Non-verbal (Spoken and Written) Personal, Social and Business Barriers and Strategies Intra-personal, Inter-personal and Group communication, *Varieties of English, Language, Accent, Dialect, Colloquialism, Historical influences on English*

Unit III: Speaking Skills: 06

Monologue Dialogue Group Discussion Effective Communication/ Mis- Communication Interview Public Speech, *Regional influences on English, Convergence and divergence, Linguistic Imperialism,*

Unit IV: Reading and Understanding-   **06**

Close Reading, *Reading analysis of a text - Audience and purpose, Content and theme, Tone and Mood, stylistic devices, structure* Comprehension- Analysis and Interpretation Translation(from Indian language to English and vice-versa) Literary/Knowledge Texts

Unit V: Writing Skills   06

Documenting Report Writing Making notes Letter writing, *Writing tabloids, diary entry, open letters, essays, newsletter and magazine articles, skits, short stories, impersonating characters*

Course outcome:

It will enhance Language of communication, various speaking skills such as personal communication, social interactions and communication in professional situations such as interviews, group discussions and office environments, important reading skills as well as writing skills such as report writing, notetaking etc. While, to an extent, the art of communication is natural to all living beings, intoday's world of complexities, it has also acquired some elements of science. It is hoped that after studying this course, students will find a difference in their personal and professional interactions.

Recommended Readings:

1. Fluency in English - Part II, Oxford University Press, 2006.
2. Business English, Pearson, 2008.
3. Language, Literature and Creativity, Orient Blackswan, 2013.
4. Language through Literature (forthcoming) ed. Dr. Gauri Mishra, Dr Ranjana Kaul, Dr Brati Biswas

Basics of Biological Sciences
(BBI102)

Unit-I: Evolution of life:

Prebiological chemical evolution, Diversity of living world, Whittaker's Five Kingdom System, Classification up to genus & species level, Brief account of Prokaryotic & eukaryotic cell.

Unit-II: Introduction to Plant World

Lower plants Algae-oodogonium,Bryophytes-Funaria, Pteridophyte-Equisetum, Gymnosperms-Pinus

Unit-III:Higher plants. Monocot-Maize, dicot-Sunflower, Morphological Differences in Monocots & Dicots, Flower- parts and their functions, Inflorescence- Types (Racemose & Cymose), Embryo structure & Seed- Structure.

Unit-IV: Brief Introduction to Animal world

Gamatogenesis, reproductive cycles, fertilization, Placentation in mammals, gestation, Partuition & lactation in mammals.

Reference Books:

- Botany for Degree Students- Vasitha- S. Chand Publication
- College Botany- B.P. Pandey- S.Chand
- Botany by –A.C. Dutta- Oxford
- A textbook of botany Volume I & II- Niranjan Shrotriya & Archna Shrotriya
- Botany for degree students Algae, bryophytes, pteridophytes, Gymnosperm, angiosperms-B.R. Vashishta.
- A textbook of Botany Volume I & II- S.N. Pandy, P.S. Trivedi &

Basics of Biological Sciences-Lab
(BBI106P)

Practical:

- Morphological study of monocots & dicots.
- Study of flower, inflorescences
- Study of eukaryotic and prokaryotic cells
- Observation of permanent slides of anther.
- Observation of permanent slides of ovule
- Observation of permanent slides of , embryo sac
- Observation of permanent slides of embryo
- Observation of permanent slides of endosperm.

Microbiology
(BBI103)

Unit-I: Bacteria

Structure of bacterial cell, Bacterial types, Nutrition, Reproduction & growth curve Transformation, Transduction and conjugation,

Unit-II: Fungi

General characteristics of fungi, Ultrastructure of typical fungal cell, hyphae structure, Nutrition (Saprophyte, parasitic, Symbiotic), Reproduction, Meiotic & Mitotic spores, dormancy population and colonization, effect of environment on growth, prevention of fungal growth. Types study-Yeast, Agaricus.

Unit-III: Virus Biology of viruses, Bacteriophages, Replication of Virus, genome, General properties of virus: Morphology, Classification and Nomenclature of virus, Virus cell interactions.

Unit-IV: Lichens Types or forms, external and internal structure, economical importance.

Reference Books:

- General Microbiology- Powar and Daginawala- Himalay Publication
- A textbook of Microbiology- R.C. Dubey and D.K. Maheshwari
3. An Introduction to Mycology- K.R.Aneja- New Age
4. An Introduction to Fungi- H.C. Dubey- Vikas
5. Fungi for Degree Students- Vashist- S.Chand
6. Microbiology- Pelczar- Tata McGraw Hill
7. An Introduction to Viruses- Biswas- Vikas
8. Viruses and Plant Diseases- Mishra- DPH

Microbiology-Lab
(BBI107P)

- General Rules and Safety in Microbiology Laboratory.
- Study of basic requirements in
  Microbiology Laboratory i)
  Autoclave ii) Hot air oven iii)
  Incubator
- Isolation of microorganisms from soil, water and air.
- Simple staining & Gram staining
- External and internal structure of Yeast and Agaricus.
- Types of lichens

Introduction to Bioinformatics
(BBI104)

Unit -I: Introduction to Bioinformatics : Various definitions of bioinformatics, history of bioinformatics, applications of bioinformatics, scope of bioinformatics, bioinformatics in business. Introduction to central dogma of molecular biology.

Unit -II: Internet and Bioinformatics : General purpose search engine: Google, Biological search engine: Entrez, SRS. What is Database? Types of Databases Biological databases: Primary databases – GenBank, DDBJ, EMBL. Protein sequence databases – Swissprot, Uniprot, TrEMBL, PIR-PSD, PRINTS. Structural databases – PDB, NDB, PubChem, ChemBank, CCSD. Bibliographic databases:-Pubmed, PMC, PloS. citeXplore.

Unit -III: Biological data mining and Human Genome Project : Introduction: Fundamentals of data mining, Data Mining Functionalities, Classification of Data Mining systems, applications of data mining. The Human Genome Project, Bioinformatics and Human diseases.

Unit -IV: Problem Solving in Bioinformatics : Genomic analysis for DNA sequence, genomic analysis for protein sequence, strategy and options for similarity searches, structure prediction, illustration some problems and solution

Unit -V: Introduction to advance fields of Bioinformatics : Genomics, Proteomics, Transcriptomics,Metabolomics,Metagenomics,Nutricogenomics,Proteinengineering,Comparative Genomics, Pharmacogenomics, Pharmacogenetics, Rational Drug Designing, CADD.

Reference Books:-
1.   Bioinformatics Concepts Skills and Application-S.C. Rastogi- PHI
2.   Essentials of Bioinformatics-Jin Xion- Cambridge
3.   Introduction to Bioinformatics- Attwood & Parry Smith- Pearson
4.   Bioinformatics-CSV Murthy-Himalaya
5.   Introduction to Bioinformatics- Arthur M. Lesk, - Oxford University
6.   Bioinformatics Computing- Bergeron- PHI
        Discovering Genomics Proteomics and Bioinformatics- Campbell, Heyer-
        Pearson
7.   Data mining: Introductory and advanced-Margeret H. Dunham- IE
        publisher

Introduction to Bioinformatics-Lab
(BBI108P)

1. Use of different browsers, search engines for desired data retrieval
2. Study of major bioinformatics companies in India and overseas
3. Study of products produced by major bioinformatics firms using biological data analysis in Health (Diagnosis, Vaccines, Therapeutics) Agriculture, Environment etc
4. Explore the sitemap of NCBI. Study the resources available on NCBI.
5. Study format of Genbank entry data retrieval from Genbank
6. Retrieve the Genbank entry with Specific accession number
7. Retrieve and save only the coding sequence of the entry AF375082 in FASTA format.
8. Retrieving Protein sequences from protein database
9. Visit and report on bioinformatics research institute/ company

Paper Code. (BBI105)
Fundamentals of IT
Objectives: This is a basic course for commerce students to familiarize with computer And it's applications in the relevant fields and exposes them to other related courses of IT.

Unit No.	Details
1	**1.1 Introduction to Computers:** 1.1.1 The evolution of computers – Computer Generation 1.1.2 Classifications of Computers – 1.1.3 Micro 1.1.4 Mini, 1.1.5 Mainframe 1.1.6 Super Computers 1.1.7 Distributed Computer System 1.1.8 Parallel Computers 1.1.9 Computer Hardware – Major Components of a Digital Computer 1.1.10 Block Diagram of Computer 1.1.11 Input devices 1.1.12 Output devices 1.1.13 Description of Computer IPO Cycle 1.1.14 CPU **1.2 Computer Memory:** 1.2.1 Memory Types, 1.2.2 Units of memory 1.2.3 Read Only Memory, 1.2.4 Random Access Memory, 1.2.5 Serial Access Memory, 1.2.6 Physical Devices Used to construct Memories, 1.2.7 Hard disk, 1.2.8 Floppy Disk Drives, 1.2.9 CD, DVD, Flash Drives, 1.2.10 Magnetic Tape Drives.
2	**2.1 Number System:** 2.1.1 Decimal, 2.1.2 Binary, 2.1.3 Octal, 2.1.4 Hexa-decimal. 2.1.5 Conversion - Decimal to all other number systems, 2.1.6 Binary to octal and Hexa Decimal, **3.1 Computer Software:** 3.1.1 System software, 3.1.2 Operating Systemconcepts, 3.1.3 Different types of operating systems, 3.1.4 Assemblers, 3.1.5 Compilers, 3.1.6 Interpreters, 3.1.7 linkers, 3.1.8 Application Software, 3.1.9 Firmware Software,
3	**3.1 Introduction of Internet and Objectives** **3.2 Basic of Computer Networks** 3.2.1 Local Area Network (LAN) 3.2.2 Wide Area Network (WAN) **3.3 Internet**

	3.3.1 Concept of Internet
	3.3.2 Applications of Internet
	3.3.3 Connecting to the Internet
	3.3.4 Troubleshooting
	3.4 World Wide Web (WWW)
	3.5 Web Browsing Software
	    3.5.1 Popular Web Browsing Software
	3.6 Search Engines
	    3.6.1 Popular Search Engines / Search for content
	    3.6.2 Accessing Web Browser
	    3.6.3 Using Favorites Folder
	    3.6.4 Downloading Web Pages
	    3.6.5 Printing Web Pages
	3.7 Understanding URL
	3.8 Surfing the web
	    3.8.1 Using e-governance website

4	**4.1 Word Processor:**
	    4.1.1 Word Processor and its features,
	    4.1.2 Editing of Text,
	    4.1.3 Find and Replace,
	    4.1.4 Bullets and Numbering,
	    4.1.5 Spell Checker,
	    4.1.6 Grammar Checker,
	    4.1.7 Auto Correct,
	    4.1.8 Auto Complete,
	    4.1.9 Auto Text,
	    4.1.10 Header and footer,
	    4.1.11 tables,
	    4.1.12 mail merge,
	    4.1.13 border and shading,
	    4.1.14 page setup,
	    4.1.15 Printing.
	4.2 Spread sheet:
	    4.2.1 Spread sheet and its features,
	    4.2.2 Entering Information in Worksheet,
	    4.2.3 Editing Cell Entry,
	    4.2.4 Moving and Copying Data,
	    4.2.5 deleting or Inserting Cells,
	    4.2.6 Rows and Columns,
	    4.2.7 Custom
	    4.2.8 Numeric Formats,
	    4.2.9 Using Formulas and functions,
	    4.2.10 Creating charts.

5	**5.1 Presentation Software**
	    5.1.1. Presentation Software and its uses,
	    5.1.2. steps for creating PowerPoint Presentation,
	    5.1.3. PowerPoint Views,
	    5.1.4. Assigning Slide Transitions,
	    5.1.5. Using Preset Animations,
	    5.1.6. Hiding Slides,
	    5.1.7. Slide Show,
	    5.1.8. Controlling the Slide Show with a Keyboard,
	    5.1.9. Setting Slide Show Timings.

Text Books:
1. Alex Leon & Mathews Leon, "Fundamentals of Information Technology", LeonTechworld, 1999.
2. Vikas Gupta, "Comdex Computer Kit", Wiley Dreamtech, Delhi, 2004
3. P. K. Sinha &PritiSinha , "Computer Fundamentals", BPB Publications, 1992.

Reference Books:
1. V. Raja Raman, "Introduction to Computers", PHI, 1998.
2. Alex Leon & Mathews Leon, "Introduction to Computers", Vikas Publishing House, 1999.
3. Norton Peter, "Introduction to computers", 4th Ed., TMH, 2001.

