Shobhit
Institute of Engineering & Technology
Deemed to-be-University
EDUCATION EMPOWERS

Syllabus

B.Tech. Bioinformatics

Approved and adopted in year 2018 (Board of Studies, August 3, 2018)
by 23rd Academic council (Agenda no-03)

SCHEME OF TEACHING – B. Tech. (Bioinformatics) II YEAR

Bachelor of technology -Bioinformatics is a four-year undergraduate programme that combines the study of information technology and computer science with the study of biology and medicine to understand the working of the human body. It involves the analysis of multiple factors which affect movement in our biological systems.

The curriculum of this programme is designed in such a manner that the students are taught all the essential concepts of bioinformatics through basic classroom teaching and experiential learning through various experiments and case studies. Students have full access to our state of the art laboratories where they can gain practical knowledge about the application of the Bioinformatics concepts in real life situations. The students also get a thorough understanding of the subjects of biotechnology so that they can focus on information analysis and biotechnology management.

After completion of this course, students can confidently do researches in the field of biotechnology and cancer cures, hence contributing to society. They can also opt for further studies in their field of interest and give wings to their career.

Program Education Objectives (PEOs):

PEO-1 The graduates will establish themselves as professionals by solving real-life problems using exploratory and analytical skills acquired in the field of Computer Science and Engineering.

PEO-2 The graduates will provide sustainable solutions to ever changing interdisciplinary global problems through their Research & Innovation capabilities.

PEO-3 The graduates will become employable, successful entrepreneur as an outcome of Industry-Academia collaboration.

PEO-4 The graduates will embrace professional code of ethics while providing solution to multidisciplinary social problems in industrial, entrepreneurial and research environment to demonstrate leadership qualities.

Program Outcomes (PO's)

PO1:Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

PO2: Problem analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

PO3: Design/development of solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

PO4: Conduct investigations of complex problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

PO5: Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

PO6: The engineer and society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

PO7: Environment and sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

PO8: Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

PO9: Individual and teamwork: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

PO10: Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

PO11: Project management and finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

PO12:Life-long learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Program Specific Outcomes

PSO1: Experiment and prepare programming concepts and provide new ideas and innovations towards research and societal issues.

PSO2: Analyse and develop computer programs in the areas related to algorithms, system software, cloud computing, artificial intelligence & machine learning, bioinformatics, big data analytics, block chain, cyber security and networking for efficient design of computer-based systems of varying complexity.

PSO3: Apply standard Software Engineering practices and strategies in software project development using open-source programming environment to deliver a quality product for business success.

Sl.No.	Course Work - Subject Area	Credits / Semester								Total Credits
		I	II	III	IV	V	VI	VII	VIII	
1	Humanities and Social Sciences including Management courses (HSS)		3	3	3					**9**
2	Basic Science Courses (BAS)	9.5	9.5	6						**25**
3	Engineering Science Courses (BIE)	8	8	3	3					**22**
4	Professional core courses (BIC)/ Minor Project/ Lab.			10	15	9	10	9		**53**
5	Professional Elective courses (BID)					6	6	6		**18**
6	Open Elective courses (..O)					6	6	6		**18**
7	Seminar, Project Work and Internship (BIC)								15	**15**
8	Mandatory Courses (MCC)			*	*	*	*	*	*	**0**
	Total	**17.5**	**20.5**	**22**	**21**	**21**	**22**	**21**	**15**	**160**

Changes: Addition of Biology for engineers in III Sem; Entrepreneurship in IV Sem; IPR and Engineering Ethics in VII Sem;Addition of Minor Project from III-VII Semester; Addition of Mandatory courses (Essence of Indian Traditional Knowledge; Cyber Security; Indian Constitution)

TEACHING SCHEME
(B.TECH BIOINFORMATICS ENGINEERING)

SCHEME OF TEACHING – B. TECH. BI II YEAR

S.No.	Subject	Subject Code	Credit	L	T	P
Semester III						
1.	Management Concept and Practices	HSS-308	3	3	0	0
2.	Biology for Engineers	BAS-311	3	3	0	0
3.	Remedial Mathematics III	BAS-309	3	3	0	0
4.	Biochemistry	BIC-301	4	4	0	0
5.	Cell Biology	BIC -302	3	3	0	0
6.	Object Oriented Programming	CSC -308	3	3	0	0
7.	Biochemistry Lab.	BIC -351	1	0	0	2
8.	Cell Biology Lab.	BMC -352	1	0	0	2
9.	**Minor Project-I**	BIC -361	1	0	0	2
10.	Essence of Indian Traditional Knowledge	MCC-301	**0**	0	0	0
		Total	**22**	**19**	**0**	**6**
Semester IV						
1.	Entrepreneurship	HSS-403	3	3	0	0
2.	Bioinformatics Algorithm	BIC-401	4	3	1	0
3.	Computational Biology	BIC-402	4	3	1	0
4.	Genetics	BTC-401	3	3	0	0
5.	Molecular Biology	BTC-403	3	3	0	0
6.	Bioinformatics Algorithm Lab.	BIC- 451	1	0	0	2
7.	Computational Biology Lab	BIC- 452	1	0	0	2

8.	Molecular Biology Lab.	BIC -453	1	0	0	2
9.	**Minor Project-II**	BIC -461	1	0	0	2
10.	Environmental Sciences	MCC- 401	**0**	**0**	**0**	**0**
		Total	**21**	**16**	**2**	**6**

SCHEME OF TEACHING – B. TECH. BM III YEAR

S.No.	Subject	Subject Code	Credit	L	T	P
Semester V						
1.	Genetic Engineering	BIC-502	4	4	0	0
2.	Immunotechnology	BIC-502	3	3	0	0
3.	Molecular Phylogeny and Evolution	BID-501	3	3	0	0
4.	Perl Programming and Bioperl	BID-502	3	3	0	0
5.	Bioinformatics	BIC-503	3	3	0	0
6.	Database Management Systems	CSC-508	3	3	0	0
7.	Perl Programming and Bioperl Lab	BIC-551	1	0	0	2
8.	**Minor Project-III**	BIC-561	1	0	0	2
9.	Cyber Security	MCC- 501	**0**	**0**	**0**	**0**
		Total	**21**	**19**	**0**	**4**
Semester VI						
1.	Immunoinformatics	BIC-601	4	3	1	0
2.	Genomics and Proteomics	BIC-602	3	3	0	0
3.	Pharmacogenomics and Pharmacogenetics	BID-601	3	3	0	0
4.	Cancer Biology	BID-602	3	3	0	0

5.	Human Computer Interface	CSC-608	3	3	0	0
6.	Artificial Intelligence	CSC-602	3	3	0	0
7.	Immunoinformatics Lab.	BIC-651	1	0	0	2
8.	Genomics and Proteomics Lab.	BIC-652	**1**	0	0	2
9.	**Minor Project-IV**	BIC-661	1	0	0	2
10.	Indian Constitution	MCC-601	**0**	**0**	**0**	**0**
		Total	**22**	**18**	**1**	**6**

SCHEME OF TEACHING – B. TECH. BM IV YEAR

S.No.	**Subject**	**Subject Code**	**Credit**	**L**	**T**	**P**
Semester VII						
1.	Drug Designing	BIC-701	3	3	0	0
2.	Bio-Python	BIC-702	3	3	0	0
3.	IPR in Bioinformatics	BID-701	3	3	0	0
4.	Biostatistics	BID-702	3	3	0	0
5.	Biophysical Techniques	BTC-705	3	3	0	0
6.	Neural Networks	CSC-702	3	3	0	0
7.	Drug Designing Lab	BIC-751	1	0	0	2
8.	Python Lab.	BIC-752	1	0	0	2
9.	**Minor Project-V**	BIC-761	1	0	0	2
10.	Technical Report Writing	MCC-708	**0**	**0**	**0**	**0**
		Total	**21**	**18**	**0**	**6**
Semester VIII						

1	Seminar ,Project Work and Internship (BIC_ 61/_71/_81)	BIC-	15	0	0	30

THIRD SEMESTER

MANAGEMENT CONCEPTS AND PRACTICES

HSS-308	Cr.	L	T	P
	3	3	0	0

Learning Objectives:

a. To understand ability and builds the confidence in the students.
b. To gain active listening and responding skills
c. To learn the style and organization in technical communication: Listening
d. To understand Politeness and Etiquette in communication; Cultural factors that influence communication
e. To learn Standard e-mail practices; Language in e-mail; Using internet for collecting information

Unit-I **[8 Hours]**

Definition of Management – Nature- Science or Art – Management and Administration – Development of Management Thought – Contribution of Taylor and Fayol – Functions of Management – Types of Business Organisation.

Unit –II **[8 Hours]**

PLANNING -Nature & Purpose – Steps involved in Planning – Objectives – Setting Objectives – Process of Managing by Objectives – Strategies, Policies & Planning Premises- Forecasting – Decision-making.

Unit –III **[8 Hours]**

Nature and Purpose – Formal and informal organization – Organization Chart – Structure and Process– Departmentation by difference strategies – Line and Staff authority – Benefits and Limitations–De-Centralization and Delegation of Authority – Staffing – Selection Process - Techniques .

Unit-IV **[8 Hours]**

Scope – Human Factors – Creativity and Innovation – Harmonizing Objectives – Leadership – Types of Leadership Motivation – Hierarchy of needs – Motivation theories – Motivational Techniques – Job

Enrichment – Communication – Process of Communication – Barriers and Breakdown – Effective Communication – Electronic media in Communication.

Unit-V **[8 Hours]**

System and process of Controlling – Requirements for effective control–The Budget as Control Technique–Information Technology in Controlling – Use of computers in handling the information– Productivity –Problems and Management –Control of Overall Performance – Direct and Preventive Control–Reporting–The Global Environment–Globalization and Liberalization–International Management and Global theory of Management.

REFERENCE BOOKS:

1. Harold Kooritz & Heinz Weihrich "*Essentials of Management*", Tata McGraw-Hill, 1998.
2. Joseph L Massie "*Essentials of Management*", Prentice Hall of India, (Pearson) Fourth Edition, 2003.
3. Tripathy PC And Reddy PN, "*Principles of Management*", Tata McGraw-Hill, 1999. David, Robbin Stephen A, "*Personnel and Human Reasons Management*", Prentice Decenzo Hall of India, 1996
4. JAF Stomer, Freeman R. E and Daniel R Gilbert, *Management*, Pearson Education, Sixth Edition, 2004.
5. Fraidoon Mazda, " *Engineering Management*", Addison Wesley,-2000

Course outcomes (COs):

Upon completion of this course, the students will be able to:

1. Develop and prepare for communications in a technical organization.
2. Develop skills for writing business letters and reports.
3. Participate in debates and interviews at global forum.
4. Communicate through phone and e-mail for business communication.
5. Coordinate meetings and projects in a technical organization.

BIOLOGY FOR ENGINEERS

BAS-311	Cr.	L	T	P
	3	3	0	0

Learning Objectives;

- To understand Biological concepts from an engineering perspective
- To understand the inter-connection between biology and future technologies
- To motivate technology application for biological and life science challenges

Unit-I **[8 Hours]**

BASIC CELL BIOLOGY -Introduction: Methods of Science-Living Organisms: Cells and Cell theory Cell Structure and Function, Genetic information, protein synthesis, and protein structure, Cell metabolism-Homoeostasis- Cell growth, reproduction, and differentiation.

Unit-II **[8 Hours]**

BIOCHEMISTRY AND MOLECULAR ASPECTS OF LIFE -Biological Diversity --Chemistry of life: chemical bonds--Biochemistry and Human biology--Protein synthesis—Stem cells and Tissue engineering.

Unit-III **[8 Hours]**

ENZYMES AND INDUSTRIAL APPLICATIONS -Enzymes: Biological catalysts, Proteases, Carbonic anhydrase, Restriction enzymes, and Nucleoside monophosphate kinases—Photosynthesis

Unit-IV **[8 Hours]**

MECHANOCHEMISTRYMolecularMachines/Motors,Cytoskeleton,Bioremediation, Biosensors

Unit-V **[8 Hours]**

NERVOUS SYSTEM, IMMUNE SYSTEM, AND CELL SIGNALING -Nervous system--Immune system- General principles of cell signaling.

Course Outcomes

CO 1: Understand the biological concepts from an engineering perspective

CO 2: Understand the concepts of biological sensing and its challenges

CO 3: Understand development of artificial systems mimicking human action

CO 4: Integrate biological principles for developing next generation technologies

CO 5: Understand the biological concepts in Human health

REFERENCE BOOKS:

1. Jeremy M. Berg, John L. Tymoczko and Lubert Stryer, "*Biochemistry*," W.H. Freeman and Co. Ltd., 6th Ed., 2006.
2. Robert Weaver, "*Molecular Biology*," MCGraw-Hill, 5th Edition, 2012.
3. Jon Cooper, "*Biosensors A Practical Approach*" Bellwether Books**, 2**004.
4. Martin Alexander, "*Biodegradation and Bioremediation,"* Academic Press, 1994.
5. Kenneth Murphy, "*Janeway's Immunobiology*," Garland Science; 8th edition, 2011.
6. Eric R. Kandel, James H. Schwartz, Thomas M. Jessell, "Principles of Neural Science, McGraw-Hill, 5th Edition, 2012.
7. S. ThyagaRajan, N. Selvamurugan, M. P. Rajesh, R. A. Nazeer, Richard W. Thilagaraj, S. Barathi, and M. K. Jaganathan, "*Biology for Engineers*," Tata McGraw-Hill, New Delhi, 2012.

REMEDIAL MATHEMATICS III

BAS-309	**Cr.**	**L**	**T**	**P**
	3	**3**	**0**	**0**

BIOCHEMISTRY

BTC- 301	**Cr.**	**L**	**T**	**P**
	4	**3**	**1**	**0**

Learning Objectives:

a. To explains the sources of energy supply of the processes running in the living organisms and molecular mechanisms of the energy transformation in the cells.
b. To analyse, compares and critically evaluates the information related to this topic.
c. To desribes the thermodynamics of the biological (living) systems: exergonic and endergonic reactions, Gibbs (free) energy, spontaneous and nonspontaneous reactions, free energy changes of coupled reactions.
d. To desribes the biological oxidation-reduction reactions and mechanisms of electron transfer by transporters of respiratory chains.
e. To describes hypotheses of origin and evolution of energy-transforming biological systems.

UNIT – I WATER, PH, & BIOLOGICAL BUFFERS [7Hrs] Important properties of water, the law of mass action, dissociation of water and its ionic product, pH, Bronsted acids, ionization of weak acids and bases. Henderson Haeselbatch equation, Titration curves, buffering action and physiological buffers.

UNIT – II CARBOHYDRATES [7Hrs]

Definition classification, Basic structure, properties and functions of saccacharides and related compounds, di-saccharides and poly- saccharides. Structural polysaccharides-cellulose and chitin, storage polysaccharides-starch, glycogen, peptidoglycan and glycosaminoglycans, proteoglycans and glycoproteins.

UNIT – III AMINO ACIDS AND PROTEINS [7Hrs]

Structure, properties, classification and functions of amino acids, amino acid sequence determination, structure and function of proteins. Protein denaturation and renaturation, folding pathways, folding accessory proteins, proteins purification procedures.