Paper Code. (BBI109-P)
Fundamentals of IT-Lab

Objectives: This is a basic course for Commerce students to familiarize with computer and it's applications in the relevant fields and exposes them to other related courses of IT.

	Details
	MS-WORD
	1. Text Manipulations
	2. Usage of Numbering, Bullets, Tools and Headers
	3. Usage of Spell Check and Find and Replace
	4. Text Formatting
	5. Picture Insertion and Alignment
	6. Creation of Documents Using Templates`
	7. Creation of Templates
	8. Mail Merge Concept
	9. Copying Text and Picture From Excel
	10. Creation of Tables, Formatting Tables
	11. Splitting the Screen
	12. Opening Multiple Document, Inserting Symbols in Documents
	MS-EXCEL
	1. Creation of Worksheet and Entering Information
	2. Aligning, Editing Data in Cell
	3. Excel Function (Date, Time, Statistical, Mathematical, Financial Functions)
	4. Changing of Column Width and Row Height (Column and Range of Column)
	5. Moving, copying, Inserting and Deleting Rows and Columns
	6. Formatting Numbers and Other Numeric Formats
	7. Drawing Borders Around Cells
	8. Creation of Charts Raising Moving
	9. Changing Chart Type
	10. Controlling the Appearance of a Chart
	MS -POWER POINT
	Working With Slides
	1. Creating, saving, closing presentation
	2. Adding Headers and footers
	3. Changing slide layout
	4. Working fonts and bullets
	5. Inserting Clip art: working with clipart,
	6. Applying Transition and animation effects
	7. Run and Slide Show

BSC(Bioinformatics)
Semester-II
Environmental Science
(BBI201A)

Unit : Introduction to Environmental Studies (6 Lecture)

- Multidisciplinary nature of environmental studies;
- Scope and importance; Concept of sustainability and sustainable development.

Ecosystems

- What is an ecosystem? Structure and function of ecosystem; Energy flow in an ecosystem: food chains, food webs and ecological succession. Case studies of the following ecosystems :
  a) Forest ecosystem
  b) Grassland ecosystem
  c) Desert ecosystem
  d) Aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries)

Unit 2 : Natural Resources : Renewable and Non---renewable Resources (6 Lecture)

- Land resources and landuse change; Land degradation, soil erosion and desertification.
- Deforestation: Causes and impacts due to mining, dam building on environment, forests, biodiversity and tribal populations.
- Water : Use and over---exploitation of surface and ground water, floods, droughts, conflicts over water (international & inter---state).
- Energy resources : Renewable and non renewable energy sources, use of alternate energy sources, growing energy needs, case studies.

Unit 3 : Biodiversity and Conservation (5 Lecture)

- Levels of biological diversity : genetic, species and ecosystem diversity; Biogeographic zones of India; Biodiversity patterns and global biodiversity hot spots
- India as a mega---biodiversity nation; Endangered and endemic species of India
- Threats to biodiversity : Habitat loss, poaching of wildlife, man---wildlife conflicts, biological invasions; Conservation of biodiversity : In---situ and Ex---situ conservation of biodiversity.
- Ecosystem and biodiversity services: Ecological, economic, social, ethical, aesthetic and Informational value.

Unit 4 : Environmental Pollution (9 Lecture)

- Environmental pollution : types, causes, effects and controls; Air, water, soil and noise pollution
- Nuclear hazards and human health risks
- Solid waste management : Control measures of urban and industrial waste.
- Pollution case studies.

Environmental Policies & Practices

- Climate change, global warming, ozone layer depletion, acid rain and impacts on human communities and agriculture

- Environment Laws: Environment Protection Act; Air (Prevention & Control of Pollution) Act; Water (Prevention and control of Pollution) Act; Wildlife Protection Act; Forest Conservation Act. International agreements: Montreal and Kyoto protocols and Convention on Biological Diversity (CBD).
- Nature reserves, tribal populations and rights, and human wildlife conflicts in Indian context.

Unit 5 : Human Communities and the Environment (4 Lecture)
- Human population growth: Impacts on environment, human health and welfare.
- Resettlement and rehabilitation of project affected persons; case studies.
- Disaster management : floods, earthquake, cyclones and landslides.
- Environmental movements : Chipko, Silent valley, Bishnois of Rajasthan.
- Environmental ethics: Role of Indian and other religions and cultures in environmental conservation.
- Environmental communication and public awareness, case studies (e.g., CNG vehicles in Delhi).

Suggested Readings:

1. Carson, R. 2002. *Silent Spring*. Houghton Mifflin Harcourt.
2. Gadgil, M., & Guha, R.1993. *This Fissured Land: An Ecological History of India*. Univ. of California Press.
3. Gleeson, B. and Low, N. (eds.) 1999.*Global Ethics and Environment*, London, Routledge.
4. Gleick, P. H. 1993. *Water in Crisis*. Pacific Institute for Studies in Dev., Environment & Security. Stockholm Env. Institute, Oxford Univ. Press.
5. Groom, Martha J., Gary K. Meffe, and Carl Ronald Carroll.*Principles of Conservation Biology*. Sunderland: Sinauer Associates, 2006.
6. Grumbine, R. Edward, and Pandit, M.K. 2013. Threats from India's Himalaya dams. *Science,* 339: 36---37.
7. McCully, P. 1996. *Rivers no more: the environmental effects of dams*(pp. 29---64). Zed Books.
8. McNeill, John R. 2000. Something New Under the Sun: An Environmental History of the Twentieth Century.
9. Odum, E.P., Odum, H.T. & Andrews, J. 1971.*Fundamentals of Ecology*. Philadelphia: Saunders.
10. Pepper, I.L., Gerba, C.P. & Brusseau, M.L. 2011. Environmental and Pollution Science. Academic Press.
11. Rao, M.N. & Datta, A.K. 1987. *Waste Water Treatment*. Oxford and IBH Publishing Co. Pvt. Ltd.
12. Raven, P.H., Hassenzahl, D.M. & Berg, L.R. 2012.*Environment*. 8th edition. John Wiley & Sons.
13. Rosencranz, A., Divan, S., & Noble, M. L. 2001. *Environmental law and policy in India. Tripathi 1992*.
14. Sengupta, R. 2003. *Ecology and economics*: An approach to sustainable development. OUP.
15. Singh, J.S., Singh, S.P. and Gupta, S.R. 2014. *Ecology, Environmental Science and Conservation*. S. Chand Publishing, New Delhi.
16. Sodhi, N.S., Gibson, L. & Raven, P.H. (eds). 2013. *Conservation Biology*: *Voices from the Tropics*. John Wiley & Sons.
17. Thapar, V. 1998. *Land of the Tiger*: *A Natural History of the Indian Subcontinent*.
18. Warren, C. E. 1971. *Biology and Water Pollution Control*. WB Saunders.
19. Wilson, E. O. 2006.*The Creation: An appeal to save life on earth*. New York: Norton.
20. World Commission on Environment and Development. 1987.*Our Common Future*. Oxford University Press.

Basics of Biochemistry
(BBI202)

Unit I: Introduction

Concept of Atom, Molecule, Biological molecules, molecular interaction as a basis of biological functions, Chiral interactions, Concept of Acid & Base, pH, pK, Buffers.

Unit II: Carbohydrates & Lipids

Definition, classification, structure, simple and complex carbohydrates, polysaccharides: structure and linkages in di and polysaccharides, glycoprotein, glycolipids, biological role of carbohydrates

Lipids: structure of fatty acid, classification of lipids, properties & Role of lipids, lipoprotein

Unit III: Amino Acids

Classification, Structure and properties of amino acids, peptides, peptide bond, types of peptides, biologically important peptides.

Unit IV: Protein and Enzymes

Classification of Proteins, Protein family, Structural level of protein, primary, secondary, tertiary and quaternary structure with examples Introduction, classification and nomenclature of enzymes, types of enzymes, Biological role of Enzymes

Unit V: Nucleic Acids

Nucleoside, Nucleotides, Structures of nucleic acids; DNA & RNA. Forms of DNA, Types of RNA. Properties and biological Role of Nucleic Acids.

Reference Books:

1. Lehniger Biochemistry- Kalyani Publication
2. Biochemistry- Powar & Chatawal- Himalaya
3. Biochemistry- Rastogi- Tata Mcgraw Hill
4. Biochemistry- U. Satyanarayana & Chakrapani- New Age
5. Biochemistry- J.L Jain- S.Chand
6. Fundamentals of Biochemistry- A.C. Deb- Central publication
7. General Biochemistry- J.H. Weil- New Age

Basics of Biochemistry-Lab
(BBI206P)

General and Safety Rules of Laboratory
1. Study and care of glassware, instruments, planning and recording of experiment
2. Introduction to measurements, balance, burette, pipette, Standard flasks etc
3. Preparation of Standard solutions – Molar, Molal, Normal, Percent.
4. Identification of Bio molecules by Spot test.
5. Study of Lambert Beer's Law
6. Estimation of Carbohydrate by DNS Reagent.
7. Estimation of Protein by Biuret method.
8. Study of principle and working of pH meter and Standard Buffers.
9. Study and preparation of Distilled water.

Basics of Cell Biology
(BBI203)

Unit I: Introduction

Life, Stanley Miller Experiment, Principles and and Electron), Introduction to Prokaryotic and Diversity of cell size and shape, cell theory, Origin of applications of different types of microscopes (Light Eukaryotic Cell

Unit II: Cell Structure and Organization

Biological membrane, Structure organization, Membrane proteins, lipids. Structure and functions of Cell wall, Nucleus (Nuclear membrane, Nucloplasm, Nucleolus, Choromosomes) Endoplasmic Reticulum, Golgi Apparatus, Lysosomes, Microbodies: Glyoxisome, Peroxisomes, Mitochondria, Chloroplast, Ribosomes, Cytoskeleton: Microtubules, Microfilament, intermediate filaments, Cilia, Flagella, and Melanosome etc

Unit III: Membrane Transport

Transport across cell membrane, Simple diffusion, Passive transport, Active Transport. Na / K ion Channel, Ca ion channel, Vesicular transport. Events of electron transport chain, ATP Synthesis photosynthesis and photorespiration,

Unit IV: Cell Division, Cell Cycle and Cell Signaling

Cell cycle, General events at Mitosis and Meiosis, Cell-cell interactions, G protein coupled receptor, Brief introduction of concept of Cancer and Stem cells

Text and Reference:
1. Cell biology -C. B.Powar; - Himalaya Pub
2. Cell Biology –V.K. Agarwal- S. Chand
3. General Microbiology- Powar & Daginawala- Himalaya
4. Cell Biology, Genetics, Molecular Biology, Evolution & Ecology- Verma, Agarwal- S. Chand
5. Cell and Molecular Biology - Gerald Karp- John Willey
6. Cytology- Verma Agrawal- S. Chand
7. The World of The Cell-Becker- Person
8. Molecular cell Biology - Darnell, Lodish, Baltimore- WH Freeman
9. Cell Biology- David Sadava- Panima
10. Molecular Biology of The Cell- Albert Bruce- Garland Science

Basics of Cell Biology-Lab
(BBI207P)

Practicals:

(I) Microscopic observation & study of different types of Cells
(II) Study of Osmosis (RBC's/ Chicken Egg/ Potato)
(III) Sub cellular fractionation and isolation of organelles (Mitochondria, Chloroplast)
(IV) Study of Mitosis
(V) Study of Meiosis
(VI) Study of Polytene Chromosome
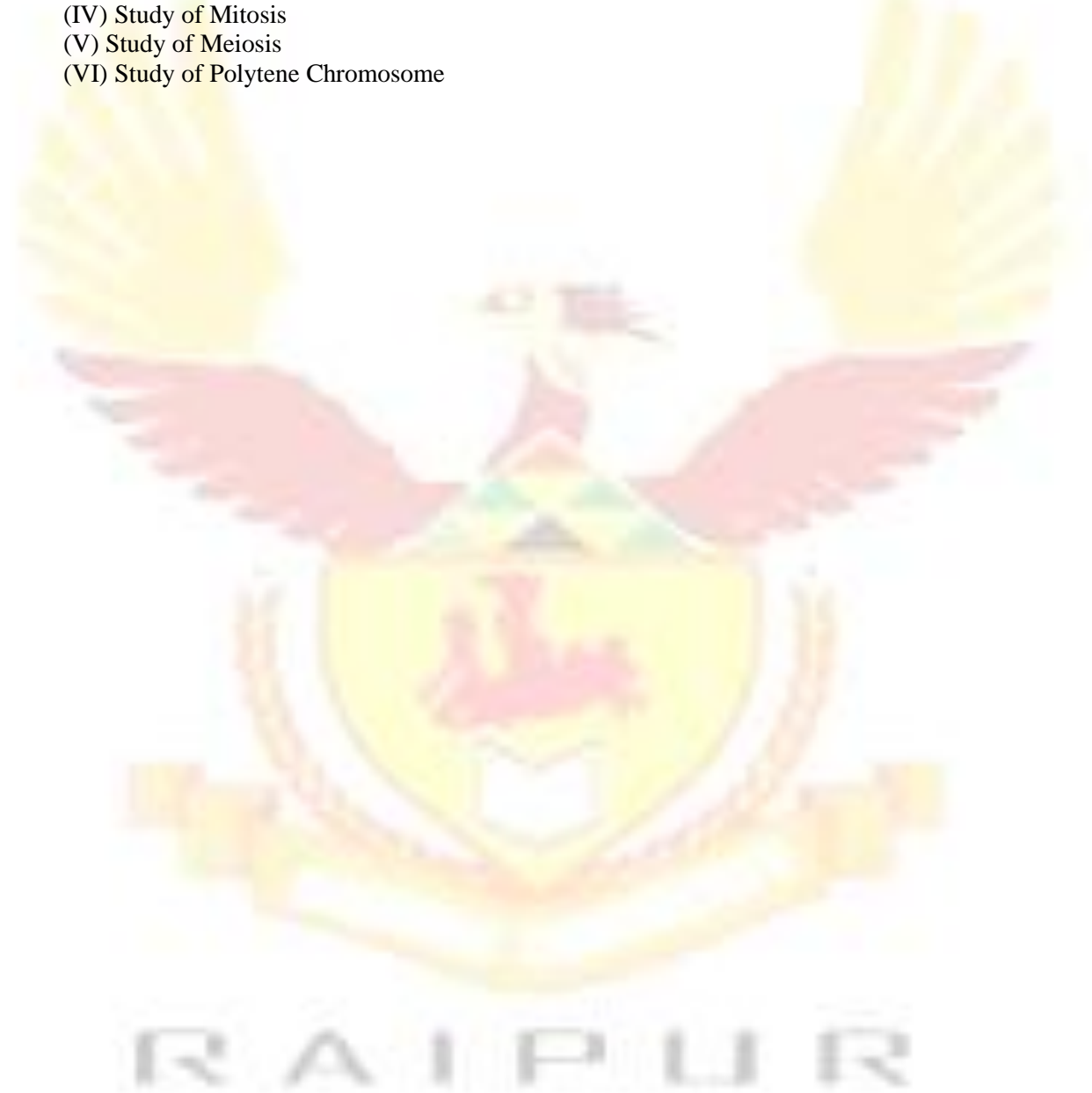
Basics of Genetics
(BBI204)

UNIT-I: Classical Genetics

Mendelian laws of Inheritance, Test cross & back cross , interaction of genes for monohybrid & dihybrid, Multiple alleles, Linkage& crossing over, its types & significance , lethality, scope & significance of genetics.

UNIT-II: Human Genetics

Sex Linkage, sex limited inheritance, sex linked diseases (any two),Anomalies in sex chromosomes, Anomalies of autosomes: Hereditary defects- Kleinefelter Turner , Cri-du-Chat & Down syndromes.

UNIT-III: Basic Microbial genetics

Conjugation, Transformation Transduction & their use in genetic mapping. Gene Concept. Classical & modern gene concepts. Structure of Chromosome, types of chromosomes. Euchromatin & heterochromatin. Polytene & Lampbrush chromosome.

UNIT-IV: Mutation

Mutations-spontaneous & induced; chemical &: Physical mutagens; induced mutation in plants, animals & microbes for economic benefit of man. Gamma garden, parthenocarpy, Structural & numerical aberrations involving chromosomes; evolution in plants (two or three examples) mutation.

UNIT-V: Population Genetics

Gene pool, Gene frequency & genotypic frequency. Population genetics Hardly-Weinberg equilibrium, gene & genotypic frequencies. Cytological inheritance. Cytoplasmic Male Sterility.

Text & References:
1. Concepts of genetics -William S. Klug & Michael R, Cummings, Person Education.
2. Genetics, -Strickberger, Prentice Hall College Division.
3. Microbial Genetics- Friefelder- Narosa Publication
4. Principles of Genetics- E.J. Gardner, John W.H. Sons Inc.
5. Genetics, R. Good enough International Thomson Publishing.
6. Genetics- Arora-Himalaya Publication
7. Principles of Genetics, D.P. Suntan & M.J. Simmons, John Wiley & Sons Inc.
8. Molecular Biology of Gene - J.D. Watson, Weiner & Hopkins, Addison-Wesly
9. Genetics, P.K. Gupta, Rastogi Publication.
10. Genetics- Verma & Agrawal- S. Chand

Basics of Genetics-Lab
(BBI208P)

1. Two examples each on Dihybrid & Monohybrid cross.
2. One example each on interaction of genes.
3. Two examples on Hardy Weinberg law.
4. Study of Karyotype.
5. Study of Human blood group.
6. Observe sex linked characters in tabulation from surroundings human population
7. Study of polytene chromosome.
8. Study of Human Traits

Bioprogramming using C Language
(BBI205)

Unit I: Introduction to C

The character set, constants, variables and keywords, types of constants, types of C variables, C keywords, C Instructions: - Type declaration instruction, arithmetic instruction, and integer and float conversion, types conversions in assignment, hierarchy of operations, storage classes and their scope rules.

Unit II: Control Structure in C

Decision control statement: if statement, use of logical operation, decisions using switch, Looping statement: for, while, do while, the break, continue, go to statement. **Arrays** What are arrays, arrays initializations, bounds checking, passing array elements to a function, initializing
a 2-dimensional array.

Unit III: Functions

What is function, Arguments and local variables, returning function results, default return type and the type void passing values between function, declaration of function type, recursion, function with variables arguments.

Character String

What are strings, standard library string functions: strlen ( ), strcpy ( ), strcat ( ), strcmp( )

Unit IV: Structures and Unions

Declaring structures, initializing structures, structure variables, accessing structure elements, arrays of structures, functions and structures, structures within structures, introduction to union. difference between structure and union. **Pointers:** Introduction to Pointers, Operations on Pointers, Pointers and Functions, Pointers and Arrays.

Unit V: Input /Output in C

Console I/O functions: - printf(), scanf(), getch(), getchar(), putchar(), gets(), puts(). Disk I/O functions :- High level file I/O or standard functions fopen(), fclose(), fgets(), fputs(), fread(), fwrite(), fseek(), feof(), fflush(), Use of command line arguments.

Reference Books:-

1. Let us C - Yeshwant kanetkar – BPB Publication
2. Programming in ANSI C - E. Balagurusamy -TATA Macgraw hill
3. Turbo C/C++ - The complete reference - H. Schildt

Bioprogramming using C Language-Lab
(BBI209P)

1. Basic operations
2. Decision and loop control structure
3. Arrays
4. Functions
5. Character strings
6. Pointers
7. Structure and unions
8. Input/ Output functions
9. Command line argument
10. File handling

BSC(Bioinformatics)
Semester-III
Molecular Biology
(BBI301)

Unit 1: DNA structure, replication & repair.

DNA structure: Structure of DNA, Properties of DNA, Cot curve DNA replication: Replication in prokaryotic and eukaryotic cells, models mechanism of DNA replication, Enzymes involved in DNA replication – Primosome, Replisome, Topoisomerase, DNA polymerase, SSBP & Ligase. DNA Repair- Direct repair – Photo Reactivation, Excision, mismatch, Recombination repair, SOS repair.

Unit 2: Transcription and RNA processing

Transcription in Prokaryotes: Initiation, Elongation & Termination. Structure of RNA polymerase, Role of sigma factor, Promoter. Transcription in Eukaryotes: Initiation, Elongation & Termination. Upstream & downstream Promoters, Enhancer. RNA Polymerase I, II & Co & Post transcriptional modification in m-RNA- 5'capping, Intron Splicing, polyadynylation. RNA processing & Transport.

Unit 3: Translation

Prokaryotic and Eukaryotic- Mechanism, initiation, elongation, termination. Co & post translational modifications in proteins, Heat shock proteins, Chaperons & Chaperonins. Properties of genetic code, Role of mRNA, tRNA, rRNA.

Unit 4: Regulation of gene expression

Regulation of transcription in prokaryotes, Operon concept, trp-operon, Lac-operon, Ara-operon.

Reference Books:
1.   Upadhya- Molecular Biology- Himalaya pub.
2.   Watson – Molecular biology of gene- Pearson pub.
3.   David Freifelder- Microbial Genetics – Narosa Pub.
4.   David Freifelder– Molecular Biology – Narosa pub.
5.   Gardner – Principals of Genetics – Wiley international pub.
6.   Albert Bruce- Molecular biology of the cell- garland science.
7.   Loddish - Molecular cell biology – W-H. freeman
8.   Lewin – Genes X- Oxford
9.   Fundamentals of Cell and Molecular biology-Baig, Telang and Ingle-Amruta
10.   Genome- T.A. Brown- John Wiley

Molecular Biology-Lab
(BBI306P)

1.   Study of Ames test
2.   Study of fluctuation test
3.   Isolation and quantitation of DNA from bacteria.
4.   Isolation and quantitation of DNA from Yeast.
5.   Effect of UV radiation on yeast / bacteria
6.   Study of DNA repair mechanism by photo reactivation.
7.   Agarose gel electrophoresis of genomic DNA & plasmid DNA
8.   Isolation of Lac mutant by using Replica plate method.
9.   Determination of Tm value of DNA.

Soft Skills and Personality Enhancement
(BBI302)

Unit – I
(I)   Team Building – The magic of synergy, characteristics of an effective team, essentials of an effective team, Team Dynamics, Team Leading, Managing a Team.
(II)   Art of Negotiation –To understand what is negotiation, Ways of negotiating and being successful in it, To understand the power of language and non-verbal communication.
(III) Grooming –To learn selection of proper attire as per the place, Practiced perception, How to carry one's self, How to project one's self in the positive frame and spirit.

Unit – II
(I)   Organising Meetings – How to announce, call and organize a meeting in a smooth manner, How to design Agenda and prepare Minutes of Meeting
(II)   Telephonic Etiquettes –Learn the tone and pitch of voice while speaking over phone, How to send a voice mail.
(III) Business Etiquettes –What does business etiquettes mean, Professional and Cultural expectations, Effective writing, Corporate Communication, Interaction with foreign clients.

Unit –III
(I)   Stress Management –Types of stress, Symptoms and causes of Stress, Power of perception,
       Reaction to stress, Stress Management techniques.
(II)   Time Management – Importance of Time Management, Prioritising Tasks, Goal setting, Barriers to Time Management , Planning Routine and Time Tables.
(III) Self Management –Self evaluation, Self discipline, Self criticism, SWOT analysis, Self Awareness, Development of the Self.

Unit – IV
(I)   Presentation Skills –How to prepare a presentation, Knowing the audience and their requirements, Effective ways to deliver presentation, How to prepare Multimedia presentation.
(II)   Organisational Skills – How to understand the nature and structure of organisation, To understand hierarchy and communication channel of the organisation, Clarity about the roles and responsibilities in an organisation, How to be a team member, How to draft reports
(III) Leadership Skills

Unit – V
(I)   Group Discussion – Understanding the nature of discussion, Difference between debate and discussion, Ways to form and present arguments, Ways to defend your point.
(II)   Personal Interview –To learn the skills of appearing in an interview and being successful in it.
(III) Public Speaking – Art of public speaking, To know the rhetoric of making a public speech, exploring rhetorical elements through various ideas..

(IV)   Conference and Meeting, Participation and Technical clarity in conference and meeting, Learning to listen and respond, Final Report drafting.