UNIT – IV LIPIDS [7Hrs]

Structure, nomenclature and physical and chemical properties of fatty acids. Classification of lipids, general structure and functions of triacylglycerole, Phospholipids, Sphingolipids, glycolipids, cholesterol & lipoproteins structure, properties and function of steroids.

UNIT – V ENZYMES [8Hrs]

Nomenclature and classification, co-enzymes and co-factors, reaction and derivation of Mchaelis-Menten equation, Line weaver-Burke, plot, inhibition kinetics and allosteric regulation of enzymes, isozymes, mode of catalysis.

UNIT – VI VITAMINS [6Hrs]

Definition and classification of vitamins, Biological role of Vitamins, diseases, visual cycle.

Course Outcomes (COs):

a. Describe the daily requirement, digestion and absorption of carbohydrates, proteins and lipids.
b. Discuss the metabolic pathways of carbohydrates and metabolic disorders associated with item.
c. Explain the metabolic pathways of lipids and metabolic disorders associated with item.
d. Demonstrate the metabolic pathways of amino acids, nucleic acids and associated disorders.
e. Summarize the hormonal regulation of metabolic pathways.

REFERENCE BOOKS:

1. Nelson, D.L. and Cox, M.M. 2007. Lehninger Principle of Biochemistry (4th eds.). W. H. Freeman and Co.
2. Berg, J.M., Tymoczko, J.L. and Stryer, L. 2007. Biochemistry (6th eds.). W.H. Freeman and Co.
3. Voet, D.J., Voet, J.G. and Pratt, C.W. 2008. Fundamentals of Biochemistry (3rd eds.). John Wiley Sons Inc.
4. Satyanarayana, U. and Chakrapani, U. 2007. Essentials of Biochemistry (2nd eds.). Books and allied Pvt. Ltd.
5. Murray, R.K., Granner, D.K. and Rodwell, V.W. Harper's illustrated biochemistry (27th eds.) Mc Graw Hill, USA.
6. Hames, D. and Hooper, N. 2008. Instant notes on biochemistry (3rd eds.). Taylor and Francis.
7. Jain, J.L., Jain, S. and Jain, N. 2008. Fundamentals of biochemistry. S. Chand, Publishers, New Delhi.

BIOCHEMISTRY LAB.

BTC- 351

Cr.	L	T	P
1	0	0	2

1. General guidelines for working in biochemistry lab.
2. Units of volume, weight, density and concentration measurements and their range in biological measurements. Demonstration of proper use of volume and weight measurement devices.
3. Preparation of different types of buffer.
4. Qualitative method for carbohydrates-distinguishing reducing from non-reducing sugar and keto- from aldo- sugar.
5. Quantitative and chromatographic method for amino acids estimation using ninhydrin reagent for distinguishing amino from imino acid.
6. Protein estimation by Biuret, Bradford and Lowry method.
7. Extraction of chloroplastic pigments, anthocyanin, carotenoids estimation and qualitative analysis by paper chromatography.
8. Estimation of sugars by anthrone method.
9. Determination of enzyme activity and effect of different factors.
10. Determination of permeability of β-cyanins across the membrane.
11. Determination of K_m and $V_{max.}$

Course Outcomes (COs):

a) Ability to understand fundamental concepts of biology, chemistry and biochemistry.

b) Ability to apply basic principles of chemistry to biological systems and molecular biology.

c) Ability to relate various interrelated physiological and metabolic events.

d) The student will get practical knowledge of Preparation of buffers and measurement of pH,

e) Qualitative tests of carbohydrates, Qualitative tests of proteins & Amino Acids, Comparative evaluation of different methods of protein analysis: UV, Lowry, Biuret, Bradford.

CELL BIOLOGY

BIC-302

Cr	L	T	P
3	3	0	0

Learning Objectives:

a) To understand the structures and purposes of basic components of prokaryotic and eukaryotic cells, especially macromolecules, membranes, and organelles
b) To understand how these cellular components are used to generate and utilize energy in cells
c) To understand the cellular components underlying mitotic cell division.
d) Students will apply their knowledge of cell biology to selected examples of changes orlosses in cell function. These can include responses to environmental or physiological changes, or alterations of cell function brought about by mutation.

UNIT – I THE CELL AND ORGANELLES [7Hrs]

Introduction, definition and type of cell, cellular compartmentalization and different cell organelles (structure and functions), the nucleus: global structure of chromosomes, chromosomal DNA and its packaging, organization and evolution of the nuclear genome.

UNIT – II BIO-MEMBRANES AND CYTOSKELETON [8Hrs]

Introduction to bio-membranes, plasma membrane: organization and transport across the plasma membrane and epithelia, nature of the cytoskeleton, intermediate filaments, extracellular matrix (ECM), cell-cell junctions.

UNIT - III CELL CYCLE [7Hrs]

General strategy of the cell cycle, mechanics of cell division, cell-cycle control, programmed cell death (apoptosis), signals that trigger cell death, growth and proliferation

UNIT – IV SIGNAL TRANSDUCTION [8Hrs]

Mechanisms of cell signaling, Intracellular receptor and cell surface receptors, signaling via G-protein linked receptors and enzyme linked receptor signaling pathways.

UNIT – V SYSTEMS BIOLOGY [9Hrs]

Structure and function of epithelial system, muscular system, circulatory system, endocrine system and nervous system.

Course Learning Outcome: Upon successful of this course student will able to

a) Describe the cell structure, components of cell, enzymes to emphasize the importance of cell as the basic unit of an organism.

b) An understanding about the role of various cellular organelles in modifying the functions of the cells, especially, metabolism and protein synthesis.

c) The role of cytoskeleton and modes of cellular transport will be discussed.

d) Understanding the cellular regulation through various types of cell signaling, cell division, apoptosis and cell differentiation.

e) Provide an overall understanding of the epithelial cells and cancer with a focus on neurobiology and neurodegenerative diseases.

REFERENCE BOOKS:

1. Cooper, G.M. and Hausman, R.E. The Cell- A molecular approach (4th eds.). A S M Press, Sinauer Associate Inc.
2. Karp, G. Cell and Molecular Biology, Concepts and Experiments, John Wiley and Sons.
3. Alberts, B., Johnson, A., Lewis, J., Raff, M., Roberts, K., Walter, P. 2008. Molecular Biology of Cell (5th eds.). Garland Sciences.
4. Benjamin Lewin. 2008. Genes IX. Oxford University Press.
5. Lodish, H., Berk, A., Kaiser, C.A., Krieger, M., Scott, M.P., Bretscher, A., Ploegh, H. and Matsudaira, P. 2008. Molecular Biology (6th eds.). W H Freeman and co.
6. Power, C.B. 2008. Cell Biology (3rd eds.). Himalaya Publishing House.
7. Gupta, P.K. 1999. Cell and Molecular Biology. Rastogi Publication, Meerut.

CELL BIOLOGY LAB

BIC-352 **Cr L T P**

1 0 0 2

1. Microscopy- Theoretical knowledge of Light and Electron microscope.

2. To study the following techniques through electron/ photomicrographs: fluorescence microscopy, autoradiography, positive staining, negative staining, freeze fracture, freeze etching shadow casting, endocytosis and phagocytosis.

3. To explain mitosis and meiosis using permanent slides.

4. Cell fractionation through centrifugation.

5. Isolation of chloroplast and its identification.

6. To study the effect of isotonic, hypotonic and hypertonic solutions on cells.

Course Learning Outcome

a) The candidate would have gained knowledge about the morphology of the basic microorganisms.

b) Basic knowledge about the operation and sterilization procedures in the laboratories would have been gained.

c) Different staining techniques to visualize the live and dead microorganisms would have been practiced.

d) An overview about blood cells and its morphology would have been studied.

e) Knowledge about different stages of cells would have been gained.

OBJECT ORIENTED PROGRAMMING

CSC-308

Cr	L	T	P
3	3	0	0

Unit I:

Introduction: Introducing object oriented approach, basic terms and ideas: abstraction, encapsulation, inheritance, polymorphism, OMT methodologies, links and associations, generalization and inheritance, aggregation, abstract classes, meta data, events and states, data flow diagrams, comparison of methodology, SA/SD, and JSD.

Unit II:

Simple programming in C++: Tokens, expression and control structures, functions in C++, classes and objects: information hiding, abstract data type, attributes, class declaration, state identity and behavior of an object.

Unit III:

Constructor and destructors: Instantiation of objects, default parameter value, object types, C++ garbage collection, dynamic memory allocation, operator overloading: Overloading unary operators and binary operators using friends, overriding methods.

Unit IV:

Inheritance and polymorphism: Defining derived classes, single inheritance, class hierarchy, derivationN-public, private and protected, virtual base classes, classification hierarchies polymorphism, method, parametric and run time polymorphism, virtual functions.

Unit V:

I/O Operations: C++ stream classes, unformatted and formatted I /O operation, working with files: open and closing file, pointer, input, output operations, class templates, function templates, exception handling: throwing and catching mechanism.

REFERENCE BOOKS:

1. Rambaugh James *et al.*, 1997. Object Oriented Design and Modeling, PHI

2. Bjarne Stroustrup. C++ Programming Language, Addison Wesley

3. Balagurusamy, E. 2001.Object Oriented Programming with C++, TMH.

4. Venugopal Rajkumar A.R, and Ravi Shankar T. 1997. Mastering C++. TMH.

5. Booch Grady, Object Oriented Analysis and Design with application 3/e, Pearson

Lab: Lab based on theory syllabus.

ESSENCE OF INDIAN TRADITIONAL KNOWLEDGE

MCC-301 **Cr L T P**

0 0 0 0

Unit I
[8Hours]

Introduction to traditional knowledge: Define traditional knowledge, nature and characteristics, scope and importance, kinds of traditional knowledge, the physical and social contexts in which traditional knowledge develop, the historical impact of social change on traditional knowledge systems. Indigenous Knowledge (IK), characteristics, traditional knowledge vis-à-vis indigenous knowledge, traditional knowledge Vs western knowledge traditional knowledge vis-à-vis formal knowledge.

Unit II **[8Hours]**

Protection of traditional knowledge: the need for protecting traditional knowledge Significance of TK Protection, value of TK in global economy, Role of Government to harness TK.

Unit III **[8Hours]**

Legal frame work and TK:**A:** The Scheduled Tribes and Other Traditional Forest Dwellers (Recognition of Forest Rights) Act, 2006, Plant Varieties Protection and Farmer's Rights Act, 2001 (PPVFR Act); **B:** The Biological Diversity Act 2002 and Rules 2004, the protection of traditional Knowledge bill, 2016. Geographical indicators act 2003.

Unit IV **[8Hours]**

Traditional knowledge and intellectual property: Systems of traditional knowledge

protection, Legal concepts for the protection of traditional knowledge, Certain non IPR mechanisms of traditional knowledge protection, Patents and traditional knowledge, Strategies to increase protection of traditional knowledge, global legal FORA for increasing protection of Indian Traditional Knowledge.

Unit V **[8Hours]**

Traditional knowledge in different sectors: Traditional knowledge and engineering,Traditional medicine system, TK and biotechnology, TK in agriculture, Traditional societies depend on it for their food and healthcare needs, Importance of conservation andsustainable development of environment, Management of biodiversity, Food security of the country and protection of TK.

COURSE OUTCOMES:

1. Identify the concept of Traditional knowledge and its importance.
2. Explain the need and importance of protecting traditional knowledge.
3. Illustrate the various enactments related to the protection of traditional knowledge.
4. Interpret the concepts of Intellectual property to protect the traditional knowledge.
5. Explain the importance of Traditional knowledge in Agriculture and Medicine.

REFERENCE BOOKS:

1. Traditional Knowledge System in India, by Amit Jha, 2009.

2. Traditional Knowledge System and Technology in India by Basanta Kumar Mohanta and Vipin Kumar Singh, Pratibha Prakashan 2012.

3. Traditional Knowledge System in India by Amit Jha Atlantic publishers, 2002

4. "Knowledge Traditions and Practices of India" Kapil Kapoor1, Michel Danino

MINOR PROJECT

BIC-361

COURSE OUTCOMES:

a) The student may develop a process of interest to achieve strategic goals
b) The student may develop skills to manage creative teams and project process effecftively and efficiently
c) The studenty may develop a leadership effectiveness in organizations
d) The students may accquire concepts to address specific management needs

The student may develop a tool to for the betterment of the society

FOURTH SEMESTER

ENTERPRENEURSHIP

HSS-403	**Cr.**	**L**	**T**	**P**
	3	**3**	**0**	**0**

UNIT I **[8Hours]**

Concept and need of Entrepreneurship, Definition of Entrepreneur, Entrepreneurship innovation, Creativity, Business idea, Entrepreneurship as a career, Entrepreneurship as a style of management, the changing role of the entrepreneur, Entrepreneurial traits

UNIT II **[9Hours]**

Influences on entrepreneurship development, External influences entrepreneurship development, Socio-cultural, political, economical, personal entrepreneurial success and failure: reasons and remedies, women entrepreneurs, Challenge to women entrepreneurs, achievements of women entrepreneurs

UNIT III **[8Hours]**

The business plan as an entrepreneurial tool; elements of businessman ;objectives ;market analysis; development of product/idea; marketing, finance, organization and management ;ownership; critical risk contingencies of the proposal ;scheduling and milestones.

UNIT IV **[8Hours]**

Technical ,financial ,marketing personnel ,and management feasibility reports; financial schemes offered by various financial institution, like commercial Banks, IDBI, ICICI, SIDBI, SFCs.

UNIT V **[8Hours]**

Role of central government and state government in promoting entrepreneurship with various incentives, subsidies, grants, etc.

Course Outcomes (Cos): After the completion of the course, the students will be able to:

a. Have the ability to discern distinct entrepreneurial traits.

b. Know the parameters to assess opportunities and constraints for new business ideas.

c. Understand the systematic process to select and screen a business idea.

d. Design strategies for successful implementation of ideas.

e. Write a business plan.

REFERENCE BOOKS:

1. Khanka,S.S.,*Entrepreneurial Development*,S.Chand, New Delhi.
2. Hisrich D.robert ,Michael P.Peters, dean A.Shepherd, *Entrepreneurshipand Small Business Management* ,PHI,4th Ed .
3. Patel ,V.G.,*The Seven Business Crises and How To Beat Them* ,Tata McGraw-Hill, New Delhi, 1995.
4. Holt H. David, *Entrepreneurship : New Venture Creation*, Prentice –Hall of India, New Delhi

BIOINFORMATICS ALGORITHM

BIC- 401 **Cr L T P**
4 3 1 0

BIOINFORMATICS ALGORITHM LAB.

BIC- 451 **Cr L T P**
1 0 0 2

COMPUTATIONAL BIOLOGY

BIC- 402 **Cr L T P**
4 3 1 0

This course will introduce the discipline of computational biology and drug design. It has been designed to explain the different aspects of nucleotide and protein sequence analyses, sequence alignments and their applications in understanding biology. The course will also emphasize on the strategic issues in drug discovery and development, principles of computational methods involved in lead generation virtual screening, quantitative structureactivity relationship and molecular docking.