Reference Books:-

1. Soft Skill for everyone –Jeff Butterfield
2. Soft Skill for-S.I. Hariharan -MJP Publications
3. Personality Development & Soft skill – Goyal Brothers Prakasan
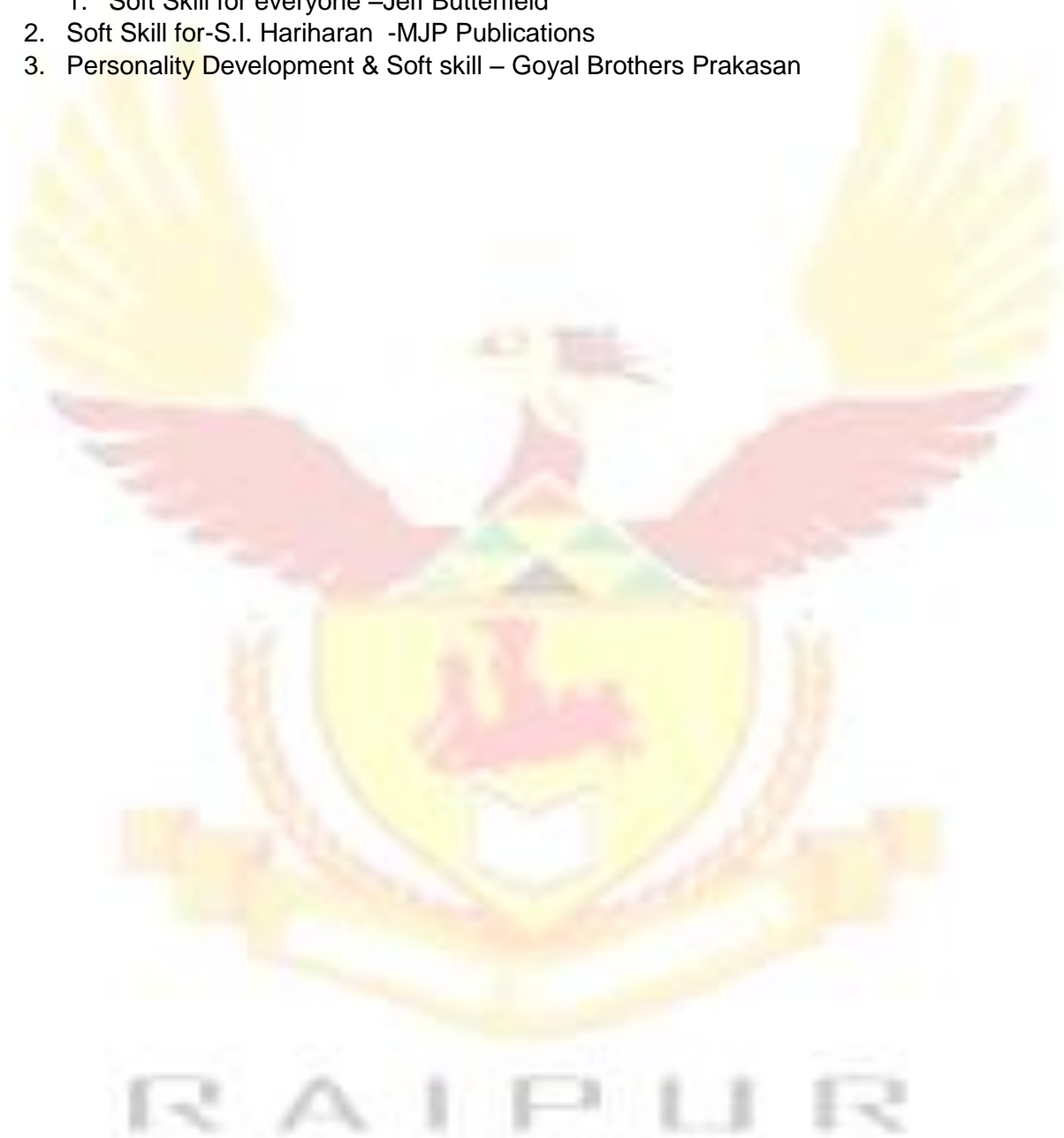
Biodiversity and Phylogenetics
(BBI303)

Unit 1: Biological Diversity
Biological diversity of life; India as mega biodiversity nation; Hotspots of diversity; Genetic diversity; Species diversity; Ecological / ecosystem diversity. Two, Three, five kingdom classification system; Diversity informatics in India, challenge and potential.

Unit 2: Biodiversity Databases
Species 2000; Tree of life; National Biological Informatics Infrastructure; International Committee on taxonomy of viruses (ICIV) and ICTVDB. Animal Virus Information System (AVIS); Global biodiversity information facility (GBIF); Other biodiversity databases.

Unit 3: Species Identification
Barcode of life;Delta; ITIS; Databases and softwares for identification of species
Metadata
Definition; Metadata standards; Metadata & biodiversity; Need for metadata Standards

Unit 4: Phylogenetic Prediction
Introduction; Relationship between phylogenetic analyses and multiple sequence alignment; Genome complexity; Evolutionary trees Rooted & Unrooted trees; Methods for phylogenetic prediction , Maximum parsimony method, Distance based alignment; Soft ware package for phylogeny prediction.

Reference Book
1) Bioformatics sequence and genome analysis – by David W. Mount.
2) Practical taxonomic computing – by Pankhurst R.J

Biodiversity and Phylogenetics-Lab
(BBI307P)

1. Study of different biodiversity databases and retrieval of biodiversity information from them
2. Study of database structures and designing biodiversity databases
3. Study of different species identification systems.
4. Study of different methods for sequence alignment.
5. Study of different methods for phylogenetic prediction

Programming in Perl
(BBI304)

Unit 1: Getting Start With Perl

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

The Art Of Programming Individual approaches to programming, bio programming strategies, the programming process.

Sequence & Strings

General introductions to DNA & protein sequence, Standard IUB/IUPAC nucleic acid codes, Standard IUB/IUPAC amino acid codes, A program to store a DNA sequence, Concatenating DNA fragments.

Unit 2: Basic Operators

Scalar variables, Arithmetic operators, comparison operators, logical operators, assignment operators, auto increment & auto decrement operators, Concatenating & repeating string operators.

File Handling Opening a file, reading a file, writing a file, closing a file, determining a status of a file.

Lists & Arrays Introduction to lists, storing lists in array variables, more about lists & arrays, Array library function.

Unit 3: Pattern Matching

How pattern matching works, pattern matching operators, anchoring the patterns, patterns matching function, program to calculate the reverse complement.

Control Flow & Looping Statements

If statements, If – else, while, until, single line conditional statement, the 'For' statement the 'for each' statement, the 'do' statement, the last, next, redo, continue statements.

Subroutines & Hashes: Introduction & advantage of subroutines, writing subroutines, use of local variable & passing parameter to subroutines, returning a value from subroutines, passing data to subroutines, hashes & its creations from an array variables.

Unit 4: The Genetic Code

Introduction to genetics code & codon table, translating codons to amino acids (using hashes), translating DNA into proteins, sequence file formats, FASTA format, Transcription:- DNA & RNA. Introduction to BioPerl.

Introduction to Python: Brief introduction of Python; comparison with Perl

Reference Books:-

1.) James Tisdall 2001 "Beginning Perl For Bioinformatics" O'reily & Associates.
2.) Schwartz , Foy and Phoenix, "Learning Perl" sixth Edition

Programming in Perl-Lab
(BBI308P)

1. write a simple program like program for storing DNA sequence in a variable
2. write programs by using different perl operators.
3. Write programs for file handling.
4. write programs by using lists and arrays.
5. write programs for pattern matching, conditional and looping statements.
6. write programs by using subroutines and hashes.

Metagenomics
(BBI305A)

Unit I: Introduction to Metagenomics
What is metagenomics; Types of metagenomes: Amplicon, Shotgun, Functional; Amplicon metagenomics: History, phylogenetic marker, examples; Shotgun metagenomics: History and examples; Functional metagenomics: Examples **Practice:** Amplicon metagenomics, Shotgun metagenomics, Functional
Metagenomics

Unit II: METAGENOMICS CASE STUDIES
Metagenomic analysis of soil microbial communities; Metagenomic Analysis of Bacteriophage; Metagenomics and Its Applications to the Study of the Human Microbiome; Archaeal Metagenomics: Bioprospecting Novel Genes and Exploring New Concepts.
Practice: Metagenomic analysis of soil microbial communities, Metagenomic
Analysis of Bacteriophage, Study of the Human Microbiome.

Unit III: LIBRARY CONSTRUCTION & ANALYSIS OF METAGENOMIC LIBRARIES
Cataloging microbes: phylogenetic tree and construction - Construction of a metagenomic library; Analysis of Metagenomic Libraries; Sequence-based Metagenomics Analysis; Function based Metagenomics Analysis; Phylogenetic analysis and Comparative genomics Softwares & Tools
Practice: Construction of a metagenomic library, Analysis of Metagenomic Libraries, Sequence-based Metagenomics Analysis, Phylogenetic analysis and Comparative genomics Softwares & Tools.

Unit IV: METAGENOMICS IN ENVIRONMENTAL STUDIES
Application of Metagenomics to Bioremediation ; Applications of Metagenomics for Industrial Bioproducts; Escherichia coli host engineering for efficient metagenomic enzyme discovery; Next-generation sequencing approaches to metagenomics; Stable isotope probing: uses in metagenomics; DNA sequencing of uncultured microbes from single cells
Practice: Applications of Metagenomics for Industrial Bioproducts, Stable isotope probing, etc.

References: -
1) Diana Marco Universidad Nacional de Cordoba, Argentina, "Metagenomics: Theory, Methods and Applications", Caister Academic Press,2010.
2) Diana Marco Universidad Nacional de Cordoba,Argentina "Metagenomics: Current Innovations and Future Trends",Caister Academic Press,2011.

Advance Bioprogramming
(BBI305B)

Objectives: To create expertise in advance programming language python which is essential skills for programming with python

Unit I : Python Basic
Introduction: what is python? Features, comparing python with other languages, installing python,testing python, basic input output, mathematical operations, data types
Practice: Installing Python, testing Python virsion

Unit II control statements
If-else, for loop ,while loop, break, dealing with files, functions and module creation, error handling
Practice: Practice programming based on conditional statements, control statements. Creating modules and programming using python modules. Programs using file handles.

Unit III Python and Object oriented programming
Object paradigm and python, creating classes, inheritance, creating new data types, making our code private, additional resources and self revaluation
Practice: Creating class, new data types. Programs on Inheritance.

Unit IV regular expressions
Introduction to regular expression(REGEX) regex syntax the re module: compiling a pattern, REGEX examples, pattern replace, REGEX in bioinformatics: cleaning up a sequence , additional resources, introduction to biopython .
Practice: Programming using regular expressions

References: -
1) Python for Bioinformatics ,Sebastian bassi ©2010 by Taylor and fancies group,LLC
2) Programming Python, Mark Lutz, 4th Ed. O'Reilly Pub.

BSC(Bioinformatics)
Semester-IV

Basics of Immunology
(BBI401)

Unit 1: Overview of immune system
History, innate and acquired immunity, passive immunity, infection.
Immunoglobulin
Antibodies: Antibody – structure and function, antigen, antigen-antibody Reaction, Complement fixation

Unit 2: Cells of immune system
Differentiation of stem cell, structure of B-cell, T-cell, Microphage, nature killer cell, Organs of immune system.

Unit 3: Immune response
Humoral immune response, Cellular immune Response, MHC I &II complex. Concept of Graft rejection

Unit 4: Immunodeficiency Diseases
Primary immunodeficiency, secondary immunodeficiency, Autoimmunity.

Reference Books:-
1.) Eli Benjamini, coico, sunshine, immunology (fourth edition)
2.) N.V. shastri, Principles of immunology (himalaya publication house)
3.) Immunology – Kuby- W.H. Freeman
4.) Essentials of Immunology- Roitt I. M.- Blackwell
5.) Immunology- Nandini Shetty- New Age International
6.) Textbook of Microbiology – Anantnarayan and Panikar-Orient Longman
7.) Immunology- A.K. Abbas- Elsevier

Basics of Immunology-Lab
(BBI406P)

1. Immunodignostics (demonstration using Kits- Widal, VDRL)

2. Determination of Blood Group

3. Immunodiffusion, Immuno Electrophoresis, Western Blotting,

4. Differential Leukocyte Count

5. Lymphoid organ, Cell and their microscopic observation

6. Immunization, collection of Serum

7. Purification of antibody from Serum

Biochemical Techniques
(BBI402)

Unit 1: Microscopy & Spectroscopy:
Light Microscopy: Simple & Compound Microscope, Phase contract Microscope, Electron Microscope (TEM/SEM) (Principle, Theory, ray diagram, Image formation and applications). Spectroscopy: General principle, Electromagnetic Spectrum, Basic law of absorption, Visible & Ultraviolet Spectroscopy, application in biology.