Students would be able in Sequence alignment and visualization and Phylogenetic and microarray analysis

Sequence alignment and database searching Global and local alignments, statistical significance of alignments, scoring matrices and gap penalties, filtering, position specific scoring matrices, internet resources, Pairwise and multiple alignment, uses of pairwise and multiple sequence alignment, programs and methods for sequence alignment, pattern searching programs, family and superfamily representation, structural inference, dynamic programming algorithms, alignment by hidden Markov models, consensus word analysis, more complex scoring.

Phylogenetic prediction Trees-splits and metrices on trees, tree interpretation, Distance – additive, ultrameric and nonadditive distances, tree building methods, phylogenetic analysis, parsimony, tree evaluation, maximum likelihood trees – continuous time markov chains, estimating the rate of change, likelihood and trees; analysis software

ESTs – databases, EST clustering, TIGER indices, gene prediction in genomic DNA, gene annotation, Protein identification, physical properties, motifs and patterns, structure, folding classes, structure classification, sequence assembly, global assembly.

Molecular modeling: PDB and MMDB, structure file formats, visualizing structural information, advance structure modeling, Internal and external co-ordinate system, cartesian and cylindrical polar co-ordinate system, Potential energy calculations using semiempirical potential energy function, Molecular mechanics and dynamics.

Secondary structure prediction of proteins and RNA, Docking of Molecules, Knowledge base structure prediction, Molecular Design, structure similarity searching; prediction of buried residues in proteins;

References

1. Baxevanis, D. A and Ouellette, F. B., Bioinformatics: A practical guide to the analysis of Genes and proteins, 2001, (IIndedi) a John Wiley & sons, inc., publication.
2. Mount, W. D.2005. Bioinformatics: Sequence and genomic analysis (2nd eds.) CBS publishers and distributors New Delhi.
3. Westhead D.R., Parish J.H. and Twyman R.M. 2003. Instant notes: Bioinformatics BIOS Scientific Publishers Ltd.

Rastogi, S.C., Mendiratta, N. and Rastogi, P. 2007. Bioinformatics: concept skill and applications

COMPUTATIONAL BIOLOGY LAB.

BIC- 452 **Cr L T P**
1 0 0 2

GENETICS

BTC- 401 **Cr L T P**
4 4 0 0

Learning Objectives:

a. To discuss the structure of nucleic acids & proteins and their interactions.
b. To describe the mechanisms of central dogma of life.
c. To study the molecular mechanisms of gene regulation in prokaryotes and eukaryotes.
d. To demonstrate Mendelian inheritance
e. To calculate recombinant frequencies and construct pedigree analysis.
f. To study chromosomal aberrations in humans.

UNIT – I PHYSICAL BASIS OF HEREDITY [6Hrs]

Basic law of inheritance, deviations of Mendel's ratios due of gene interaction, concept of alleles, complementation test, multiple factors of inheritance. genes and environment interaction. probability and statistical testing.

UNIT – II CELL DIVISION, LINKAGE, RECOMBINATION AND GENE MAPPING METHODS [8Hrs]

Mitosis, meiosis, chromosomal inheritance, concept of linkage, crossing over and mapping to genes by recombination frequency , three point test cross, tetrad analysis, mitotic crossing over, sexuality and recombination in bacteria and viruses, molecular mechanism of genetic recombination.

UNIT – III SEX DETERMINATION AND SEX LINKAGE [7Hrs]

Mechanism of sex determination in animals and plants, sex linked, sex influence and sex limited traits, sex linked disorders in human beings.

UNIT – IV CYTOGENETIC, MUTATION AND EXTRA CHROMOSOMAL INHERITANCE [7Hrs]

Chromosome aberrations, polyploidy. Mutation: type, cause and detections, application of mutants. Maternal inheritance: inheritance of mitochondrial and chloroplast genes, Transposable elements, transpositions of transposons in genome.

UNIT – V MOLECULAR AND HUMAN GENETICS [8Hrs]

Identification of genetic materials, the genetic code, gene regulation and gene expression. Pedigree analysis, genetic disorders, inborn errors of metabolism (Phenylketonuria and Galactosemia), neurogenetic disorders (Alzheimer's and Parkinson's), muscle genetic disorders (Muscular Dystrophy), cancer genetics and genetic counselling.

Course Outcomes (COs):

a. Discuss the basic organization of the human genome.
b. Explain the Mendelian inheritance patterns in humans and the associated complications.
c. Describe the Mitochondrial inheritance, X-inactivation.
d. Learn in detail about the chromosomal basis of human diseases and genetics of pregnancy.
e. Describe the different types of mutations and their relevance for diseases and basic concepts in molecular pathology.

REFERENCE BOOKS:

1. Gardner, E.J., Simmons, M.J. and Snustad, P.D. 2007. Principles of Genetics (8th eds.). Wiley's India, New Delhi.
2. Gupta, P.K. 1999. Cell and molecular biology (1st ed.). Rastogi Publications
3. Hartl, D.R. and Jones, J. 2008. Genetics, Analysis of Genes and Genomes (5th eds.). Johns and Barttlett Publishers.
4. Tamarin, R.H. 2006. Principles of Genetics (7th eds.). TMH Publications.
5. Strickberger, M.W. 2007. Genetics (3rd eds.). Prentice Hall of India.
6. Prasad, S. 2004. Elements of biostatistics (1st eds.). Rastogi Publication.

Russell, P.J. 2006. *i*Genetics: a molecular approach (2nd eds.). Pearson Benjamin Cummings

MOLECULAR BIOLOGY

BTC-403

Cr	L	T	P
3	3	0	0

Learning Objectives:

a. To describe the structure of nucleic acids & proteins and their interactions.
b. To explain the mechanisms of central dogma of life.
c. To study the molecular mechanisms of gene regulation in prokaryotes and eukaryotes.
d. To demonstrate Mendelian inheritance
e. To calculate recombinant frequencies and construct pedigree analysis.

To study chromosomal aberrations in humans

UNIT – I DNA STRUCTURE REPLICATION AND REPAIR [10Hrs]

Nucleic acids and their structure, nucleic acid as genetic material, types of DNA, DNA replication in prokaryotes and eukaryotes, model of DNA replication, DNA repair: types and

mechanism DNA repair in prokaryotes and eukaryotes.

UNIT – II ORGANIZATION OF GENETIC MATERIAL [7Hrs]

Packaging of DNA as nucleosides in chromosome, repetitive and unique DNA sequences, split genes, overlapping genes and pseudo genes.

UNIT – III TRANSCRIPTION IN PROKARYOTES AND EUKARYOTES [8Hrs]

Central dogma concept, transcription in prokaryotes: initiation, elongation and termination.

Transcription in eukaryotes: RNA polymerase, transcription factors and initiation RNA synthesis, elongation and termination of RNA synthesis. Transcription in mitochondria and chloroplast.

UNIT – IV RNA PROCESSING [6Hrs]

Ribosome- Structural features of prokaryotic and eukaryotic ribosome. Types of RNA, processing of RNA and RNA Splicing, mRNA transport, mRNA synthesis in prokaryotes and eukaryotes.

UNIT – V TRANSLATION IN PROKARYOTES AND EUKARYOTES [7Hrs]

Initiation and elongation of polypeptide, formation of peptide bond, termination of polypeptide, modification, folding and transport of released polypeptide, protein sorting or protein trafficking, protein folding.

UNIT – VI REGULATION OF GENE EXPRESSION [6Hrs]

Regulation of gene expression in bacteria- operon concept, inducible and repressible operons (lac and trp), catabolite repression of lac operon in *E.coli*. Control of gene expression in eukaryotes. enhancers, silencers and other upstream controlling elements. DNA methylation. Chromatin remodelling.

Course Outcomes (COs):

a. Exhibit a knowledge base in genetics, cell and molecular biology, and anatomy and physiology.
b. Demonstrate the knowledge of common and advanced laboratory practices in cell and molecular biology.
c. Exhibit clear and concise communication of scientific data.
d. Engage in review of scientific literature in the areas of biomedical sciences.
e. Critique and professionally present primary literature articles in the general molecular biology field.

REFERENCE BOOKS:

1. Cooper, G.M. and Hausman, R.E. The Cell- A molecular approach (4th eds.). A S M Press, Sinauer Associate Inc.
2. Karp, G. Cell and Molecular Biology, Concepts and Experiments, John Wiley and Sons.
3. Alberts, B., Johnson, A., Lewis, J., Raff, M., Roberts, K., Walter, P. 2008. Molecular Biology of Cell (5th eds.). Garland Sciences.
4. Benjamin Lewin. 2008. Genes IX. Oxford University Press.
5. Lodish, H., Berk, A., Kaiser, C.A., Krieger, M., Scott, M.P., Bretscher, A., Ploegh, H. and Matsudaira, P. 2008. Molecular Biology (6th eds.). W H Freeman and co.
6. Power, C.B. 2008. Cell biology (3rd eds.). Himalaya Publishing House.
7. Gupta, P.K. 1999. Cell and Molecular biology. Rastogi Publication. Meerut.
8. Russell, P.J. 2006. *i*Genetics: a molecular approach (2nd eds.). Pearson Benjamin Cummings.

MOLECUAR BIOLOGY LAB

BTC-453

Cr	L	T	P
1	0	0	2

1. Estimation of DNA content by diphenyl amine method.
2. UV quantitation of DNA by UV absorbance spectrophotometry.
3. Estimation of RNA content by orcinol method.
4. Isolation of plant cell genomic DNA.
5. Isolation of bacterial/fungal genomic DNA.
6. SDS-PAGE for proteins.
7. Regulation of prokaryotic gene expression (Lac Operon)

Course Outcomes (COs):

1. By the end of this course, students should be able to demonstrate knowledge and understanding of the principles underpinning DNA isolation from various sources.
2. By the end of this course, students should be able to demonstrate knowledge and understanding of restriction digestion.
3. By the end of this course, students should be able to demonstrate the ability to carry out competent cell preparation and transformation.
4. By the end of this course, students should be able to demonstrate the ability to carry out phage titration.
5. By the end of this course, students will be aware of the hazardous chemicals and safety precautions in case of emergency.

ENVIRONMENTAL SCIENCES

MCC-401

Cr	L	T	P
0	0	0	0

Learning Objectives:

a. To discuss the natural environment and its relationships with human activities to Integrate facts.
b. To describe the concepts and methods from multiple disciplines and apply to environmental problems.
c. To explain types of pollution- Air, water.
d. To learn methods of environmental protection, biological indicators, biosensors.
e. To discuss Climate change- Reasons, Greenhouse effect, Global warming.

UNIT I:

Natural Resources- Renewable and Non-renewable Resources, Forests, water, minerals, Food and land (with example of one case study

UNIT II:

Biodiversity and its conservation-Biodiversity at global, national and local levels; India as a mega-diversity nation; Threats to biodiversity (biotic, abiotic stresses), and strategies for conservation.

UNIT III:

Environmental Pollution-Types of pollution- Air, water (including urban, rural, marine), soil, noise, thermal, nuclear; Pollution prevention.

UNIT IV:

Environmental Biotechnology- For environmental protection, biological indicators, biosensors, bioremediation, phytoremediation, biopesticides, biofertilizers.

UNIT V:

Social Issues and Environment- Climate change- Reasons, Greenhouse effect, Global warming. Legal issues- Environmental legislation (Acts and issues involved), Environmental ethics.

Course outcomes (COs):

Upon completion of this course, the students will be able to:

a. Understand the environmental issues pertaining to day-to-day living; gain awareness for need of environmental education vis-à-vis education for sustainable development.
b. Understand and be aware of the management of natural resources; importance of the conserving energy and environmental resources.
c. Understand the need for intellectual property associated with endemic and valuable biological resources.

d. Understand about global issues associated with climatic changes and international protocols.
e. Aware of the diverse variety of social issues associated with environmental deterioration involving human component such as population, rights, ethics.

REFERENCE BOOKS:

1. Gilbert M. Masters, (2004),Introduction to Environmental Engineering and Science, 2nd Ed., Pearson
2. Benny Joseph, (2006), Environmental Science and Engineering, Tata McGraw Hill, New Delhi
3. Rajagopalan.R., (2005), Environmental Studies – from crisis to cure, Oxford University Press
4. DarmendraS.Senger., (2007), Environmental Law, Prentice Hall of India (P) Ltd, New Delhi
5. Hans-JoachinJoerdening and Josef Winter., (20 05)), Environmental Biotechnology; Concepts and Applications, Willy-VCH Verlag

MINOR PROJECT

BIC-461

COURSE OUTCOMES:

a) The student may develop a process of interest to achieve strategic goals
b) The student may develop skills to manage creative teams and project process effecftively and efficiently
c) The studenty may develop a leadership effectiveness in organizations
d) The students may accquire concepts to address specific management needs
The student may develop a tool to for the betterment of the society

FIFTH SEMESTER

GENETIC ENGINEERING

BIC- 501 **Cr L T P**
3 3 0 0

Learning Objectives:

a. To familiarize the student with emerging field of biotechnology i.e. Recombinant DNA Technology as well as to create understanding and expertise in wet lab techniques in genetic engineering.
b. Design process equipment, plants, biosensors and recombinant molecules for biotechnological and allied processes.
c. Apply research based knowledge and biotechnological methods to investigate complex biological problems.

To apply Recombinant DNA Technology for the human welfare

UNIT – I **[8Hrs]**

Gene cloning and need to clone a gene; Isolation and purification of plasmid, chromosomal and genomic DNA from bacterial, plant and animal cells.

UNIT – II **[8Hrs]**

Different cloning vectors like plasmids, cosmids, phagemids, shuttle vectors, and other vectors for plant and animals; enzymes used in recombinant DNA technology like restriction

endonucleases, ligases, polymerases, kinases and phosphatases.

UNIT – III **[8Hrs]**

Cloning of a specific gene; studying gene location and structure; studying gene expression; expression of foreign genes in research and biotechnology; maximization of recombinant proteins; brief introduction to sequencing and site directed mutagenesis, different types of PCR and applications; safety measures and regulations for recombinant DNA work

UNIT – IV **[8Hrs]**

A brief introduction to the followings: phage display system, Yeast two hybrid system, and RNAi technology.

UNIT – V **[8Hrs]**

Applications of recombinant DNA technology in the fields of Medicine, Agriculture, Forensic and Environment.

Course Learning Outcomes (COs):

a. Learn about the vectors and their ideal characteristics.
b. Understand different methods of recombinant DNA techniques like labeling DNA, PCR and gene sequencing.

c. Gain knowledge about prokaryotic and mammalian expression vectors and cloning in plants.
d. Learn about preparation of genomic and cDNA libraries, mutagenesis, and cloning techniques for altering gene expression.
e. Learn about various applications of rDNA technology and how to handle the genetically modified organisms.

REFERENCE BOOKS:

1. Primrose, S.B. and Twyman, R.M. 2006. Principles of gene manipulation and genomics (7th eds.). Blackwell Publishing.
2. Winnacker, Ernst-L. 2003. From Gene to Clone Introduction to gene technology. Panima publishing Corp., New Delhi.
3. Old, R.W. and Primrose, S.B. 1985. Principles of gene manipulation: An introduction to genetic engineering. Blackwell Science Publication.
4. Brown, T.A. 2008. Gene Cloning and DNA analysis (5th eds.). Blackwell Sciences LTD.
5. Gupta, P.K. 2008. Biotechnology and Genomics (1st ed.). Rastogi Publication.