Unit 2: Chromatography
Adsorption chromatography, Partition chromatography: Paper Chromatography, TLC, Column Chromatography, Ion exchange chromatography, GC.

Unit 3: Centrifugation
Centripetal Force, Centrifugal force, basic principle of centrifugation, centrifuge type, types of rotor density gradient centrifugation, Nature of density gradient, preparative centrifugation, Differentials centrifugation & applications.

Unit 4: Electrophoresis Techniques
General Principles, Factors affecting on Electrophoretic Mobility, Agarose PAGE & SDS PAGE. Isoelectric focusing (IEF), Pulse field gel electrophoresis

Reference Books:

1. Biophysical Chemistry- Upadhyay, Upadhyay and Nath-Himalaya

2. Practical Biochemistry- Wilson & Walker -Cambridge

3. Practical Biochemistry- David Plummer- Tata McGraw Hill

4. Principles of Biochemistry- Lehninger –Kalyani Publications

5. Light Microscopy in Biology-A.J. Laccy.

6. Instrumental Methods of Chemical Analysis- Chatwal Anand- Himalaya

7. Instrumental Methods of Chemical Analysis –B.K. Sharma-Goel

8. Physical Biochemistry- David Freifelder

Biochemical Techniques-Lab
(BBI407P)

1. Study and Care of Microscope, Observation of Microscopic samples
2. Study of Colorimeter and determination of Lambda Max.
3. Study of UV-Visible Spectrophotometer
4. Study of Paper Chromatography/ TLC.
5. Separation of Pigments/ Biomolecules by Chromatography.
6. Separation of pigments by column chromatography
7. Demonstration of GC/ HPLC/ HPTLC
8. Principals and working of different centrifuges.
9. UV Spectroscopic Analysis of DNA, RNA & Proteins
10. Study of Paper/PAGE/ SDS-PAGE/ Agarose Gel Electrophoresis

Biological Database Management
(BBI403)

Unit 1: Relational Database
Introduction; Codd's 12 rules; Principles of RDBMS; Comparison between HDB-NDB-RDB; Concept of domain; Tuple; Cardinality; Oracle data type; Interactive SQL; Oracle & client server technology; Data manipulation in Database Management system (DML commands); DDL commands; Creating Tables; Insertion of Data in to table; Viewing data in Table; Renaming table , Destroying tables; Examining the objects created by Users; Working with ASCII file from the SQL prompt.

Unit 2: Manipulation On Oracle Tables
Competition on table data; Oracle table; Dual, Sys- date; Oracle functions; Data Constraint; Data constraints; Defining different constraints on table; User constraints table; defining dropping integrating constraints in the Alter table command; default value concept.

Unit 3: SQL , PL/SQL
Grouping data from table in SQL; Sub queries, joins, using the Union. Introduction; Generic PL/SQL; PL.SQL execution environment. Oracle transaction; Processing PL/SQL for block; What is cursor?; cursor for loops.

Unit 4: Database Objects
Store procedure and functions; Where do stores procedure and function resides; How oracle engine execute procedure and function; Advantage using procedure and function; procedure V/S function; Syntax of creating procedure and function.

Reference Books:-
1) Database System Concept –By Koarth
2) Modern Database Management –Iv-Edition By Fred R.Meffadden, Jeffrey, A. Hoffer(Aw)
3) Principle Of Database Management – By James Martin.
4) Database Management System – By Bipin Desai
5) Plsql – The Programing Language Of Oracles By Ivan Bay Rows – Ii Edition Bpb Publication

Biological Database Management-Lab
(BBI408P)

1. Creating and manipulating tables by using DDL and DML commands

2. Study of different oracle functions.

3. Study of different oracle constraints.

4. Study of grouping data from tables with SQL.

5. Study of sub queries and joins with SQL.

6. Study of PL/SQL

Object Oriented Programming
(BBI404)

Unit 1: Introduction Oops
Object oriented programming, basic concept of oops , benefits of oops Tokens, keywords, identifier data types, constants, operation precedence and associating, I/O – statements, structure of c++ program, Control statements, looping statements, Type casting, array, pointer, structure & unions.

Unit 2: Functions In C++
Function, function prototype, Call by value, call by reference, Return by reference, Inline function, friend function, Default argument, function overloading.
Class & Objects
Defining class, members, objects, visibility mode, static data members, static member function, pointer to members, array of objects.

Unit 3: Constructiors And Destructors
Introduction to constructors, Parameterized constructors, Multiple constructors in a class, copy Constructors, Destructors.
Operators Overloading
Defining operator overloading, overloading unary operators, overloading binary operators, rules of overloading operators.

Unit 4: Inheritance & Polymorphism
Concept of inheritance, type of inheritance, polymorphism, virtual class, virtual functions, rules for virtual function, pure virtual function.
Console I/O Operations
C++ streams, C++ streams classes, unformatted I/O operations, formatted
I/O operations.

Reference Books
1. Object oriented programming with c++ By :- E. Balaguruswami.
2. Object oriented programming with c++ by :- Richard Johnsonburg & Martin Kalin.
3. C++ Complete Reference By: - H. Dhieldt

Object Oriented Programming-Lab
(BBI409P)

1. Study of structure of C++ program.
2. Write C++ programs using control and looping statements.
3. Write C++ programs using arrays, pointers, structures and unions.
4. Write C++ programs using class and objects.
5. Write C++ programs for operator overloading.
6. Write C++ programs for inheritance and polymorphism
7. Write C++ programs using consol I/O functions

Analytical Techniques for Bioinformatics
(BBI405A)

Unit-I
Spectroscopy: UV Visible, NMR, ESR, Atomic Absorption, Raman Spectroscopy
Practice: practical based on Spectroscopic analysis of biomolecules

Unit II
Protein isolation, Estimation, Protein sequencing methods, detection of post translation modification of proteins.
Practice: Practical based on protein isolation and analysis

Unit III
Proteome-General Account; Tools of proteome analysis. DNA microarray: understanding of microarray data and correlation of gene expression Methods of Genome sequencing, EST, STS, GSS database and their generation Whole Genome comparison.
Practice: 1) Tools of proteome analysis
2) Practical Study of EST, STS, GSS database.

Unit IV
Sequencing methods: Genome sequencing: High-throughput sequencing, shot-gun sequencing. sequence alignment pair-wise, multiple sequence alignment along with molecular phylogenetics
Practice: 1) Tools for sequence alignment.
2) Gene prediction and Protein Structure Prediction

Reference Books
1. Wilson, K, Walker, J.: Principles and Techniques of Practical Biochemistry. 5th Ed. - Cambridge University Press,. Cambridge 1999.
2. Biotechniques: Theory & Practice: Second Edition by SVS Rana, Rustogi Publications.
3. Biochemical Methods of Analysis : Saroj Dua And Neera Garg : Narosa Publishing House, New Delhi.
4. Bioanalytical Techniques : M.L. Srivastava ; Narosa Publishing House, New Delhi.
5. Hobert H Willard, D.L. Merritt and J.R.J.A. Dean, instrumental methods of analysis, CBS Publishers and Distributors, 1992
6. Handbook of Analytical Techniques Published Online: 2008. Helmut Günzler, Alex Williams. Wiley Interscience.
7. Analytical Tools for DNA, Genes & Genomes: by Arseni Markoff, New Age.

Immunoinformatics
(BBI405B)

Unit I :Introduction to Immunoinformatics and Immunological Databases

Introduction to immunology & Bioinformatics, immunoinformatics, the immune system, cellular immunity, antibody mediated immunity. Immunological databasesdb MHC- MHC database at NCBI, T-cell epitope databases, B-cell epitope databases

Practice: Immunological Databases, T-cell epitope databases, B-cell epitope Databases

Unit II Descriptors/Topics: Immunological Tools

Experimental and theoretical description of peptide-MHC binding, selection of epitopes using bioinformatics, prediction of proteasome processing, Predictions of Class I and Class II MHC Epitopes, IEDB analysis Resourse, CTLPred, Population Coverage analysis, Epitope conservancy analysis **Practice:** Predictions of Class I and Class II MHC Epitopes, IEDB analysis Resourse, CTLPred

Unit III Descriptors/Topics: Computational Vaccinology

Introduction to vaccines, Different generations of Vaccines, Concepts of reverse vaccinology, case study of Reverse Vaccinology with Meningococcus B, Comparision of Traditional Vaccinology and Reverse Vaccinology,

Practice: case study of Reverse Vaccinology, Vaccine databases

Unit IV regular expressions

Tools & servers for computational Vaccine design-from Genome to Vaccine. **Practice:** Tools & servers for computational Vaccine design-from Genome to Vaccine

References: -

1) Kuby IMMUNOLOGY. 2007 by W. H. Freeman and Company.
2) Immunoinformatics: Bioinformatic Strategies for Better Understanding of Immune (2008), Wiley Publications.
3) Predicting Immunogenicity In Silico Series(2013): Methods in Molecular Biology, Flower, Darren R.

BSC(Bioinformatics)
Semester-V
Genetic Engineering
(BBI501)

Salient features: This course will help to understand concept Genetic Engineering and Applications of r-DNA technology.
Utility of course: To understand basics of Genetic engineering techniques
Learning Objective: to improve the knowledge of genomic techniques
Prerequisites: Basic knowledge of biology and Genetic Engineering

Unit 1:- Principles of Gene Cloning
Endonuclease – an essential tool for Gene cloning, Types & Properties, DNA Ligases, Plasmids. Antibiotic résistance markers, Vectors: Plasmids (pBR322, pUC18/19), Bacteriophages (λ Phage, M 13 Phage), Cosmids, Artificial Chromosomes, Ti plasmid. Methods of Gene Transfer-vector based and direct transfer of DNA: Gene Cloning Strategies. Markers and reporter genes in gene cloning

Unit 2:- Techniques in Molecular Biology
Denaturation & Renaturation of DNA, Tm, GC content from Tm. Renaturation Kinetics of DNA & Complexity of DNA. Electrophoresis: Agarose Gel Electrophoresis, Blotting techniques: Southern, Northern, Western Blotting and applications. PCR: Mechanism, Types and Application. DNA Micro array principle & applications DNA Sequencing: Sanger's and Maxam Gilbert's Method, Automated DNA sequencing.

Unit 3:- Library construction
Library construction, screening and applications: Genomic library, cDNA library. Nucleic Acid Probe, Chemical Synthesis of DNA, Autoradiography of DNA Screening of library-Probe based direct and indirect methods.

Unit 4:- Applications of r-DNA technology
Agricultural applications i) BT-Cotton, ii) Transgenic maize, iii) Golden rice etc. Protein engineering: to improve properties of proteins and enzymes. Pharmaceutical Applications: i) Recombinant hormones ii) Vaccines iii) Blood Clotting factors v) Tissue Plasminogen Activator vi) Erythropoietin v) Human growth hormone. Concept of Gene Therapy4

Reference book:-
1. Principles of Genome analysis and Genomics - Old & Primrose-Black well
2. Molecular biology of Gene – J.D Watson
3. From Genes to Clones- Winnacker- Panima
4. Molecular Biotechnology –Glick-ASM
5. ABC of Gene cloing- Wong-Springer
6. Genomes 3 - T.A.Brown-Garland Science
7. Gene cloning and DNA Analysis- T.A. Brown- Wiley- Blackwell
8. Text book of Biotechnology – U Satyanarayan –Book & Allied

Genetic Engineering-Lab
(BBI506P)

Course Objectives:

The objective of the course is to give practical exposure to student about basic tools and techniques employed in recombinant DNA technology and genomics.