IMMUNOTECHNOLOGY

BIC- 502

Cr	L	T	P
3	3	0	0

Learning Objectives:

a. To understand innate and adaptive immune responses.
b. To understand the role of primary and secondary lymphoid organs.
c. To understand antigen and antibody interactions.
d. To understand the mechanism of immunization.
e. To understand the role of immune system in organ transplantation, autoimmune disorders and Cancer.

Unit I:

. **Introduction to Immunology:** History and terminology, innate and acquired immunity, active and passive immunity, immune responses, cells (T-cells, B-cells) and organs of immune system, cell mediated and humoral immunity, cytokines, toll-like receptors.

Unit II:

. **Antibody:** Classification, isotypes, fine structure**,** biosynthesis of immunoglobulin, rearrangement of genes and class switching, complement system.

Antigen: Nature of antigens, haptens, adjuvants, vaccines.

Unit III:

MHC complex: Function, structure and MHC restriction.

Unit IV:

Principles of virulence and pathogenicity: Host-parasite interactions.

Transplantation and tumor immunology: Tumor cell immunity, transplantation of tissues and organs, relationship between donor and recipient, role of MHC molecules in allograft rejection, bone marrow and haematopoietic stem cell transplantation, tumor antigen, tumor immunoprophylaxis.

Unit IV:

Applied immunotechnology: Antigen-antibody interaction, affinity and avidity, agglutination and precipitation reactions, immunoflourescence, fluorescence activated cell sorting analysis.

Antibody engineering: Hybridoma and monoclonal antibody (Mab), recombinant antibody molecules, human and humanized antibodies, uses of Mab.

Antigen engineering: ELISA, RIA, immunodiffusion, immunoelectrophoresis, immunoblotting, antibody for diagnosis, antibody for therapy, cytokine therapy

Course Outcomes (COs):

a. Relate the formation and phases of active and passive immune reactions with immunotherapeutic products.
b. Describe agents producing immune reaction
c. Compose the pharmaceutical design and application fields of immunological agents
d. Relate the formation and phases of active and passive immune reactions with immunotherapeutic products
e. compose the pharmaceutical design and application fields of immunological agents

REFERENCE BOOKS:

1. Willey, J.M., Sherwood, L.M. and Woolverton, C.J. 2008. Prescott, Harley and Klein's Microbiology (7th eds.). Mc Graw Hill, USA.
2. Playfair, J. and Bancroft, G. 2007. Infection and Immunity (3rd eds.). Oxford University Press.
3. Chakravarty, A.K. 2008. Immunology and Immunotechnology (3rd eds.). Oxford University Press.
4. Tizard. 2008. Immunology: An introduction (4th eds.). Cengege learning.
5. Rao, C.V. 2008. Immunology: A text book. Narosa Publishing House.

MOLECULAR PHYLOGENY AND EVOLUTION

BID- 501

Cr	L	T	P
3	3	0	0

PERL PROGRAMMING AND BIOPERL

BID- 502

Cr	L	T	P
3	3	0	0

PERL PROGRAMMING AND BIOPERL LAB.

BID- 552

Cr	L	T	P
1	0	0	2

BIOINFORMATICS

BIC- 503

Cr	L	T	P
3	3	0	0

Learning Objectives:

a. To provide a national bio-information network designed to bridge the inter-disciplinary gaps in biotechnology information.

b. To establish link among scientists in organizations involved in R & D and manufacturing activities in biotechnology.

c. To build up information resources, prepare database on biotechnology and to develop relevant information handling tools and techniques.

UNIT – I INTRODUCTION [7Hrs]

Introduction to strings, edit distance strings, string similarity, elementary commands and protocols, Scope of Bioinformatics.

UNIT – II SEQUENCE DATABASES AND THEIR USE [8Hrs]

Introduction to databases, database search, algorithms issues in database search, sequence

database search, parametric sequence alignments, sub optimal alignments, dynamic programming global and local alignment gaps, multiple alignment, common multiple alignment methods. FASTA and BLAST. Amino acid substitution matrices PAM and BLOSSOM.

UNIT – III EVOLUTIONARY TREES AND PHYLOGENY [7Hrs]

Ultrasonic trees, parsimony, ultrametric problem, perfect phylogeny, phylogenetic alignment, connection between multiple alignment and tree constructions.

UNIT – IV PROTEIN CLASSIFICATION AND STRUCTURE VISUALIZATION [9Hrs]

Overview of the protein structure, protein structure visualization, visualization tools and databases, protein structure alignment, protein classification approaches, tools for plotting

Protein - ligand interaction.

UNIT – V PROTEIN STRUCTURE PREDICTION [9Hrs]

Protein identification and characterization, primary structure analysis and prediction, secondary structure analysis and prediction, *Ab initio* method for protein prediction, protein function prediction.

UNIT – VI APPLICATIONS OF BIOINFORMATICS [8Hrs]

DNA mapping and sequencing, gene predictions, molecular predictions with DNA strings, role of bioinformatics in drug design.

Course Outcomes:

a. Infer the biological problems using appropriate in silico approaches.
b. Select the suitable tools or servers to solve the specific biological issue and curate experimental data.
c. Perform and analyze database similarity search and sequence alignment.
d. Construct and analyze phylogenetic trees.
e. Use appropriate tools and packages to analyze varied range of biological problems.

REFERENCE BOOKS:

1. David W. Mount. 2005. Bioinformatics: Sequence and Genome analysis, Cold Spring Harbor Laboratory Press.

Jones, N.C. and Pevzner, P. A. 2004. An Introduction to Bioinformatics Algorithms. The MIT Press

DATABASE MANAGEMENT SYSTEMS

CSC- 503

Cr	L	T	P
3	3	0	0

MINOR PROJECT

BIC-561

COURSE OUTCOMES:

a) The student may develop a process of interest to achieve strategic goals
b) The student may develop skills to manage creative teams and project process effecftively and efficiently
c) The studenty may develop a leadership effectiveness in organizations
d) The students may accquire concepts to address specific management needs
e) The student may develop a tool to for the betterment of the society

CYBER SECURITY

MCC- 501

Cr.	L	T	P
0	2	0	0

UNIT-1

Introduction to information systems, Types of information Systems, Development of Information

Systems, Introduction to information security, Need for Information security, Threats to Information Systems, Information Assurance, Cyber Security, and Security Risk Analysis.

UNIT-2

Application security (Database, E-mail and Internet), Data Security Considerations-Backups, Archival Storage and Disposal of Data, Security Technology-Firewall and VPNs, Intrusion Detection, Access Control. Security Threats -Viruses, Worms, Trojan Horse, Bombs, Trapdoors, Spoofs, E-mail viruses, Macro viruses, Malicious Software, Network and Denial of Services Attack, Security Threats to E-Commerce-Electronic Payment System, eCash,Credit/Debit Cards. Digital Signature, public Key Cryptography.

UNIT-3

Developing Secure Information Systems, Application Development Security, Information Security Governance & Risk Management, Security Architecture & Design Security Issues in Hardware, Data Storage & Downloadable Devices, Physical Security of IT Assets, Access Control,CCTV and intrusion Detection Systems, Backup Security Measures.

UNIT-4

Security Policies, Why Policies should be developed, WWW policies, Email Security policies, Policy Review Process-Corporate policies-Sample Security Policies, Publishing and Notification Requirement of the Policies. Information Security Standards-ISO, IT Act, Copyright Act, Patent Law, IPR. Cyber Laws in India; ITAct 2000 Provisions,Intellectual Property Law: Copy Right Law, Software License, Semiconductor Law and Patent Law.

REFERENCE BOOKS:

1. Charles P. Pfleeger, Shari Lawerance Pfleeger, “Analysing Computer Security ”, Pearson Education India.

2. V.K. Pachghare, “Cryptography and information Security”, PHI Learning Private Limited, Delhi India.

3.Dr. Surya Prakash Tripathi, Ritendra Goyal, Praveen kumar Shukla ,”Introduction to Information Security and Cyber Law” Willey Dreamtech Press.

4. Schou, Shoemaker, “ Information Assurance for the Enterprise”, Tata McGraw Hill.

5. CHANDER, HARISH**,”** Cyber Laws And It Protection **”** , PHI Learning Private Limited ,Delhi ,India

COURSE OUTCOMES:

a) Describe network security services and mechanisms.
b) Symmetrical and Asymmetrical cryptography
c) .Data integrity, Authentication, Digital Signatures.
d) Various network security applications, IPSec, Firewall, IDS, Web security, Email security, and Malicious software etc.

SIXTH SEMESTER

IMMUNOINFORMATICS

BIC- 601

Cr	L	T	P
4	3	1	0

GENOMICS AND PROTEOMICS

BIC- 602

Cr	L	T	P
3	3	0	0

Learning Objectives:

a. Understand organization and structure of prokaryotic, eukaryotic and organellar genomes.
b. Study molecular markers, DNA sequencing and bioinformatic tools for genome analysis.
c. Analyse gene expression using northern blotting, RT-PCR and micro array.
d. Comprehend the techniques of protein separation, sequencing, identification and protein-protein interactions.
e. Understand the clinical and biomedical applications of proteomics.

UNIT - I BASICS OF RECOMBINANT DNA TECHNOLOGY [8Hrs]

Manipulation of DNA – Restriction and Modification enzymes, Design of linkers and adaptors. Characteristics of cloning and expression vectors based on plasmid and bacteriophage, Vectors for insect, yeast and mammalian system, Prokaryotic and eukaryotic host systems, Introduction of recombinant DNA in to host cells and selection methods.

UNIT – II DNA LIBRARIES [8Hrs]

Construction of genomic and cDNA libraries, Artificial chromosomes – BACs and YACs, Chromosomal walking, Screening of DNA libraries using nucleic acid probes and antisera.

UNIT – III SEQUENCING AND AMPLIFICATION OF DNA [8Hrs]

Maxam Gilbert's and Sanger's methods of DNA sequencing. Inverse PCR, Nested PCR, AFLP-PCR, Allele specific PCR, Assembly PCR, Asymmetric PCR, Hot start PCR, inverse PCR, Colony PCR, single cell PCR, Real-time PCR/qPCR – SYBR green assay, Taqman assay, Molecular beacons. Site directed mutagenesis.

UNIT – IV [8Hrs]

Organization and structure of genomes, Genome sequencing methods, Conventional and shotgun genome sequencing methods, Next generation sequencing technologies , Ordering the genome sequence, Genetic maps and Physical maps, STS content based mapping, Restriction Enzyme Finger Printing, Hybridization mapping, Radiation Hybrid Maps, Optical mapping. ORF finding and functional annotation.

UNIT - V [8Hrs]

Current status of genome sequencing projects, Introduction to Functional genomics, Microarrays, Serial Analysis of Gene expression (SAGE), Subtractive hybridization, DIGE,

TOGA, Yeast Two hybrid System, Comparative Genomics, Proteogenomics, Web resources for Genomics, Applications of genome analysis and genomics.

Course Outcomes (COs):

a. Recall and relate the role of genes, genetic code, recombinant methods in rDNA technology.
b. Describe the role of various enzymes in genetic manipulation.
c. Make use of the techniques involved in isolation, purification and separation of nucleic acids.
d. Apply rDNA technology in various fields using suitable methodology.
e. Appraise the use of genetic engineering principles for gene therapies.

PHARMACOGENOMICS AND PHARMACOGENETICS

BID- 601

Cr	L	T	P
3	3	0	0

CANCER BIOLOGY

BID- 602

Cr	L	T	P
3	3	0	0

HUMAN COMPUTER INTERFACE

CSC- 608

Cr	L	T	P
3	3	0	0

ARTIFICIAL INTELLIGENCE

CSC- 602

Cr	L	T	P
3	3	0	0

IMMUNOINFORMATICS LAB.

BIC- 651

Cr	L	T	P
1	0	0	2

GENOMICS AND PROTEOMICS LAB.

BIC- 652

Cr	L	T	P
1	0	0	2

MINOR PROJECT

BTC-661

COURSE OUTCOMES:

a) The student may develop a process of interest to achieve strategic goals
b) The student may develop skills to manage creative teams and project process effecftively and efficiently
c) The studenty may develop a leadership effectiveness in organizations
d) The students may accquire concepts to address specific management needs

The student may develop a tool to for the betterment of the society

INDIAN CONSTITUTION

MCC- 601

Cr.	L	T	P

0 2 0 0

Learning Objectives:

a. To enable students to understand the basic concepts of Indian constitution and its development.
b. A student therefore, learns about fundamental rights and fundamental duties.

Unit-I [**5Hrs.**]

Constitutional developments since 1858 to 1947, Making of the Indian Constitution, Nature and special features of the Constitution. Equality &Social Justice , Gender justice.

Unit-II [**5Hrs.**]

Speech and expression, media, press and information, Freedom of Speech and contempt of court, Personal Liberty.

Unit-III [**5Hrs.**]

Fundamental Rights & Directive Principles - inter relationship - judicial balancing. Constitutional amendments -to strengthen Directive Principles. Reading Directive Principles into Fundamental Rights.

Unit-IV [**5Hrs.**]

The need and status in constitutional set up, Interrelationship with fundamental rights and directive principles.

COs: At the end of the course, learners should be able to

a. Identify and explore the basic features and modalities about Indian constitution.
b. Differentiate and relate the functioning of Indian parliamentary system at the center and state level.
c. Differentiate different aspects of Indian Legal System and its related bodies.
d. Discover and apply different laws and regulations related to engineering practices.
e. Correlate role of engineers with different organizations and governance models.

REFERENCE BOOKS:

1. G. Austin, History of Democratic Constitution: The Indian Expenditure (2000) Oxford

2. D. D. Basu, Shorter Constitution of India, (1996), Prentice Hall of India, Delhi

3. Constituent Assembly Debates Vol. 1 to 12 (1989) 4. H. M. Seervai, Constitution of India, Vol. 1-3 (1992), Tripathi, Bombay

4. S. C. Kashyap, Human Rights and Parliament (1978) Metropolitan, New Delhi

SEVENTH SEMESTER

DRUG DESIGNING

BIC- 701

Cr	L	T	P
3	3	0	0

Learning Objectives:

a. To understand the concept of structure-function relationship of lead molecules in drug discovery.
b. To understand the target identification in drug discovery.
c. To apply the proteomics and genomics techniques in drug design.
d. To understand the methods of drug delivery.
e. To design new drugs using computational methods.

UNIT – I INTRODUCTION [8Hrs]

Introduction to the drug discovery and development, structural effects on drug action, physicochemical properties that are related to drug action, role and types of chemical bonding involved in drug-target interactions.

UNIT – II APPROACHES AND PRINCIPLES TO DRUG DESIGN [8Hrs]

Enzyme Inhibition, molecular recognition, receptor based molecular modelling, molecular docking, QSAR, agonist and antagonist. Computer-aided drug Design: lead optimization and computer-aided drug design, overview of ligand-based and structure-based design, viewing tools and graphics tools.

UNIT – III PRECLINICAL DEVELOPMENT [5Hrs]

Clinical trials, patenting and clearance for application.

UNIT – IV DESIGNED DRUG IN APPLICATION [6Hrs]

Antihypertensive, antiviral, anticancer and antibiotic, combinatorial library and highthrouput Screening

UNIT – V DRUG DELIVERY APPROACHES [7Hrs]

Pharamacokinetics and its role in drug discovery, vehicles used for drug delivery, drug development and process development, drug absorption, distribution and excretion.

UNIT – VI DRUG METABOLISM [7Hrs]

Different routes of drug administration, drug absorption, drug transport in biological systems, drug permeation through biological barriers, drug distribution, transcapillary exchange of drugs, perfusion limited and permeability limited distribution of drugs, drug excretion.

Course Outcomes:

a. Review pharmaceutical methodology for the design of new drugs and propose synthetic pathways for their preparation.

b. Devise appropriate methodology for the design of new drugs.

c. Apply drug design methodology, including computer-aided and related techniques to the design of a new drug.

d. Review and present data to peers and demonstrators with responsibility and accountability.

REFERENCE BOOKS:

1. Graham, L. Patricks. An Introduction to Medicinal Chemistry, Oxford University Press.
2. A.R.Leach, Molecular Modelling Principles and Application, Longman, 2001.
3. J.M.Haile, Molecular Dynamics Simulation Elementary Methods, John Wiley and Sons, 1997.
4. SatyaPrakash Gupta, QSAR and Molecular Modeling, Springer - Anamaya Publishers, 2008.

BIO-PYTHON

BIC- 702

Cr	L	T	P
3	3	0	0

Learning Objectives:

f. To understand the concept of structure-function relationship of lead molecules in drug discovery.

g. To understand the target identification in drug discovery.

h. To apply the proteomics and genomics techniques in drug design.

i. To understand the methods of drug delivery.

j. To design new drugs using computational methods.

UNIT – I INTRODUCTION [8Hrs]

Introduction to the drug discovery and development, structural effects on drug action, physicochemical properties that are related to drug action, role and types of chemical bonding involved in drug-target interactions.

UNIT – II APPROACHES AND PRINCIPLES TO DRUG DESIGN [8Hrs]

Enzyme Inhibition, molecular recognition, receptor based molecular modelling, molecular docking, QSAR, agonist and antagonist. Computer-aided drug Design: lead optimization and computer-aided drug design, overview of ligand-based and structure-based design, viewing tools and graphics tools.

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f. Devise appropriate methodology for the design of new drugs.

g. Apply drug design methodology, including computer-aided and related techniques to the design of a new drug.

h. Review and present data to peers and demonstrators with responsibility and accountability.

REFERENCE BOOKS:

5. Graham, L. Patricks. An Introduction to Medicinal Chemistry, Oxford University Press.
6. A.R.Leach, Molecular Modelling Principles and Application, Longman, 2001.
7. J.M.Haile, Molecular Dynamics Simulation Elementary Methods, John Wiley and Sons, 1997.
8. SatyaPrakash Gupta, QSAR and Molecular Modeling, Springer - Anamaya Publishers, 2008.

IPR IN BIOINFORMATICS

BID- 701 **Cr L T P**
3 3 0 0

UNIT - I TECHNOLOGY TRANSFER AND R&D [8Hrs]

Role of Research & development University-industry technology transfer arrangements, how and why a biotech company can benefit, status of R&D in India, different GLPs, GMPs and other practices.

UNIT - II INTELLECTUAL PROPERTIES AND APPLICATION [8Hrs]

Intellectual properties in biotechnology, definitions. Trademarks, copyright and related rights, industrial design, traditional knowledge, patent laws, procedures, precautions, patent infringement. WIPO, international conventions.

UNIT – III BIOETHICS AND RELATED LEGAL ISSUES [7Hrs]

Bioethics and current legal issues. Ethics of new technology. Marketing and public perceptions in product development.

UNIT – IV PATENTING [7Hrs]

Patents, copyrights, Trademarks, Patent Act (1970), Patent (Amendment) Act (2002) Salient features, Different types of patents and patent specifications, Filling and processing of applications for patents.

UNIT – V BIO-SAFETY [8Hrs]

Bio-safety regulation and national and international guidelines, r-DNA guidelines. Experimental protocol approvals, levels of containment, Environmental aspects of biotech applications, Use of genetically modified organisms and their release in environment, Special procedures for r-DNA based product production (GMP).

REFERENCE BOOKS:

1. N. R. Subbaram, *Handbook of Indian Patent Law and Practice*, S. Viswanathan (Printers and Publishers) Pvt. Ltd., India, 1998.
2. Teece, David J., Managing Intellectual Capital: Organizational, Strategic and Policy Dimensions, Oxford University Press, 2000.

Course Oucomes (COs):

a) Upon completion of the course the students will learn about basics of entrepreneurship
b) Upon completion of the course the students will learn about protection of rights
c) Upon completion of the course the students will learn about different types of patents
d) Upon completion of the course the students will learn about patent filing
e) Upon completion of the course the students will learn about biosafety levels

BIOSTATICTICS

BID- 702 **Cr L T P**
3 3 0 0

. Learning Objectives:

a. To understand the mathematical basis and foundations of probability and statistics.
b. To apply statistical methods to solve biological problems.
c. To apply the basic and modern statistical software for the analysis of the biological and clinical data.
d. To provide an in-depth understanding of various bio-statistical approaches, used for data analyses.
e. Also provides a perspective of research methodology and familiarizes students with the development of research tools and research proposal writing and publishing.

Unit-I **[9 Hours]**

Data type, classification and summarization of data, diagrams and graphs, measures of dispersion, Skewness and Kurtosis.

Unit-II **[8 Hours]**

Introduction to probability, Laws of probability, Bayer's theorem, Binomial distribution, Poison distribution.

Unit-III **[9 Hours]**

Positive and negative correlation, correlation coefficient, Non parametric tests, multiple regression, equation of line of regression, regression coefficient, Linear and Non linear regression.

Unit-IV **[8 Hours]**

Hypothesis tests, Chi square tests and F tests, Variant, One way and two way analysis of variants, ANOVA.

Unit-V **[6 Hours]**

Principles of experimental design and analysis.

Course Outcomes (COs):

a. Critically analyze research methodologies identified in existing literature.
b. Propose and distinguish appropriate research designs and methodologies to apply to a specific research project.
c. Use basic and modern statistical software to analyze the biological and clinical data.
d. Develop a comprehensive research methodology for a research question.
e. Apply the understanding of feasibility and practicality of research methodology for a proposed project

REFERENCE BOOKS:

Gurumani N. (2005) An Introduction to Biostatistics, MJP Publishers.

George W. and William G. Statistical Methods, IBH Publication

ANALYTICAL TECHNIQUES

BTC-705	**Cr.**	**L**	**T**	**P**
	3	**3**	**0**	**0**

Learning Objectives:

a. To understand the origin of bio-potentials and their physical significance.
b. To compare different techniques of measuring blood pressure, blood flow and volume.
c. To interpret the principle and operation of therapeutic and prosthetic devices.
d. To differentiate between the various techniques for measurement of parameters.

UNIT – I **[9Hours]**

MICROSCOPY -Principle, working, sample preparation and biological applications of different microscopes light microscope (bright field and dark field, phase contrast, polarization, differential interference contrast), electron microscope (TEM, SEM), fluorescence microscope (simple and confocal) and Atomic force microscope.

UNIT – II **[7Hours]**

CENTRIFUGATION -Principle, construction, working of centrifugation and concept of RCF, types of instruments and rotors used in centrifugation, types of centrifugations- preparative, differential density gradient centrifugation and analytical ultracentrifuge.

UNIT – III **[8Hours]**

ELECTROPHORESIS -Principle & Working of zonal and continuous electrophoresis, types of electrophoresis- paper, cellulose acetate, gel and capillary electrophoresis, native and denaturing gels, isoelectric focusing, two dimensional gel electrophoresis, pulse-field gel electrophoresis.

UNIT – IV **[8Hours]**

CHROMATOGRAPHY -Principle, instrumentation and biological applications of paper and thin layer (TLC) chromatography, gel permeation (GPC), ion exchange chromatography, affinity chromatography, gas liquid (GC) and high pressure liquid chromatography.

UNIT – V **[8Hours]**

SPECTROSCOPY-Basic concepts of spectroscopy, beer lamberts law, principles, instrumentation and applications of UV-Visible spectroscopy, nephelometry, turbidometry, fluorescence spectroscopy, atomic absorption spectrophotometry. Basic concepts, instrumentation and biological applications of infra red spectroscopy and mass spectroscopy.

Course Outcomes (COs):

a. Explain the basic principles of analyses and detection systems involved in photometric, fluorometric and luminescence -based methods.
b. Explain principles of electrophoresis and immunochemical techniques and discuss how these techniques can be used in molecular medicine.
c. Discuss the use of enzyme kinetics in analytical methods.
d. Explain basic principles for chromatographic separation techniques.
e. Discuss quality control, error sources, documentation and storage of experimental data.

REFERENCE BOOKS:

1. Wilson, K. and Walker, J. 1994. Principles and Techniques Practical Biochemistry, Cambridge University Press, Cambridge.
2. Willard, H.H., Meritt, L.L., Dean, J.A. and Settle, F.A. 1986. Instrumental method of analysis (7^{th} eds.). Wadsworth Pub. Co., USA.
3. Rana, S.V.S. 2006 and 07. Biotechniques– Theory and Practice (2^{nd} eds.). Rastogi Publications.
4. Chatwal, G.R. and Anand, S.K. 2008. Instrumental methods of chemical analysis (5^{th} eds.). Himalaya Publishing House.

5. Skoog, D.A., Holler, F.J. and Crouch, S.R. 2007. Instrumental analysis. Brooks/Cole Cengage Learning.
6. Upadhayay, A. and Upadhayay, K. 2008. Biophysical chemistry (4th eds.). Himalaya Publishing House.

NEURAL NETWORKS

CSC- 702

Cr	L	T	P
3	3	0	0

DRUG LAB DESIGNING LAB..

BIC- 751

Cr	L	T	P
1	0	0	2

PYTHON LAB.

BIC- 752

Cr	L	T	P
1	0	0	2

MINOR PROJECT

BTC-761

COURSE OUTCOMES:

a) The student may develop a process of interest to achieve strategic goals
b) The student may develop skills to manage creative teams and project process effecftively and efficiently
c) The studenty may develop a leadership effectiveness in organizations
d) The students may accquire concepts to address specific management needs
e) The student may develop a tool to for the betterment of the society

TECHNICAL REPORT WRITING

MCC-708

COURSE OUTCOMES:

a) The students would have gained knowledge to disseminate the area of interest
b) The students would have gained knowledge about literature survey
c) The students would have gained knowledge to select the methodologies for the research work
d) The students would have gained knowledge about the principles behind the process
e) The students would have gained knowledge about the expected outcome of the work

EIGHT SEMESTER

1	**Seminar ,Project Work and Internship**	**BIC-861**	**15**

COURSE OUTCOMES

a) Upon completion of the project work the students would have achieved the expected outcome of the research
b) Upon completion of the project work the student would have gained knowledge to develop a product which will benefit the society

c) Upon completion of the project work the student would have predicted the commercial probability of their product
d) Upon completion of the project work the student would gain knowledge about the success rate of the product
e) Upon completion of the project work the student would have assessed the impact of the research work

SHOBHIT UNIVERSITY, MEERUT

SCHOOL OF BIOTECHNOLOGY

B.Tech. (Bioinformatics): (IIIrd and IVth Semester)

IIIrd Semester

Course Code	Course/ Title	L	T	P	Cr
BIN-201	Biological database and resources	3	0	2	4
BIN-203	Cell biology	3	0	2	4
BIN-205	Object oriented programming using C++	4	0	2	5
BIN-207	Biochemistry	3	0	4	5
BIN-209	Microbiology	3	0	4	5

Credits=23

IVth Semester

Course Code	Course/ Title	L	T	P	Cr
BIN-202	Biomolecular sequencing and analysis	4	0	0	4
BIN-204	Object oriented programming using java	4	0	2	5

BIN-206	Molecular biology	3	0	4	5
BIN-208	Genetics	3	0	4	5
BIN-210	Basic statistics and mathematics	4	1	0	5
BIN-272	Study oriented project	0	0	4	2

Credits=26

BIOLOGICAL DATABASE AND RESOURCES

BIN-201 **Cr L T P**

4 3 0 2

Unit I:

Data base: Introduction, types of database, application of biological database, classification schema of biological database, database search: genome database search and protein database search, sequence file format.

Unit II:

Nucleotide sequence database: Introduction, primary and secondary database, format vs. content: computer vs. humans, GenBank flat file dissection, GCG, ACDEB, major bioinformatics resources: NCBI, EBI, GeneBank, DDBJ, knowledge of various databases and bioinformatics tools available at these resources like BLAST and algorithm, ORF etc. SIFT tool for SNPS detection, submitting DNA sequences to the databases introduction, where to submit, what to submit, how to submit on the world wide web, how to submit with sequin, PubMed, PubMed central, public library of sciences etc., Bioseq: sequences, Bioseqsets: collections of sequences, annotating the sequences

Unit III:

Protein sequence and structure databases: Introduction to structures and sequence, PDB, MMDB, structure file formats, visualizing structural information, database structure viewers. protein sequence databases, Expasy: SWISSPROT, feature of SWISSPROT, TrEMBL, PIR, and genome databases at NCBI: Unigene and homologene, TIGR, SANGER, high throughput genomic sequences EST, STS GSS, etc.

Unit IV:

Derived databases: composite database: Conserved domain database (CDD), EN-MSD (European Bioinformatics Institute's Macromolecular Structure Database), protein secondary database like PROSITE, PRINT, BLOCK, PRODOM etc., gene expression database, chemical database, biochemical pathway database like KEGG and pathDB.

Unit V:

Structural bioinformatics: Relationship of protein 3N-D structure to protein function, data deposition tool, classification of proteins of known 3N-D Structure: CATH and SCOP, alignment of 3N-D structure of proteins: VAST, DALI, DSSP, FSSP and PALI.

REFERENCE BOOKS:

1. Mount, D.W. 2005. Bioinformatics: Sequence and genomic analysis (2nd eds.). CBS Publishers and Distributors, New Delhi.
2. Simon Levin. Conceptual molecular biology an introduction.
3. Arachne Gig. Introduction to bioinformatics.
4. Westhead, Parish and Twyman. Instant notes in bioinformatics.
5. Rastogi, S.C., Mendiratta, N. and Rastogi, P. 2007. Bioinformatics: concept, skill and applications (2nd eds.). CBS Publishers and distributors, New Delhi.

Lab.N- Lab. based on theory syllabus

BIOMOLECULAR SEQUENCING AND ANALYSIS

TH-1/BIN-202/4BI

Cr	L	T	P
4	4	0	0

Unit I:

Introduction: Basic concepts of sequence similarity, identity and homology, definitions of homologues, orthologues, paralogues.

Unit II:

Scoring matrices: Dot matrix method, scoring matrices, Hamming or edit distance, basic concept of scoring matrix, matrices of nucleic acid and protein sequence, substitution matrices, PAM and BLOSUM series, principle based on which these matrices are derived, differences between distance and similarity matrix.

Unit III:

Sequence alignment: Basic concepts of sequence alignment, computational methods of sequence alignment, Bayesian method, hidden markov models, wordN-based techniques, dynamic programming method for sequence alignment, pairwise alignment, global alignment or Needleman and Wuncsh, local alignment or Waterman algorithms, gap penalties use of pairwise alignment for analysis of nucleic and protein sequences and interpretation of results.