Course Outcomes:

Course Outcomes

CO1-Students will be able to isolate and analyze plasmid vectors. Technical

CO2-Students will be cut and ligate DNA fragments/vectors with help of restriction enzymes

and ligase. Technical

CO3-The students will be able to prepare competent cells Technical

CO4-The students will be able demonstrate bacterial transformation with given vectors

Technical

CO5-Students will be able to perform genome annotations, gene and molecular marker

prediction Technical

S.No.	Description	Hours
1	Introduction to rDNA laboratory, w.r.t. working bench, types of instruments and their handling, lab. Preparation of stock solutions of buffers for use in gel running, gel loading, their autoclaving; preparation of working buffers, antibiotic stocks, and storage of buffers required in rDNA practicals with detailed methodology	4
2	Plasmid DNA Preparation: Preparation of LB medium with and without antibiotics for the growth of bacterial cultures, Growth of *E. coli*, Isolation of Plasmid DNA, Electrtrophoresis of Plasmid DNA and Interpretation of results	4
3	Restriction of given plasmid or λ DNA with the restriction enzyme *Eco*RI and HindIII or any other Restriction Enzymes	4
4	To perform ligationof λ/*Eco*R I digest using T4 DNA Ligase 4 Electrophoresis of the uncut and digested DNA and Interpretation of the results Electrophoresis of ligated samples by agarose gel electrophoresis, Interpretation of the results	4
5	Preparation of competent cells of *E. coli* transformation	4
6	Transformation of E.coli. DH5 α cells with Empty puc/ pcambia1301/and Confirmation of transformed cells by scoring the expression of LacZ gene.	4
7	Dnastar Modules	4
8	Primer Designing	4
9	Unknown Gene Prediction Tools And Packages	4
10	Molecular Markers Prediction (SSR And SNP)	4
11	Overview Of Genomic Resources: Data Retrieval And Analysis	4

| 12 | Tools For Expression Data Analysis | 4 |

Suggested Books/Resources:

1. Lab Manual.
2. Discovering Genomics, proteomics & bioinformatics. Second edition by A Malcolm Campbell, Davidson College; Laurie J. Heyer Davidson College ; With Foreword by Francis S. Collins
3. Virtual Lab
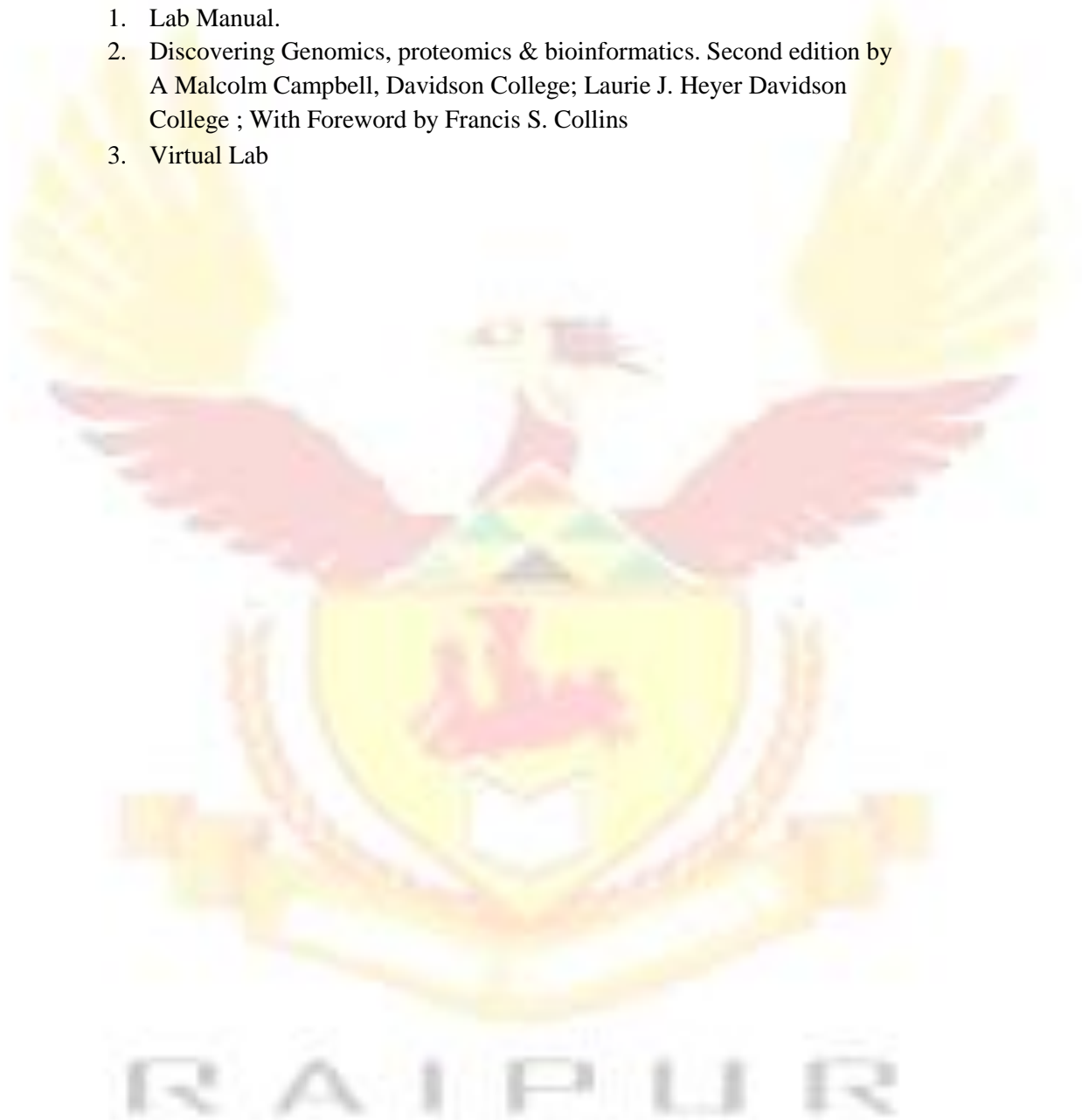
Computational Structural Biology

(BBI502)

Salient features: To understand basic Advance structural Biology

Utility of course: To uncover structure of Biomolecules through computational approach & applied Bioinformatics

Learning Objective: to improve the knowledge of computational approach & applied Bioinformatics (Visualization and Manipulation of Protein Structures, Basics of Protein Structure Modeling — Structure validation & refinement).

Prerequisites: basic knowledge about Biomolecules, structural database and Molecular visualization tools

UNIT - I

Structural data, databases and structure analysis Exploring the Database & searches on PDB and CSD, WHATIF

UNIT - II

Molecular visualization tools Visualization of tertiary structures, quaternary structures, architectures and topologies of proteins and DNA using molecular visualization softwares such as RasMol, Cn3D, Chime, PyMOL etc.

UNIT -III

Methods for prediction of secondary structure of proteins Prediction of secondary structures of proteins using at least 5 different methods with analysis and interpretation of the results. Comparison of the performance of the different methods for various classes of proteins.

UNIT - IV

Methods for prediction tertiary structure of proteins along with analysis and interpretation of results Homology modeling: InsightII, Discovery Studio, SWISSMODEL, SWISSPDB Viewer Fold recognition methods: PHYRE, TOPITS, GenThreader (or other equivalent methods)

References:

Cesareni Giovanni, Gimona Mario, Sudol Marius, Yaffe Michael (Editors).
Modular Protein Domains. Publisher: Weinheim Wiley-VCH. 2005. ISBN: 352730813X.
Höltje Hans-Dieter, Sippl Wolfgang, Rognan Didier, Folkers Gerd. Molecular Modeling: Basic Principles and Applications. Publisher: New York, Wiley-VCH.
2003. ISBN: 3527305890.
Webster David (Editor). Protein Structure Prediction: Methods and Protocols (Methods in Molecular Biology) Volume 143. Publisher: New Jersey Humana Press. 2000. ISBN: 0896036375.
Sternberg Michael J. E. Protein Structure Prediction: A Practical Approach. Publisher: USA, Oxford University Press. 1997. ISBN: 0199634953.

Computational Structural Biology-Lab
(BBI507P)

Course Objectives:
1. To use and develop bioinformatics programs for comparing &analyzing biological sequence data to identify probable function.

S.No.	Course Outcomes	Level of Attainment
CO1	Basic algorithms used in Pairwise and Multiple alignments.	Assessment
CO2	Understanding the methodologies used for database searching, and determining the accuracies of database search.	Assessment
CO3	Application of probabilistic model to determine important patterns.	Assessment
CO4	Prediction of structure from sequence and subsequently testing the accuracy of predicted structures.	Assessment
CO5	Determine the protein function from sequence through analysis of data.	Assessment
CO6	Analysis and development of models for better interpretation of biological data to extract knowledge.	Assessment

S.No.	Description	Hours
1	Different sequence formats such as FASTA, PIR, EMBL, PDB, etc.Different sequence databases, retrieval of sequences from those databases and different ways to store the sequences. Calculation of the score of a pairwise alignment by using a scoring pattern (Take Home).	4
2	Write a program to align two sequences using Needleman-Wunsch algorithm?	4
3	Use EBI (European Bioinformatics Institute) Needle sequence alignment tool to align above two sequences and compare your result with that of Needle tool	4
4	Use of BLAST on line server to retrieve sequences from a database Develop a program based on BLAST algorithm to carry out database search?	4
5	Use Clustaw software or on line server to align sequences from a family.	4
6	Develop a Multiple Sequence Alignment (MSA) program based on ClustalW algorithm.	4
7	Understanding Protein structures and Visualization	4
8	Drawing helical wheel for alpha helix	4
9	Using Rasmol and PyMOL for 3-D visualization	4
10	Analysis of protein-protein interaction and protein-DNA interaction	4
11	Advanced PyMOL usage	4
12	Use of PDBsum for structural analysis	4

<p align="center">**Chemoinformatics**
(BBI503)</p>

Salient features: this subject will help to understand the basic concept of chemoinformatics
Utility of course: To understand the chemoinformatics for drug designing.
Learning Objective: to improve the knowledge of chemical structure representation and Chemoinformatics tools for drug discovery.
Prerequisites: basic knowledge about chemical entities, chemical databases and drug.

Unit 1: Introduction
Chemoinformatics definition, scope of chemoinformatics, history of chemoinformatics, why to use informatics methods in chemistry?

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

Unit 3: Molecular Descriptors
Introduction, Descriptors Calculated from the 2D Structure: Simple Counts, Physicochemical Properties, Molar Refractivity. Structure Searching: Substructure Searching, Screening Methods, Similarity searching,

Unit 4: Drug and Drug-Targets
Drug: definition, "Drug-Likeness" and Compound Filters, rule of five. Lead Compound: definition, natural and synthetic resources of lead compounds. Drug targets: Enzymes, receptors, carrier proteins, structural proteins, nucleic acids, etc.

Unit 5: Chemoinformatics tools for drug discovery
Combinatorial Synthesis and Combinatorial Library, QSAR, 3D Pharmacophores. Screening Methods: High-throughput screening, Virtual Screening. Protein–Ligand Docking. The Prediction of ADMET Properties, Toxicity Prediction.

Reference Books:
1. Handbook of Chemoinformatics, volume 1, by John Gastiger, Thomas Engel, WILEYVCH pub 2003.
2. An Introduction to Chemoinformatics, by Andrew R. Leach & Valerie j. Gillet, Springer
3. Instant Notes in Medicinal Chemistry, by G. Patrick, BIOS Scientific pub. 2001

Chemoinformatics-Lab
(BBI508P)

Course Outcome:

CO -1:To differentiate and understand the features different molecular representation of a molecule.

CO - 2: To be capable in interpreting the chemical molecular structure from different molecular representation.

CO - 3: To observe the different molecular file formats, its variation and application.

CO - 4: To acquire structural knowledge from the given molecular file formats.

CO - 5: To observe the molecular patterns of various molecules.

CO - 6: To workout tools available for describing molecular pattern of a chemical substance.

1. Chemical Structure representation for the following categories,   **12**
- ➢ 1 Dimension Structures,
- ➢ 2 Dimension Structures
- ➢ 3 Dimension Structures

2. Analysing Molecular file formats for the following,   **12**
- ➢ SMILES,
- ➢ WLN
- ➢ SDF
- ➢ MOL

3. Analysing Molecular patterns for the following,   **12**
- ➢ SMARTS
- ➢ SMIRKS

4. Analysing Molecular Database Screening for   **10**
- ➢ Lipinski Rule: Drug/Lead like molecules

5. Analysing Molecular Descriptors for the following,   **14**
- ➢ 1 Dimension Structures,
- ➢ 2 Dimension Structures
- ➢ 3 Dimension Structures

Text Book:

Gasteiger Johann, Engel Thomas. Chemoinformatics: A Textbook. Publisher: WileyVCH; 1st edition. 2003. ISBN: 3527306811.

References:

1. Bunin Barry A. SieselBrian,MoralesGuillermo,Bajorath Jürgen. Chemoinformatics: Theory, Practice, & Products Publisher:New York, Springer. 2006. ISBN: 1402050003.
2. Leach Andrew R., Valerie J. Gillet. An introduction to chemoinformatics. Publisher: Kluwer academic , 2003. ISBN: 1402013477.

Programming in JAVA
(BBI504)

Salient features: understanding the basic concepts and techniques of java programming and develop skills of using recent software

Utility of course: the subject will help in skilled in programming language.

Learning Objective: To enhance the knowledge of programming.

Prerequisites: basic knowledge about programming

Unit 1: An Introduction and overview of Java

A Short History of Java, Features of Java, Comparison of Java and C++, Java Tools And Editors(Appletviewer,Jar,Jdb). Java Environment. Types of Comments, Built In Data Types, Variables and Constants(Final Keyword Related to variables), Operators, Memory Allocation Using new Operator., Output using println() method, Control Statements, Arrays, Simple Java Program.

Unit 2: Objects and Classes

Defining Your Own Classes, methods and objects, using this keyword, constructors, types of constructors, constructor overloading, static variables and methods, access specifiers (private, protected and public), packagescreating, accessing and using packages, Garbage collection, finalize() method.

Unit 3: Inheritance and Interfaces

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

Unit 4: Exception Handling

Dealing Errors, types of exception, exceptions handling using try and catch, using throws keyword, uses finally block.

Unit 5: Strings, Streams and Files

String class and String Buffer Class, Stream classes, Byte Stream classes, Character Stream Classes, Using the File class, Creation of files, Reading/Writing characters and bytes, Handling primitive data types.

Applet Programming with Graphical User Interface

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

Reference Books:

1. Complete reference Java by Herbert Schildt(5th edition)

2. Java 2 programming black books, Steven Horlzner

3. Programming with Java , A primer ,Forth edition , By E. Balagurusamy

4. Java servlet Programming by Jason Hunter, O'Reilly

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

6. Prentice Hall, Sun Microsystems Press.

7. Core Java Volume-II-Advanced Features, Eighth Edition, Cay S. Horstmann, Gary Cornell, Prentice Hall, Sun Microsystems Press.

Programming in JAVA-Lab
(BBI509P)

COURSE OBJECTIVES
- ➢ To describe the basic internet concepts and to explain java, HTML and applied tools for internet programming.
- ➢ To provide an elementary knowledge of bioinformatics and biological information on the web. scope of bioinformatics, types of data bases and their use pair wise and sequence alignment, predictive methods

COURSE OUTCOMES:
After completion of this course student would be able to
- ➢ Write the java program for find the area and circumference of circle.
- ➢ Record a java program for find the day of a weak using switch case statement.
- ➢ Write a java program for sort a given string.

1. To find the average of two numbers.

2. To find the area and circumference of circle.

3. To find the day of a week using switch case statement.

4. To find the average of given numbers using for statement.

5. To sort a given string.

6. To demonstrate sample packages.

7. To find the nature of the solution (pH concentration).

8. To find the AT+GC content of given DNA sequence.

Molecular Interactions
(BBI505A)

Unit I: Fundamentals of atomic and molecular orbitals:
Theory of atomic and molecular orbitals; Linear combination of atomic orbitals; Quantitative treatment of valency bond theory and molecular orbital theory;

Unit II: Fundamentals of chemical bonding and non-bonding interactions: Electrovalent bond, stability of electrovalent bond. Co- valent bond – partial ionic character of co-valent bonds. Shape of orbitals and hybridization. Coordination bond, Vander Waals forces; Metallic bond. Molecular geometry- VSEPR Theory

Unit-III: Folding pathways:
Principles of protein folding, role of chaperons, hydrophobic interactions, electrostatic interactions, non-bonded interactions

Unit IV: Molecular interactions:
protein-protein, protein-DNA, DNA-Drug, Protein-Lipid, Protein-Ligand, Protein-Carbohydrate interaction

Reference Books
1) Frenking, G. and Shaik. S. (2014). The Chemical Bond: Fundamental Aspects of Chemical Bonding, Wiley Publishers.
2) Gromiha, M.M. (2010). Protein Bioinformatics: From Sequence to Function, Academic Press, First Edition.
3) Meyerkord, C.L. and ui , H. (2015). Protein-Protein Interactions: Methods and Applications, Humana Press, second edition
4) Winter, M.J. (2016). Chemical Bonding. Oxford University Press, Inc., New York.

Introduction to Biosensor
(BBI505B)

Unit-I
Sensor: Introduction and classification, history, principles of physical and chemical and mechanism chemical sensors.

Unit-II
Biosensor: Definition, Introduction of Avidin-Biotin mediated biosensor, Luminescent and Glucose biosensors.

Unit-III
Nanomaterials based Biosensor: Introduction and challenges of biosensor. Nanomaterials and nanodevices, nanocrystalline and carbon nanotube based biosensor.

Unit-IV
Medical biosensor: Introduction to biosensors for medical applications

Reference Books:
1.   Blum, "Biosensor Principles and Applications", Vol-15, CRC Press, (1991).
2.   J. Vetelino, and A.Reghu, (2010) "Introduction to Sensors", Publisher-CRC Press.
3.   A.Mulchandani and K. Rogers, (2010) "Enzyme and Microbial Biosensors: Techniques and Protocols", Publisher-Humana Press.
4.   S. Higson, (2012) "Biosensors for Medical Applications", Publisher-Elsevier.
5.   J. Li, N. Wu, (2013) "Biosensors Based on Nanomaterials and Nanodevices", PublisherCRC press.
6.   M. Bock Gu, H-S. Kim, (2014) "Biosensors Based on Aptamers and Enzymes", Springer.

Industrial Training Evaluation
(BBI510P)

Salient features: To introduce with basic Genomics and bioinformatics tools and methods to help student in order to conduct advanced research in genomics.
Utility of course: To understand complex biological systems and computational research
Learning Objective: To enhance the knowledge of genomics
Prerequisites: Basic knowledge of genome and genomics databases

Unit 1: Introduction.
Genomics definition, History- Early sequencing efforts DNA sequencing technology developed, Complete genomes, The "omics" revolution, C-Value paradox, Human Genome Project.

Unit 2: Genome Analysis
Sequencing- Shotgun sequencing, High-throughput sequencing, Illumina (Solexa) sequencing, Ion Torrent Assembly- Assembly approaches, Finishing. Annotation. Genome databases

Unit 3: Introduction to Research Areas of Genomics
Functional genomics, Structural genomics, comparative genomics Epigenomics, Metagenomics, Pharmacogenomics. Study systems - Viruses and bacteriophages genomics, Cyanobacteria genomics, Human genomics.

Unit 4: Applications of genomics
Biomarker discovery, gene expression, transfection, epigenetics, agriculture, Pharmaceuticals, genomic medicine, Synthetic biology and bioengineering, etc.

Reference Books:
1. Principles of Genome analysis and Genomics-Primrose and Twyman-

   Blackwell Publishing

2. Principles of Proteomics-R.M Twyman-BIOS advanced text

3. Functional Genomics-Stephen Hunt, Livesey- Oxford

4. Genetic Programming-W. Banzhaf, Nordin, Keller, Francone- Elsevier

   Bioinformatics: sequence and genome analysis by David Mount, cold springer

   harbour press, 2004.

5. Comparative genomics: empirical and analytical approaches to gene order   dynamics, map

alignment and the evolution of gene families by Sankoff, D. &

   Nadeau, J.H., Netherlands, Kluwer Academic Publishers, 2000.

Concept of Genomics-Lab
(BBI606P)

COURSE OBJECTIVES

> ➢ To study prokaryotic and eukaryotic genomes , general methods of genome sequencing techniques, genome analysis and annotations, genome mapping techniques and applications of genomics.

COURSE OUTCOMES

After completion of this course student would be able to

➢ Describe the details on the tools involved for genome annotation.
➢ Explain the methods and tools involved for horizontal gene transfer.
➢ Describe the tools to design and analyze primers for PCR.
➢ Explain the method to analyze the transcription factor binding sites in whole bacterial genomes.
➢ Analyze the steps involved for pathway reconstruction.
➢ Give details about genome databases.
➢ Understand the aspects on the origin of replication prediction.
➢ Apply the method to carry out the DNA repeats prediction.

1. HGT-Horizontal Gene Transfer.

2. Vista tool - Genome Annotation.

3. Human Genome -Wellcome Trust Genome Browser.

4. FlyBase - A Database of Drosophila Genes & Genomes.

5. Tandem repeats finder- A program to analyze DNA sequences.

6. LALIGN - Find multiple matching sub segments in two sequences.

7. OMIM - Online Mendelian Inheritance in Man - An Online Catalog of Human Genes and genetic Disorders.

8. NEBcutter V2.0 – To find the large, non-overlapping open reading frames in a DNA sequence.

9. ORF Finder - Searching for open reading frames in DNA sequence.

10. Primer3 - Tool to design and analyze primers for PCR.

11. Virtual Footprint - To analyze transcription factor binding sites in whole bacterial genomes.

12. ClustalW2 - DNA or protein multiple sequence alignment program.

Concept of Proteomics
(BBI602)

Salient features: To introduce with basic proteomics and bioinformatics tools and methods to help student in order to conduct advanced research in proteomics.
Utility of course: To understand complex biological systems and computational research
Learning Objective: To enhance the knowledge of proteomics
Prerequisites: Basic knowledge of genome, proteome and genomics databases

Unit 1: Introduction.

Definition, Proteome, Different protein functions, What Is Proteomics?; Why Proteomics?; Applications of proteomics, Protein Structure Basics- Amino Acids, Peptide bond, Hierarchy, Determination of Protein Three-Dimensional Structure, Protein Structure Database.

Unit 2: Protein synthesis and Modifications
Translation, Post translational modifications- Protein processing in Endoplasmic Reticulum and Golgi apparatus, role of chaperons, The modifications such as proteolytic cleavage; formation of disulfide bonds; addition of phosphoryl, methyl, acetyl, or other groups onto certain amino acid residues; attachment of oligosaccharides or prosthetic groups to create mature proteins.

Unit 3: Protein separation and Identification
Extracting Proteins from Biological Samples, Protein Separations- 1D- and 2DSDS- PAGE, Isoelectric Focusing (IEF), HPLC (reverse phase (RP), size exclusion, ion exchange, or affinity chromatography), identification using MS, MALDI-TOF etc.

Unit 4: Protein Analysis
Protein-protein interactions, Protein array, protein structure prediction Tools and servers.

Reference Books:
1. Principles of Genome analysis and Genomics-Primrose and Twyman- Blackwell Publishing
2. Introduction to proteomics: tools for the new biology by Liebler, D.C. & Yates, J.R.III, Humana Press
3. Protein Science-Arthur M. Lesk- Oxford
4. Proteomics: from protein sequence to function by Pennington, S. R. & Dunn, M. J.: Viva Books Introduction to proteomics: tools for the new biology by
Liebler, D.C. & Yates, J.R.III, New York. Humana Press, 2002.

Concept of Proteomics-Lab
(BBI607P)

COURSE OBJECTIVES
➢ To understand the proteins enclosed by the genes with respect to structure, function, protein – protein interactions, techniques for separation and analysis, database and applications.

COURSE OUTCOMES
    After completion of this course student would be able to
➢ Retrieve the protein sequence from uniprot database.
➢ Retrieve the Protein network from string database.
➢ Attain the knowledge to calculate protein protein interaction using PIC.
➢ Retrieve information about the metabolic pathway from KEGG database.
➢ Analyse the protein patterns and profiles using PROSITE database.
➢ Scan the various physical and chemical properties of the given protein using Protparam database.
➢ Study the conserved domain prediction by CDD.
➢ Explain the facts about the Peptide Cutter.

1. ProtParam - Computation of various physical and chemical parameters for a given protein.

2. CDD - Conserved Domain Prediction.

3. SWISS-2DPAGE - Proteins identified on various 2-D PAGE and SDS-PAGE reference maps.

4. PeptideCutter - Predicts potential cleavage sites cleaved by proteases or chemicals in a given protein sequence.

5. Mascot Server - Peptide Mass Fingerprint and MS/MS database searches.

6. PSORT - Program for the prediction of protein localization sites in cells.

7. PROSITE - Protein Domain, Family & Functional Site Prediction.

8. KEGG Pathway Database - Metabolic Pathway Prediction.

9. RADAR - Detection and alignment of repeats in protein sequences.

10. epestfind - Identification of PEST motifs.