Unit IV:

Multiple sequence alignment: Introduction to MSA, basic concepts of various approaches for MSA, progressive strategies, iterative strategies, hierarchical etc., algorithms for CLUSTAL W and Pielup and their application of sequence analysis, dendrograms.

Unit V:

Sequence pattern and profiles: Basic concept and definition of sequence pattern, motif and profiles, various types of pattern representation viz. consensus, regular expression and interpretation of profile based searches.

REFERENCE BOOKS:

1. Mount, D.W. 2005. Bioinformatics: Sequence and genomic analysis (2nd eds.). CBS Publishers and Distributors, New Delhi.
2. Simon Levin. Conceptual molecular biology an introduction.
3. Arachne Gig. Introduction to bioinformatics.
4. Westhead, Parish and Twyman. Instant notes in bioinformatics.
5. Rastogi, S.C., Mendiratta, N. and Rastogi, P. 2007. Bioinformatics: concept, skill and applications (2nd eds.). CBS Publishers and distributors, New Delhi.

OBJECT ORIENTED PROGRAMMING USING JAVA

BIN-204 **Cr L T P**

5 4 0 2

Unit I:

i. **Object oriented approach:** Java language fundamentalsN- properties, Java execution model language components– keywords, identifiers, variables, data types and operators, classes, objects and methods, constructors, inheritance, the super and final keywords, polymorphism and abstraction.

Unit II:

i. **Interfaces and packages:** InN-Built interfaces, userN-defined interfaces, understanding CLASSPATH, importing packages, exception handling, overview of exception, handling, flow of control of exception, throwable classes, use of throw and throws clauses, finally keyword, user defined exception.

Unit III:

i. **Multithreading:** Overview, main thread, creating a thread, priorities, synchronization, deadlocks issues, suspending, resuming and stopping threads.
ii. **Applet programming:** Applet architecture, applet skeleton, the applet class, embedding applets in HTML.

Unit IV:

i. **Networking basics:** Fundamental of Java networking, socketsN- creating client and server socket, datagram.
ii. **File handling**: File class, stream classes, creating a file, copy contents of one file to another.

Unit V:

i. **Abstract window toolkit:** AWT classes, windows fundamental components, working with frame windows, dialogs, creating menus.
ii. **Event handling:** The event delegation model, event classes, event listener, swings.

REFERENCE BOOKS:

1. Balagurusamy, E. 2008. Programming with Java –A Primer, (3rd eds.). Tata McN-Graw Hill.
2. Herbert Schildt. 2008. The Complete ReferenceN- Java 2 (4th eds.). Tata McN-Graw Hill.
3. Rich Raposa. 2005. Learning Java (3rd eds.). Wiley Publication.
4. Steven Holzner. 2005. Java 2 programming BLACK BOOK (JDK 5th eds.). Dreamtech Press.
5. Arnold, K., Gosling, J. and Holmes, D. 2006. The Java Programming Language (3rd eds.). Pearson Education.
6. Decker and Hirshfield. 2005. Programming Java: An introduction to Programming using Java (2nd eds.). Vikas Publishing House.

LABORATORY COURSE IN OBJECT ORIENTED PROGRAMMING WITH JAVA

1. Write a program showing how the attributes and methods are declared and defined in the class.
2. Write a program showing the implementation of different types of constructors.

3. Write a program for method overriding and method overloading.

4. Write a program for showing exception handling using tryN-catch and throw clauses.

5. Write a program for creating a package and sub packages and importing them within some other source file.

6. Write a program for creating a thread using all possible ways.

7. Write a program for copying the contents of a file into another file.

8. Create an applet and show some graphics objects such as ellipse, line, rectangle etc. on it.

9. Write a program implementing the methods of following interfacesN-

   KeyListener, MouseListener, ActionListener, MouseMotionListener etc.

LABORATORY COURSE IN GENETICS

1. Identification and mapping of unknown mutations in *Drosophila melanogaster*
2. UltraN-violet mutagenesis in the bacterium *Escherichia coli*
3. Exercise based on quantitative genetics and inheritance.
4. Exercise based on Mendelian inheritance.
5. Exercise based on linkage and mapping.
6. Exercise based on population genetics.
7. Exercise based on sex linked inheritance.
8. Cytological examination of special types of chromosomes: Barr body, lampbrush and polytene chromosomes.
9. Analysis of genetic problems statistically by various methods.

BASIC STATISTICS AND MATHEMATICS

TH-5/BIN-210/4BI	Cr	L	T	P
	5	4	1	0

Unit I:

Introduction to statistics: Definition of statistics, diagrammatic and graphical representation of data, measure of central tendency, dispersion, skewness and kurtosis.

Unit II:

Applied statistics: Introduction, discrete and continuous random variable, addition and multiplication theorem, introduction to correlation and regression analysis, simple linear regression analysis, multiple linear regression analysis.

Unit III:

Probability distribution: Introduction to probability, axiom probability, discrete probability distribution, continuous probability distribution, statistical hypothesis, null hypothesis, alternative hypothesis, one tail and two tail test, chiN-square test, FN-test, ZN-test, TN-test, one way and two way ANOVA.

Unit IV:

Application of statistics in bioinformatics: Gene expression prediction, genetic linkage analysis, nucleotide alignment, protein alignment, protein structure prediction.

Unit V:

Application in biosystem: Introduction to mathematical model, logistic equation, LotkaN-Voltera equation, butterfly effect, chaotic theory, fractals, optimization techniques, genetic algorithm, simulated annealing, Mote Carlo simulation.

REFERENCE BOOKS:

1. Montgomery, D.C. and Runger, G.C. Applied statistics and probability for engineers (3rd eds.). JohnN-Wiley and Sons Publication.
2. Prasad, S. 2004. Elements of biostatistics (1st ed.). Rastogi Publication.
3. Kapur, J.N. and Saxena, H.C. Mathematical statistics (1st ed.) S. Chand and Company Ltd.

SHOBHIT UNIVERSITY, MEERUT
SCHOOL OF BIOTECHNOLOGY

B.Tech. (Bioinformatics): (Vth and VIth Semester)

Vth Semester

Course Code	Course/ Title	L	T	P	Cr
BIN-301	Recombinant DNA technology	3	0	4	5
BIN-303	Phyloinformatics	4	0	2	5
BIN-305	Perl programming	3	0	4	5
BIN-307	SAS-R Language	4	0	2	5
BIN-309	Data base management system	4	0	2	5

Credits=25

VIth Semester

Course Code	Course/ Title	L	T	P	Cr
BIN-302	Omic technology	4	0	0	4
BIN-304	Computer aided drug design	4	0	2	5

BIN-306	Molecular structure prediction and visualization	4	0	0	4
BIN-308	Neural network	4	0	0	4
BIN-310	Data mining and warehousing	4	0	0	4

Credits=21

RECOMBINANT DNA TECHNOLOGY

BIN-301 **Cr L T P**
5 3 0 4

Unit I:
i. Molecular tools of genetic engineering: Types of restriction endonucleases, isoshizomers, DNA Polymerase I, Klenow fragment, T7 DNA Polymerase, DNA ligases, Topoisomerase, Kinases and phosphatases,prokaryotic and eukaryotic host cells.
ii. Cloning and expression vectors: Properties of a vector DNA molecule, Plasmids, ColE1 plasmid, pBR322, pUC series, Lambda phage vectors, Insertional vectors, replacement vectors, M-I3 phage vectors cosmids, artificial chromosomes (BAC, PAC, YAC, MAC), Fosmid vectors.
iii. Expression vectors**:**

Unit II:
Construction and screening of genomic and c-DNA libraries: Construction of chimeric DNA, staggered cleavage, linkers, adapters, addition of poly-dA and poly-dT, blunt end ligation by T4 DNA ligase, selection of recombinant clones, molecular probes, screening of c-DNA and genomic libraries by colony and plaque hybridization, preparation of oligonucleotide, c-DNA and antibody probes, radioactive labeling, nonradioactive labeling, cloning in bacteria other than E. coli., cloning in S. cerevisiae

Unit III:
Genetic engineering and transgenic plants: Agrobacterium medicated gene transfer Ti-plasmid and Ri-plasmid mediated gene transfer, geminivirus and RNA plant virus mediated gene transfer, direct DNA
transfer viz. electroporation, biolistics, microinjection, liposome mediated transformation, calcium phosphate coprecipitation method.

Unit IV:
Genetic engineering and transgenic animals: Gene transfer methods in animal cell, chemical tranfection, physical transfection: ultrasound transfection, use of viruses as gene transfer vectors: Aderoviral, Baculoviral, unarmed herpes, retroviral and vaccinia viral vectors, transgenic mice, rabbit, cattle, goat, sheep, gene knockout in animals, somatic and germ line therapy.

Unit V:
Basic techniques in genetic engineering: Southern, northern and western blotting, DNA sequencing, DNA fingerprinting.

Unit VI:
Applications of recombinant DNA technology: Transgenic animals and plants as bioreactors, production of recombinant therapeutic proteins in bacteria, yeast and mammalian cells, improving agronomic traits by genetic modification, gene medicines, DNA vaccines, gene augmentation
therapy.

REFERENCE BOOKS:

1.Primrose, S.B. and Twyman, R.M. Principles of gene manipulation and genomics (7th eds.). Blackwell Publishing.

2. Winnacker, Ernst-L. 2003. From Gene to Clone Introduction to gene technology. Panima publishing Corp., New Delhi.

3.Old, R.W. and Primrose, S.B. Principles of gene manipulation: An introduction to genetic engineering. Blackwell Science Publication.

4. Brown, T.A. 2008. Gene Cloning and DNA analysis (5th eds.).
Blackwell Sciences LTD.

5.Gupta, P.K. 2008. Biotechnology and Genomics (1st ed.). Rastogi Publication

PHYLOINFORMATICS

BIN-303 **Cr L T P**
5 4 0 2

Unit I:

Introduction to phylogenetic Analysis: Terminology of phylogenetic trees root, internal nodes, internal branches, external branches, terminal nodes, rooted and unrooted trees, cladograms vs. phylograms, phylogeny, species trees, gene tree, characters, cladistics, evolutionary tree, properties of phylogenetic trees: Ultrametric trees and Additive trees

Unit II

Distance matrix methods: clustering, algorithms, measuring genetic change; models of sequence evolution, introduction to maximum likelihood, UPGMA, neighbor joining methods, Fitch-Margolish method

Unit III

Character based method of phylogenetics: Parsimony, maximum parsimony method, maximum likelihood method, Markov model, dynamic programming, analysis of true tree, Tree construction using partial distance matrices, consensus trees, Tree confidence, minimum distance trees.

Unit IV

Model of molecular evolution: Introduction to molecular, mode of evolutionary process, genome and biological network evolution, evolutionary change in nucleotide sequences, mathematical modeling of nucleotide substitution in a DNA sequence, Probabilistic models of evolution, derivation of the Jukes-Cantor model, Kimura's two-parameter model, introduction to Hidden Morkov model.

Unit V

Evaluation and softwares: Perfect phylogeny, compatibility, bootstrap, Jacknife, PHYLIP, PAUP.

REFERENCE BOOKS:

1. Mount, D.W. 2005. Bioinformatics: Sequence and genomic analysis (2nd eds.). CBS Publishers and Distributors, New Delhi.
2. Roderic, D. M., Edward, C.M. Molecular evolution, A phylogenetic approach. Blackwell science.
3. Westhead, Parish and Twyman. Instant notes in bioinformatics.
4. Rastogi, S.C., Mendiratta, N. and Rastogi, P. 2007. Bioinformatics: concept, skill and applications (2nd eds.). CBS Publishers and distributors, New Delhi.

PERL PROGRAMMING

BIN-305 **Cr L T P**
5 3 0 4

Unit I
Introduction to Linux: History, vi editor, Reading files, creating files, deleting files, renaming files, handling files, browsing files, manipulation, searching, locating files, listing files, basic shell programming.

Unit II
Introduction to Perl: Perl interpreter, Basic I/O, statement, token, white space, standard input files, standard output files, variables, scalar, operators, control structure, conditional expression.

Unit III
List and Array variables: Arrays, Arrays manipulation, sorting array, push, pop, shift, unshift, splice, associative arrays, hash traversing, hash inverting, hash sorting, expression evaluation, accessing substring, controlling case, capitalizing title, escaping characters.

Unit IV
Pattern matching, regular expression, matching letters, matching words, substitute, translation, file handling, opening files, reading files, writing files, merging files.

Unit V
Subroutine: creating subroutine, arguments, return, wantarray, passing arrays, passing hashes, scoping, recursive subroutine, sort subroutine, nested subroutines, references, creating references.

REFERENCE BOOKS:
1. Tisdall, J.D. 2004. Beginning of perl for bioinformatics (4th eds.). Shroff Publishers and Distribution Pvt. Ltd.
1. 2. Scott, G., Shishir, G., Gundavaram, and Birznieks, G. 2000. CGI Programming with Perl (2nd eds.). O'Reilly.
2. Lemay, L. 1999. SAMS Teach Yourself Perl in 21 days (1st eds.). Techmedia Pearson Education Group USA
3. Christiansen, T. and Torkington, N. Perl cookbook, 2003, O'Reilly ,ISBN-0-596-00313-7
4. Jamison, D. C. Perl Programming for Biologists, 2003, John Wiley & Sons

SAS-R language

BIN-307 **Cr L T P**
5 3 0 4

Unit I

Overview of statistical computing packages**:** introductions, importing text and excel files into SAS, statistical analysis concepts, importing text and excel files into r, random sample, stratification, survey weights, descriptive statistics, graphical analysis, exploratory analysis, confirmatory analysis.

Unit II

Univariate Analysis in SAS: Exploratory Analysis, Descriptive Statistics, Graphical Analysis, Group Comparisons

Unit III

Bivariate Analysis in SAS: Exploratory Analysis (Descriptive Statistics and Graphical Analysis), Cross-tabulations, Regression Concepts, Correlation

Unit IV

Multivariate Analysis: Exploratory Analysis, Descriptive Statistics & Graphical Analysis, Cross-tabulations

Multivariate Regression, Introduction to the Analysis of Survey Data.

Unit V

Fundamental structures: objects, classes, Objects and vectors, Indexing, Operators, Matrices, Data frames, Attributes and classes

References:

1. Kleinman, K. and Horton, N. (2009). *SAS and R: Data Management, Statistical Analysis, and Graphics***,** Chapman & Hall/CRC.
2. Heiberger and Holland, (2004). *Statistical Analysis and Data Display: An Intermediate Course with Examples in S-PLUS, R, and SAS*, Springer Texts in Statistics.
3. Hatcher and Stepanski (1994). *A Step-by-Step Approach to Using the SAS System for Univariate and Multivariate Statistics*, SAS Institute, Inc. Cary, NC.
4. *The Little SAS Book: A Primer*, Third Edition by Lora D. Delwiche, is a good reference for SAS.

DATA BASE MANAGEMENT SYSTEM

BIN-309 **Cr L T P**
5 4 0 2

Unit I:
Introduction: An overview of database management system, database system vs. file system, database system concepts and architecture, data models schema and instances, data independence and data base, language and interfaces, data definitions language, DML, overall database structure.

Unit II:
Data modeling using the entity relationship model: ER model concepts, notation for ER diagram, mapping constraints, keys, concepts of super key, candidate key, primary key, generalization, aggregation, reduction of an ER diagrams to tables, extended ER model, relationships of higher degree.