11. STRING - Known and Predicted Protein-Protein Interactions.

12. EAWAG-BBD - Microbial biocatalytic reactions and biodegradation pathway database.

Metabolomics
(BBI603)

Salient features: To understand basic metabolomics

Utility of course: To uncover Biological pathway through computational approach & applied Bioinformatics

Learning Objective: to improve the knowledge of computational metabolomics, Metabolite separation and Detection, etc

Prerequisites: basic knowledge about Biomolecules, biological pathways database

Unit 1: Introduction to Metabolomics

Definition, origin, Terms- metabolom, metabolites, catabolism, anabolism, metabolism metabonomics. Applications- medical diagnosis, biomarker discovery, agriculture, Toxicity assessment/toxicology, Functional genomics. Nutrigenomics, etc

Unit 2: Metabolic Pathways

Major Metabolic Pathways: Gluconeogenesis, Pentose phosphate pathway, Glycogen synthesis and degradation, Fatty acid oxidation and synthesis, Amino acid catabolism, Purine and pyrimidine nucleotide synthesis,

Unit 3: Metabolite separation and Detection Methods

Separation -Gas chromatography, HPLC, CE. Detection- Mass spectrometry (MS), MALDI, Nuclear magnetic resonance (NMR) spectroscopy. Statistical methods- XCMS, MZmine, MetAlign, etc.

Unit 4: Computational metabolomics

Full Genome Annotation through knowledge of Metabolic Pathways Organism Specific Metabolic Pathways, Comparison of Metabolic Pathways

Reference Books:

1. Fundamentals of Biochemistry (2nd edition) by D.,Voet, Voet, J.G. & Pratt,   C. W. John Wiley & Sons, 2006.
2. Lehninger Principles of Biochemistry (4th edition) by D. L. Nelson & M. M.   Cox, W. H. Freeman & Co, 2005.
3. Gene regulation and metabolism: postgenomic computational approaches. By Collado-Vides, J. & Hofestadt, R. Cambridge, The MIT Press, 2002.

Metabolomics-Lab
(BBI608P)

1. Estimation of total protein in given solutions by Lowry's method.

2. Detection of SGOT and SGPT or GST and GSH in serum/ tissue

3. To study the enzymatic activity of Trypsin and Lipase.

4. Study of biological oxidation (SDH) [goat liver]

5. To perform the Acid and Alkaline phosphatase assay from serum/ tissue.

6. Dry Lab: To trace the labelled C atoms of Acetyl-CoA till they evolve as CO_2 in
the TCA cycle

Microbial Informatics
(BBI604A)

Unit 1

Bioinformatics, Genomics, and Antimicrobial Drug Discovery, Genomics of Bacterial Pathogens, Global Aspects of Antibiotic Resistance

Unit 2

The Pathway Tools Software and Its Role in Antimicrobial Drug Discovery.

Unit 3

Genomic Strategies in Antibacterial Drug Discovery, Genomics-Based Approaches to Novel Antimicrobial Target Discovery, Pathogenesis Genes as Novel Targets.

Unit 4

Microbial Proteomics: New Approaches for Therapeutic Vaccines and Drug Discovery Phenotype Micro Arrays: Their Use in Antibiotic Discovery, Surrogate LigandBased Assay Systems for Discovery of Antibacterial Agents for Genomic Targets.

Reference Books
1. R.H. Burdon, P.H. Van Knippenberg, (1990) "Laboratory techniques in Biochemistry and Molecular biology"; Elsevier Amsterdam. New York. Oxford, Second Edition, volume 8.
2. Michael R. Green, Joseph Sambrook, (2012) "Molecular cloning: a laboratory manual"; Cold Spring Harbor, N.Y.: Cold Spring Harbor Laboratory Press, 4th Edition.
3. Prescott's Microbiology 10th Edition By Joanne Willey and Linda Sherwood and Christopher J. Woolverton
4. Drug Discovery, Design & Development Singh Arjun Edition: 2013 ISBN: 9783659459986, 3659459984

Scientific writing and Statistics
(BBI604B)

Unit – 1
Research Definition ,Characteristics, Objectives, Research and Scientific method, and Types of Research

UNIT – 2
Literature Review, Review Concepts and Theories , Formulation of Hypothesis Sources of Hypothesis, Characteristics of Hypothesis, Role of Hypothesis and Tests of Hypothesis Threats and Challenges to Good Research

UNIT–3
Writing a Article, Essay, Research Paper, Research Project, Thesis, dissertation, Book Research Ethics , Citation Methods, Bibliography, Citation Rules

UNIT-4
Statistics: Probability & Sampling distribution; Estimation, Hypothesis testing & application; Correlation

Reference Books:
1) Russell A Jones: Research Methods in Social and Behavioural Sciences (Sinauer Associates Inc., Publishers, Sutherland Massachusetts 1996)
2) Fredrick L. Whitney – Elements of Research
3) Kothari C.K. (2004) 2/e, Research Methodoloy – Methods and Techniques (New Age International, New Delhi)

Drug and Molecular Modelling
(BBI605A)

UNIT I
Classification of drugs, routes of drug administration. Absorption & Distribution of drugs. Role of kidney in drug interaction with biomolecules. Binding of drugs to plasma proteins.

UNIT II
Drug receptors: Drug-receptor interaction, Drug action not mediated by receptors. Structural based drug design, mechanism of their action. Lipinski's rule of 5, Clinical trials

UNIT III
Effect of drug doses on the rate of metabolism- mechanisms and importance of Phase I and Phase II biotransformation. Role of cytochrome p450. Enzyme inhibition strategies, enzyme induction and pharmacological activity, LD50 and IC50.

UNIT IV
Principles & mode of action cancer and HIV chemotherapy agents and target sites for cancer and HIV chemotherapeutic agents. antimetabolites, antibodies, plantibodies, radiation therapy and alkylating agents. PUBCHEM database. Quantitative Structure Activity Relationship (QSAR). Types of descriptors

Reference Books:
1. Singh.H and Kapoor. V.K, 2002. Organic pharmaceutical chemistry. Vallabh prakashan publishers. New Delhi
2. Andrew, R., 1998. Molecular modeling: principles and application. Leach. Harlow.
3. Andrew, R., 1997. Molecular modeling: Basic principles and applications. Hans- X.
4. Leach A. R., "Molecular Modeling- Principles and applications", Prentice Hall, 2ndedition, 1996.
5. Paul S Charifson, "Practical application of CADD", Informa Health Care, 1997.
6. PerunT.J. and C.L. Propst, "Computer Aided Drug Design", Informa Health Care, 1992.
7. Rastogi et al, "Bioinformatics – Genomics, proteomics, and drug discovery", PHI Publishing, 2008.

Advanced Techniques in Bioinformatics
(BBI605B)

Unit 1: Introduction

Biological data representation in digital form, Microarray, Next Generation Sequencing, Introduction to Artificial Intelligent, Introduction to search, Search algorithms, Heuristic search methods, optimal search methods,

Unit 2: Machine learning approaches

Principles Methods and Applications of: - Dynamic programming, Hidden Markov Model, Neural networks, Genetic algorithms.

Unit 3: Molecular Modeling

An overview. Introduction and challenges Molecular modeling methods – Conformational searching, Ramachandran maps, Ab-initio methods, Homology Modeling.

Unit 4: Data Mining

Introduction to Data Mining in Bioinformatics, data mining process- Data collection, Data preprocessing, data mining, information interpretation, visualization. Data mining tasks, classification, clustering, association, summarization, text mining etc. Data mining techniques- Databases and data ware housing, statistics, machine learning

Reference Book:-

1) Handbook of Hidden Markov models in Bioinformatics-Martin Gollery- CRC Press

2) Algorithms in Bioinformatics-Ed. Gary Benson, Roderic Page- Springer

3) Bioinformatics-The machine learning Approach- Pierre Baldi and Soren Brunek

4) Advance data mining techniques in Bioinformatics- Hui- Huan G Hsu- IGP

5) Building Bioinformatics Solutions –Cornod Bessant, I Shadforth, Oakleyoxford

6) Bioinformatics - machine learning Data mining in Bioinformatics - Bedi & Brunak

7) Protein Bioinformatics-Eidhammer, Jonassen, Taylor-Wiley

8) Bioinformatics: sequence and genome analysis by David Mount, cold spring harbor

Visual Basic and PHP
(BBI605C)

Unit 1: VB Fundamentals
Introduction to visual basic, menu bar, tool bar, project explorer, tool bar property window, form layout window, project types . Anatomy of forms – properties, methods & forms working with MDI form.

Unit 2 : Study of Various Controls
Command button, text button, Label box, Option button, check bar, frame controls, combo box, image controls, picture box, scroll bar, list bar, designing menu structure, Visual basic programming

Unit 3: Introduction to PHP
Evaluation of PHP, Basic Syntax, Defining variable and constant Php Data type, Operator and Expression Handling, Html Form With Php, Capturing Form Data, Dealing with Multivalue filed, Generating File uploaded form, Redirecting a form after submission.

Unit 4 : Decisions and loop and Function
Making Decisions, Doing Repetitive task with looping, Mixing Decisions and looping with Html What is a function, Define a function, Call by value and Call by reference, Recursive function

Unit 5: String and Array
Creating and accessing String, Searching & Replacing String, Formatting String, String Related Library function Definition, creation of array in PHP, Accessing array, Performing different operation in array

Reference Books:
1. Mastering Visual Basic by BPB publication

2. Peter Norton Guide to visual Basic

3. visual Basic 6 by Gary Cornell

4. Beginning with SQL server (TMH publication)

5. VB. Black book

6. PHP, My SQL, Apache –J C Meloni

Biochemical and Molecular Biology Methods
(BBI605D)

UNIT –1

Bio- safety rules and regulations and Good Laboratory Practice (GLP), Material safety Data sheets (MSDS). Preparation of Reagents, buffers, pH Analysis,

UNIT –2

Various Centrifugation methods, Quality and Quantity analysis of nucleic acids by Spectrophotometer and Bio Photometer. Quantification of Proteins by Lowry's and Bradford's methods

Unit -3

Isolation and Separation of Genomic DNA from plants/human/microorganisms; Plasmids isolation from microorganisms; RNA from Yeast; Agarose Gel Electrophoresis; Isolation, separation and analysis of Proteins by Native- PAGE and SDS- PAGE.

Unit -4

Gene amplification and Screening techniques: Primer Design, PCR; Blotting techniques: Southern, Northern and Western Blots; Bio Probe (Demonstration) and Radioactive probe (Theory). Molecular Markers by RFLP, AFLP, RAPD
methods (Demo).

Reference Books

1) John M. Walker and Ralph Rapley, (2002) "Molecular Biology and Bio technology"; University of Hertfordshire, Hatfield, UK, Fourth Edition
2) Bansal, M. P. (2013) "Molecular Biology and Biotechnology": Basic Experimental Protocols, New Delhi: TERI.
3) R.H. Burdon, P.H. Van Knippenberg, (1990) "Laboratory techniques in Biochemistry and Molecular biology"; Elsevier Amsterdam. New York. Oxford, Second Edition, volume 8.
4) Michael R. Green, Joseph Sambrook, (2012) "Molecular cloning: a laboratory manual"; Cold Spring Harbor, N.Y.: Cold Spring Harbor Laboratory Press, 4th Edition.

Biodiversity, Agriculture, Ecosystem and Environment
(BBI605E)

UNIT – I Biodiversity:
Biodiversity: status, scope, types, monitoring and documentation; major drivers of biodiversity change; biodiversity management approaches. Uses of Biodiversity, Loss of biodiversity, Metadatabases, Virtual libraries, Special interest networks, Biodiversity Application Software

UNIT – II Agriculture:
Crops: Comparative genomes of plant and model plants, Insect resistance, Improve nutritional quality, Grow drought resistant crops in poorer soils, Biodiversity of Indian medicinal plants. Ecosystem: Ecosystem structure; ecosystem function; energy flow and mineral cycling (C, N, P); primary production and decomposition; structure and function of some Indian ecosystems.

UNIT – III Conservation Biology:
Principles of conservation, major approaches to management, Indian case studies on conservation/management strategy (Project Tiger, Biosphere reserves)

UNIT – IV Environment:
Waste cleanup: Superbugs and their concept, Microbes and Climate change, Alternative energy sources and Fuel cells. Biotechnological applications of microbes, Antibiotic resistance, Forensic analysis of microbes, the reality of bioweapon, Metagenomics.

Reference Books:

2. Tandon, P., Abrol, Y.P. and Kumaria, S. (2007). Biodiversity and its Significance. I. K. International Publishing House Pvt. Ltd, New Delhi.

3. Singh, J.S., Singh, S.P. and Gupta, S.R. (2006). Ecology, Environment and Resource Conservation. Anamaya Publishers, New Delhi.

4. Raven, P.H., Berg, &ninK Wuano .tKeuniKSnKE .)2012(.M.D ,aKa kassnK ana .R.L .tu nE tauEuiK .cKI ,miKs

Project Work
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