Unit III:
Relational data model and language: Relational data model concepts, integrity constraints, entity integrity, referential integrity, keys constraints, domain constraints, relational algebra, relational calculus, tuple and domain calculus, data base design and normalization, functional dependencies, normal forms, first, second, third normal forms, BCNF, inclusion dependences, loss less join decompositions, normalization using FD, MVD, and JDs.

Unit IV:
Transaction processing concepts: Transaction system, testing of serializability, serializability of schedules, conflict and view serializable schedule, recoverability, recovery from transaction failures, log based recovery, checkpoints, deadlock handling.
Concurrency control techniques: Concurrency control, locking techniques for concurrency control, time stamping protocols for concurrency control, validation based protocol, multiple granularity.

Unit V:
Introduction to SQL and PL/SQL: Characteristics of SQL, advantage of SQL, SQL data types and literals, types of SQL commands, SQL operators and their procedure, tables, views and indexes, queries and sub queries, aggregate functions, insert, update and delete operations, joins, unions, intersection, minus.

REFERENCE BOOKS:

1. Desai, C.B. An introduction to database system (4th eds.). West Publishing Company, USA.
2. Silberchatz, A., Korth, H.F. and Sudarshan, S. Database system concepts. McGraw Hill.
3. Bayross, I. SQL, PL/SQL: The programming language with oracle (3rd eds.). BPB Publication.
4. Post, G.V. Database management system designing & building business application (2nd eds.). Tata Mc-Graw Hill Publication.
5. Date, C.J. An introduction to database system (7th eds.). Pearson Education Publication.

6. Navathe, S.B. and Elmarsi, R. Fundamentals of database systems (3rd eds.). Pearson Education Publication.
7. Leon, A. and Leon, M. Database management system. Vikas Publishing House.
8. Prath, P. and Adamski, J. Concept of database management (3rd eds.). Vikas Publishing House.
9. Ramakrishnan, R. Gehrke, J. Database management system. McGraw Hill.
10. Weman, J.O. Principle of database management system (2nd eds.)
11. Martein, J. Principle of database management system. Prentica Hall of India Pvt. Ltd.
12. Najumdar, A.K. Database management system. Tata Mc-Graw Hill Publication.

OMIC TECHNOLOGY

BIN-302 **Cr L T P**
4 4 0 0

Unit I: GENOMICS

i. **Mapping and sequencing of genomes:** Genetic mapping, DNA markers for genetic mapping, physical mapping, FISH, Restriction mapping, optical mapping, STS mapping, radiation hybrid mapping, large insert genomic libraries and genetic maps as the resources for physical mapping, SNPs and haplotypes.
ii. **Genome sequencing:** Whole genome sequencing by clone contig and shotgun approach, methods of DNA sequencing: Maxam and Gilbert degradation method and Sanger's dideoxy chain termination method, automated DNA sequencing, Cycle sequencing, Dye primer and dye terminator chemistries, capillary array electrophoresis, pyrosequencing, P454 sequencing, sequencing by hybridization; fully sequenced genomes, new generation sequencing methods, Illumina technology, nanopore sequencing, Metagenomics.

Unit II:

i. **Annotation of whole genome sequencing and functional genomics:** *In silico* methods, homologous recombination, insertional mutagenesis by T-DNA and transposon insertion, RNA interference for functional genomics, TILLING.

Unit III: TRANSCRIPTOMICS

i. **Common techniques of transcriptomics:** SAGE, DNA microarrays and DNA chips.
ii. **Bioinformatical methods in transcriptomics:** Gene expression profiling, tissue and stage of development specific patterns of expression, co expression of genes: Microarray data analysis, microarray databases, microarray image processing, image handling in MATLAB.
iii. **Cluster analysis of microarray information**: Basic concept of clustering, principles of clustering, hierarchical clustering, self-organizing map, K-means clustering, principal component analysis, pros and cons of clustering, visualization, programs for clustering and visualization, function prediction, gene spring and clustering, clustering tool, principal components analysis tool.

Unit IV: PROTEOMICS

i. **Methods and applications of proteome analysis:** Protein expression mapping, 2D-PAGE, limitations of 2D PAGE for protein expression profiling, DIGE. Protein expression profile databases, Protein identification by Mass spectrometry, MALDI, ESI, tandem mass spectrometry, Peptide mass fingerprinting, Multidimensional LC-tandem mass spectrometry, ICAT (Isotope coded affinity tags, Identification of post translational modifications, Protein–protein interaction mapping, Yeast 2-hybrid system, Bacterial 2-hybrid system, Phage display, protein microarrays and protein chips, SPR Biosensors, multiprotein complexes.

Unit V: METABOLOMICS

i. Metabolite analysis: Different levels of metabolite analysis, metabolite profiling, Mass spectrometry in metabolomics.
ii. Metabolic Engineering: Metabolomic control analysis and FANCY, redirecting metabolic flow, desensitizing feedback inhibition, elevation of the activity of the rate limiting enzyme, metabolic engineering, and molecular breeding of biosynthetic pathway.

REFERENCE BOOKS:

1. Tuimala, J., Laine, M.M. 2003. DNA micro array data analysis. CSC– Scientific Computing Ltd.
2. Brown, T.A. 2008. Genome (3rd eds.). Garland Science.
3. Gupta, P.K. 2008. Biotechnology and Genomics. (1st ed.). Rastogi Publications.
4. Lodish, H., Berk, A., Kaiser, C.A., Krieger, M., Scott, M.P., Bretscher, A., Ploegh, H. and Matsudaira, P. 2008. Molecular Biology (6th eds.). W H Freeman and co.
5. Primrose, S.B. and Twyman, R.M. Principles of gene manipulation and genomics (7th eds.). Blackwell Publishing.

COMPUTER AIDED DRUG DESIGN

BIN-304

Cr	L	T	P
5	4	0	2

Unit I:

Introduction: History of drug development, basic pharmacodymanics and pharmacokinetics, strategies for drug designing and development, lead optimization.

Unit II:

Small molecule rotation and string mapping: chemical nomenclature and notation like SMILE, ROSDAL string notation, protein 3-D structure file formats MOL, PDB, SDF.

Unit III:

Pharmacophores: Introduction, pharmacophore modeling, pharmacophore generation, hypogen theory, hip-hop theory.

Unit IV:

QSAR (Quantity structure activity relationship): Historical development of QSAR, tools and technique of QSAR, parameter used in QSAR, application of QSAR, QSPR (quantity structure and property relationship).

Unit V:

Modeling and docking: History of homology modeling, assumption of homology modeling, homology modeling step, model validation, introduction to docking, types of docking, basic principle and method of docking.

REFERENCE BOOKS:

1. Gasteiger, J., Engel, T.E. 2003. Chemoinformatics: A text book. Wiley publication.

2. Leach, A.R., Gillet, V. 2005 An introduction to chemoinformatics.

MOLECULAR STRUCTURE PREDICTION AND VISUALIZATION

BI-306 **Cr L T P**
4 4 0 0

Unit I:

Introduction: chemical aspect of molecular structure, protein structure and their prediction (primary structure, amino acid, backbone, secondary structure, tertiary structure, dihedral angles) mathematical and computational formalism related to molecular structure (optimization and simulation) forces responsible for stabilizing protein structure, importance of visualization and visualization softwares.

Unit II:

Protein structure determination by X-ray and NMR:

X-ray principle: theory of x-ray diffraction, Bragg's law, protein structure determination by x-ray crystallography.

NMR principle: population and equilibrium magnetization, relaxation, Larmour frequency, Block frequency, chemical shift, Pulse Fourier transform, protein secondary structure determine by 2D NMR,NOE, coupling constant, Karpuls relationship**.**

Unit III:

Introduction to simulation and modeling: basic of simulation lattice simulation, Ab initio simulation method (random walk, self avoiding walk), threading model

Unit IV:

Molecular dynamics and HMM: Introduction of molecular dynamics, Monte Carlo method, energy minimization, introduction of Markov chain, Hidden markov model, viterbi algorithm, back propagation algorithm, application of HMM in gene prediction, advantage of HMM.

REFERENCE BOOKS:

1. Leach, A.R. 1996 Molecular modeling principles and application.
2. Mount, D.W. 2005. Bioinformatics: Sequence and genomic analysis (2^{nd} eds.). CBS Publishers and Distributors, New Delhi.

Lab. based on theory syllabus

NEURAL NETWORK

BI-308 **Cr L T P**
4 4 0 0

Unit I:

Introduction: Neural network, human brain, biological and artificial neurons, model of neuron, artificial intelligence and neural network, characteristics of neural network, network architecture, basic approach of the working of ANN – training, learning and generalization.

Unit II:

Basic learning laws, supervised learning: single- layer networks, perception-linear separability, limitations of multi layer network architecture, back propagation algorithm (BPA) and other training algorithms, applications of adaptive multi-layer network architecture, recurrent network, feed-forward networks.

Unit III:

Unsupervised learning: Winner-takes-all networks, Hamming networks, simple competitive learning vector-quantization, counter-propagation network, adaptive resonance theory, Kohonen's self organizing maps, principal component analysis.

Unit IV:

Associated models: Hopfield networks, brain-in-a-box network, Boltzman machine.

Unit V:

Optimization methods: Hopfield networks for-TSP, solution of simultaneous linear equations, Iterated radiant descent, simulated annealing.

REFERENCE BOOKS:

1. Yaganarayana, B. Arificial Neural Network. PHI.
2. Simon Haykin. 1994. Neural Networks – A Comprehensive Foundation. Mac Millan Publishing Co., New York.
3. Mahrotra, K. Mohan, C.K. and Ranka, S. 1997. Elements of Artificial Neural Networks. MIT Press. Indian Reprint Penram International Publishing (India).
4. Cichocki, A and Unbehauen, R. 1993. Neural networks for optimization and signal processing. Publication John Wiley and Sons.
5. Zurada, J.M. 1997. Introduction to artificial neural networks (Indian edition). Jaico Publishers, Mumbai.
6. Limin Fu. Neural Networks in Computer Intelligence. TMH.

DATA MINING AND WAREHOUSING

BIN-310	Cr	L	T	P
	4	4	0	0

Unit I

Introduction: Fundamentals of data mining, data mining functionalities, classification of data mining systems, major issues in data mining, data warehouse and OLAP technology for data mining data warehouse, multidimensional data model, data warehouse architecture, data warehouse implementation, further development of data cube technology, data warehousing to data mining.

Unit II

Data preprocessing: Importance of preprocessing the data, data cleaning, data integration and transformation, data reduction, discretization and concept hierarchy generation, online data storage.

Unit III

Concepts description: characterization and comparison: data generalization and summarization-based characterization, analytical characterization: analysis of attribute relevance, mining class comparisons: discriminating between different classes, mining descriptive statistical measures in large databases.

Unit IV

Mining association rules in large databases: association rule mining, mining single-dimensional boolean association rules from transactional databases, mining multilevel association rules from transaction databases, mining multidimensional association rules from relational databases and data warehouses, from association mining to correlation analysis, constraint-based association mining.

Unit V

Classification and prediction: issues regarding classification and prediction, classification by decision tree induction, Bayesian classification, classification by back propagation, classification based on concepts from association rule mining, other classification methods, prediction, classifier accuracy.

Unit VI

Cluster analysis introduction: Types of data in cluster analysis, categorization of major clustering methods, partitioning methods, density-based methods, hierarchical method, model-based clustering methods, outlier analysis.

Unit VII

Application and trend in data mining: data mining for biological data analysis, data mining for other scientific application, data mining, privacy and security

REFERENCE BOOKS:

1. Inmon, W.H. Building data warehouse, Publication John Wiley & Son.
2. Anahory, S. and Murray, D. data warehousing, Pearson Education.

SHOBHIT UNIVERSITY, MEERUT

SCHOOL OF BIOTECHNOLOGY

B.Tech. (Bioinformatics): (VIIth and VIIIth Semester)

VIIth Semester

Course Code	Course/ Title	*L*	*T*	*P*	*Cr*
BIN-401	Chemoinformatics	4	0	0	4
BIN-403	Advance CADD and drug delivery	3	0	4	5
BIN-405	Project management	4	0	0	4
BIN-421,423, 425,427	Elective-I	4	0	2	5
BIN-431,433, 435,437,439	Elective-II	4	0	0	4

Credits=23

Elective I

BIN-421	Bio-Python
BIN-423	Bio-Perl
BIN-425	Immunoinformatics
BIN-427	Microarray Analysis

Elective II

BIN-431	Entrepreneurship Opportunities in Bioinformatics
BIN-433	Parasite Bioinformatics

BIN-435	IPR in Bioinformatics-Detailed Study
BIN-437	Nanotechnology in life science
BIN-439	Human Genome Project

VIIIth Semester

BIN-492	Dissertation	22	0	44	

Credits=22

CHEMOINFORMATICS

BIN-401 **Cr L T P**

4 4 0 0

Unit I:

Introduction:scope of chemoinformatics, structure databases, reaction databases, biochemical pathway databases, searching chemical structure, full structure search, substructure search, screening, 3-dimensional structure method.

Unit II:

Representation of chemical compound: Introduction, advantage and disadvantage, graph theory, matrix representation, Adjacency matrix, distance matrix, atom connectivity matrix, bond matrix, incidence matrix, bond-electron matrix, advantage and disadvantage of matrix, connection table, advantage and disadvantage of connection table.

Unit III:

Standard structure exchange format: Structure of Mol file, Sdf file, PDB file, Morgan algorithm, Hash codes, application of hash code, stereochemistry in SMILE and Mol file

Unit IV:

Molecular surface: Introduction, Van der Waal's surface, solvent accessible surface, solvent excluded surface, enzyme activity surface, method for data analysis, machine learning techniques, machine learning process, decision tree, chemomerices.

Unit V:

Structure descriptors: introduction, classification of molecular descriptors, 1-D descriptors, 2-D descriptors, 3-D descriptors, distance and similarity measure, Method of data analysis.

REFERENCES:

1. Patrick, G. 2002. Instant notes medicinal chemistry (1st ed.). Viva Publication.
2. Gasteiger, J. and Engle, T. 2003. Chemoinformatics.

Lab based on Theory Syllabus

ADVANCE CADD

BIN-403 **Cr L T P**

5 3 0 4

Unit I:

Introduction, history, discovery and development of drugs, strategies in drug discovery, ADMET, pre clinical trials and source of drugs- plant, marine, animal, synthetic.

Unit II:

Molecular biology concepts in drug designing – structure, function and drug action on membrane and receptor molecule, membrane permeability, mode of action-enzyme inhibitors, activators, design of agonist and antagonists, receptor theories

Unit III:

Physico chemical principles of drug action, drug – receptor interactions, Hansch analysis, COMFA-2D, 3D, COMSIA, free Wilson method, Topliss and Craigs model, morphological effects, drugs affecting CNS and drugs use- addiction, regulation, drugs affecting hormonal system- epinephrine, histamine

Unit IV:

Concept of quantum mechanics, force fields, energy minimization, conformational search, molecular dynamics, ligand based drug designing, receptor based drug designing, analog approach, pharmacophore mapping, irrational drug design.

Unit V:

Combinatorial library design –combinatorial libraries, optimization approaches, virtual library, pharmacophore based fingerprints, structure based library design, docking as virtual screening tool, regulatory affairs

REFERENCES:

1. Haile, J.M. 1997. Molecular Dynamics Simulation Elementary Methods, John Wiley and Sons.
2. Leach. A. 1998. Molecular Modeling, Principles and Applications, Longman publications.
3. Doucet, P. J. and Weber, J. Computer-Aided Molecular Design: Theory and Applications. Academic Press

Lab based on Theory Syllabus

PROJECT MANAGEMENT

BIN- 405 **Cr L T P**

4 4 0 0

Unit- I:

Introduction of project management:

Definitions, scope, overview, project plan management principles applied to project, project management life cycles and uncertainty, generation and screening of project ideas.

Unit-II:

Project analysis:

Meaning, various aspects of market and demand analysis, technical analysis, financial analysis, project planning, scope, problem statement, project goals, objectives, success criteria, projects and strategic planning.

Unit-III:

Selection of project:

Basic concepts, principle and techniques of selection, time value of money, capital budgeting, cost of capital, appraisal criteria, analysis of risk, social cost benefit analysis, multiple projects and constraints, quantitative factors, strategic aspects and organizational consideration.

Unit-IV:

Project implementation:

Project resource requirements, types of resources, men, materials, finance, project team management, recruitment, organizing, human resources team operating rules, project organization, various forms,, charting project contracts, principles compilation of contracts, practical aspects, legal aspects, global tender negotiations, insurance, project scheduling PERT and CPM, project communication.

Unit-V:

Project monitoring evaluation and control:

Project network technique planning for monitoring and evaluation project audits, project management information system, post project reviews, closing the project, types of project termination strategic implications project in trouble, termination strategies, evaluation of termination possibilities, termination procedures.

REFERENCE BOOKS:

1. Chandra, Prasanna. 1995. Projects planning analysis selection implementation and review (4th eds.), Tata McGraw-Hill.

Elective I
BIO-Python

BIN-421 **Cr L T P**

5 4 0 2

Unit I
Introduction, Python programming language, interpreter, Python's basic data types, literals constant, error handling, lists.

Unit II
Conditional Statements, if-then, looping, while-loops, for-loops, break, continue, functions, arguments, function parameter, local variables, global variables, return values, operators, passing arguments, reference argument.

Unit III
String processing, case changing method, string manipulation, string slices, string comparison, regular expression, non greedy matching, Module, make own module, import statement, loading, classes, creating instances.

Unit IV
Biopython introduction, bio sequence, sequence reading, sequence writing, bio Swissprot, Regular entries, bio genbank, reading entries, running blast, clustal W.

Unit V
Seq feature, slicing seq record, reading sequence file, writing sequence file, sequence alignment, single alignment, multiple alignment, ambiguous alignment.

References:

1. Brueck, D. and Tanner, S., Python 2.1 bible, hungry minds Inc.
2. Schuerer, K. and Letondal, C., Python course in Bioinformatics, Pasteur Institute

Elective I
BIO-Perl

BIN-423	**Cr**	**L**	**T**	**P**
	5	**4**	**0**	**2**

Unit I
Introduction, Bioperl documentation, advantage of bioperl, bioperl objects, sequence objects, bioperl classes, sequence classes.

Unit II
Databases, database classes, accessing local database, accessing remote databases (genbank), indexing and accessing local databases, bioperl modules, perl reminders, references, file handling.

Unit III
Alignment, single alignment, multiple alignment, ambiguous alignment, transforming alignment file, manipulating sequences, identifying restriction enzyme site, identifying amino acid cleavage site, converting coordinate system.

Unit IV
Bioperl libraries, bioperl-run, bioperl-db, sequence manipulation using bioperl EMBOSS, alignment by SW algorithm, Biosql, bioperl alphabet, DNA/RNA, amino acid.

Unit V
b12seq: blast 2 sequence, blast, running blast, PSI-blast, blast internal class structure, parsing blast, parsing HMM report, running blast locally (StandAloneBlast) , searching for gene and other structure on genomic DNA (genscan, Sim4, ESTscan), sequence annotation .

Reference:

1. Tisdal, J. d., Mastering Perl for Bioinformatics, O' Reilly
2. Christiansen, T. and Torkington, N. Perl cookbook, 2003, O'Reilly ,ISBN-0-596-00313-7
3. Jamison, D. C. Perl Programming for Biologists, 2003, John Wiley & Sons

Elective I

IMMUNOINFORAMTICS

BIN-425 **Cr L T P**

5 4 0 2

Unit I

Immunology: Introduction: overview of the immune system: a case study, classification of immunity, concepts in immunology**,** antigens, antibodies, compliment system, antigen-antibody reactions, major histocompatibility complex, allele selection, antigen presentation, TAP, T cell receptors

Unit II

Advanced immunology: Immune effector mechanisms, cytokines, chemokines, hypersensitive reactions, immune system in health and disease, autoimmunity, transplantation immunology, classification of vaccine.

Unit III

HLA System in model organism: Defining HLA super types in: HLA–structural and modeling principles, HLA supertypes by GRID/CPCA, hierarchical clustering methods, structural sasis for HLA-A2 supertypes, clustering of MHC peptide-binding repertoires, HLA alleles- electrostatic distribution maps

Unit III

***In Silico* Prediction of Immunogenicity :** Databases searching**,** MHCDB(NCBI), IMGT, IMGT/HLA database, IPD, immuno polymorphism database, SYFPEITHI: database for searching and T-cell epitope prediction, mapping of T-cell epitopes, MHC binders, TAP binders, mapping of linear\B-cell epitopes in bcipep database, haptens, carrier proteins, anti-hapten antibodies.

Unit V

Prediction: Predicting peptide-MHC binding**, p**eptide–MHC binding using profiles**,** machine learning techniques for MHC binders**,** artificial intelligence methods for predicting T-Cell epitopes**,** MHC-Class I and II binding affinity, MHC– molecular affinity and QSAR models**,** support vector machine for mhc-

binding peptides**,** static energy analysis of MHC Class I and Class II peptide-binding affinity**,** nonlinear predictive modeling of MHC class II–peptide binding using bayesian, neural networks

Reference:

1. Richard, A., Goldsby, Kindt, J.T., Barbara, A., Kubey, and Osborne, J., Immunology (5^{th} eds) 2003, W.H. Freeman & Company
2. Roitt's Essential Immunology; Ivan M. Roitt, Peter J. Delves Blackwell Science Ltd., 10th Edition (2001)

3. Darren R., Immunoinformatics**:** predicting Immunogenicity *in-silico,* Flower Humana Press.
4. Lydyard, P.M., Whelan, A. and Fanger, M.W. Instant Notes in Immunology (1^{st} eds.), BIOS Scientific Publishers Ltd, 2003.

Elective I

MICROARRAY ANALYSIS

BIN-427	**Cr**	**L**	**T**	**P**
	5	**4**	**0**	**2**

Unit I:

Introduction: Microarray production, extracting and labeling the RNA sample, RNA extraction from scarse tissue samples, hybridization, scanning, Affymetrix technology, single array analysis.

Unit II:

Genotype system and data analysis: Introduction , DNA microarray data analysis, methodologies genotype calls, cDNA microarray data analysis, Affymetrix data analysis, normalization, preprocessing of data, rationale for preprocessing , missing values , calculation of expression change, handling of replicates, types of replicates, time series, case-control studies, power analysis , averaging replicates

Unit III:

Normalization: Introduction, sources of systematic bias, dye effect, scanner malfunction, uneven hybridization, experimenter issues, normalization terminology, normalization, standardization and centralization, per-chip and per-gene normalization, global and local normalization, using GeneSpring for normalization.

Unit IV:

Cluster analysis of microarray information: Basic concept of clustering , principles of clustering hierarchical clustering, self-organizing map, K-means clustering, principal component analysis, pros and cons of clustering, visualization, programs for clustering and visualization, function prediction, geneSpring and clustering, clustering tool, principal components analysis tool, predict parameter value tool.

Unit V:

Identifying over and under expressed genes, filtering the absolute expression change, noise envelop, data mining for promoter sequences

REFERENCE BOOKS:

1. Tuimala, J. and Minna, M. 2003. DNA Microarray Data Analysis. CSC – Scientific Computing Ltd.
2. Speed, T. 2003. Interdisciplinary statistics: statistical analysis of gene expression microarray data, CRC Press Company

Elective II

ENTREPRENEURSHIP OPPORTUNITIES IN BIOINFORMATICS

BIN-431 **Cr L T P**

4 4 0 0

Unit I
The Entrepreneurial Development Perspective - concepts of entrepreneurship development, evolution of the concept of entrepreneur, entrepreneur vs. intrapreneur, entrepreneur vs. entrepreneurship, entrepreneur vs. manager.

Unit II:
Attributes and characteristics of a successful Entrepreneur, role of entrepreneur in Indian economy and developing economies with reference to self-employment development, Bioentrepreneur.

Unit III:
Environmental Analysis- search and scanning, identifying problems and opportunities, defining business idea, geographic clustering in biotechnology, mergers and acquisitions in the biotechnology industry.

Unit IV:
Role of Central Government and State Government in promoting Bio Entrepreneurship - introduction to various incentives, subsidies and grants, role of – Small Industries Service Institute (SISI), Entrepreneurship Development Institute of India (EDII), National Institute of Entrepreneurship & Small Business Development (NIESBUD), National Entrepreneurship Development Board (NEDB).

Unit V:
Case study of respective bio based company- Dr. Reddy's Research foundation, Ranbaxy Laboratories Ltd. (Pvt.), Biocon, Ocimum Biosolutions.

REFERENCES:

1. Osborne, E.A. 2008.Entrepreneurs toolkit - tools and techniques, Harvard Business School Press.
2. Ashton, R. Instant Entrepreneur – the faster way to start up success, Pearson paperback.
3. Patzelt, H. and Brenner, T. (Eds.). 2008. Handbook of Bioentrepreneurship, International Handbook series on Entrepreneurship,Vol.4.

Elective II

PARASITE BIOINFORMATICS

BIN-433	**Cr**	**L**	**T**	**P**
	4	**4**	**0**	**0**

Unit I:

Bioinformatics and parasitic information – significance, parasite specific databases, knowledge of TIGR, the Global Mammal Parasite database, Comparasite database.

Unit II:

Parasitic diseases- Malaria, leishmania, trypanosome, filiarisis, study of their life cycles, distribution of their strains, filarial genome network, leishmania genome network, Malaria database

Unit III:

Parasite genome and proteome databases, tools for identification of parasitic genes/ gene products using PIR, UNI-PROT knowledgebase database and tools.

Unit IV:

Plant parasite and diseases, disease resistant genes of plants, plant pathogen interactions, multi drug resistance genes, study of World *Spodoptera* Database

Unit V:

Full parasite genome study of Malaria and Trypansoma, gene prediction, signal sequence prediction, study using role category pie chart, protein motif search, GC content display, codon usage by JCVI-CMR.

REFERENCES:

1. www.tjpr.freehosting.net - Malaria
2. www.tigr.org/tdb/parasites/ - parasite genome and proteome database

3. http://www.mammalparasites.org/
4. http://microbialgenomics.energy.gov/links/parasite.shtml
5. http://cmr.jcvi.org/cgi-bin/CMR/shared/Menu.cgi?menu=genome

Elective II

IPR IN BIOINFORMATICS- DETAILED STUDY

BIN-435	**Cr**	**L**	**T**	**P**
	4	**4**	**0**	**0**

Unit I:

Life Sciences and law, need to go for IPR, fields in which IPR could be applied- genetic engg., gene therapy, genetically modified plants and organisms, monoclonal antibody and cloning.

Unit II:

U.S patent law, U.K patent law, European community law in relation to the patentability of live forms-case study of – Amgen Inc vs. Chugai Pharmaceutical Co. ltd and Biogen vs. Medeva case, patetability of computer programs.

Unit III:

Biological database protection and Traditional Knowledge Digital Library, need for data- database protection, sui generis form of data protection, U.K data protection ac 1998, US safe harbor principle.

Unit IV:

Biological software protection-copyright on computer software, are biological softwares patentable, literal copying and non-literal copying, adaptation and fair use, reverse engineering

Unit V:

Urgent need of data protection in India, knowledge of International treaties-WIPO, TRIPS, Paris convention, Berne convention, UPO, EPO, IPO, case study of Myriad genetics, Axys. Pharmaceuticals patent case on cells and genes of New Guinea, Duke university case on Alzheimer's disease.

REFERNCES:

1. Alikhan, Shahid. Socio-Economic Benefits of Intellectual Property Protection in Developing Countries, World Intellectual Property Organization.

2. Rao, R., Rao, A. and Bhanoji. 2008. Intellectual Property Rights- A Primer. Eastern Book Company.

3. Singh, B.D. 2008. Biotechnology-Expending horizons, Kalyani Publications.

Elective II

NANOTECHNOLOGY IN LIFE SCIENCE

BIN-437	**Cr**	**L**	**T**	**P**
	4	**4**	**0**	**0**

Unit I:

Introduction to Nanobiology:

Nanobiotechnology: A historical perspective, Nanotechnology and Bionanotechnology, Nanoimages, Opportunities and Challenges, growth potential, roadmap to realization of nanobiotechnology.

Unit II:

Significance of Nanodomain and Nano Drug Delivary:

Limitation of micron size, need for nano-size, surface volume ratio significance, Derivation of Bhor's Atomic radius, comparision of particle bahivour at nano-size to micro-size, top-down and bottam-up approaches, advantage of scaling down.

Conventional drug delivary, targeted drug delivary, drug delivary vehicles, delivary profiles, the role of nanotechnology in drug delivery and its advantages.

Unit III:

Bionanoimaging:

Quantum dots, ultrasound contrast agents, magnetic nano-particle, Atomic force microscopy

Unit IV:

Successful Applications of Bionanotechnology:

Nanostructures and nano-systems, nano-particles, in vitro diagnostics, medical applications of nano-systems, molecular imaging

Unit V:

Biosynthesis of Nanomaterial:

Biosynthesis of Nano-particles, Microbial Nano-particle production, Biomineralization, Magnetosomes, Nanoscale magnetic iron minerals in bacteria, virus & fungi. DNA based Nano-structures, Protein based Nano-structures.

REFENCENCE BOOKS:

1. Hornyak, G. Louis, Tibbals, H. F., Dutta, Joydeep. 2010. Fundamentals of Nanotechnology. CRC Press,
2. Charles P. Poole Jr., Frank J. Owens. 2003. Introduction to Nanotechnology. John Wiley & Sons,
3. David E. Reisner, 2008. Bionanotechnology: Global Prospects. CRC Press.

Elective II

HUMAN GENOME PROJECT

BIN-439 **Cr L T P**

4 4 0 0

Unit I:

Concept of human genome, goals, history, the five year project planning, research groups involved, and land mark covered, time lines set and achieved, public vs. private approach.

Unit II:

Ethical, social, legal issues in HGP- psychological impact and stigmatization, reproductive issues, conceptual and philosophical implications - privacy and confidentiality, gene testing, gene therapy, behavioral genetics.

Unit III:

Medicine and the new genetics in HGP – gene testing, gene therapy, pharmaco-genomics, genetic counseling and disease specific information.

Unit IV:

Human genome information under following headings – bioinformatics tools, chromosome viewer, genetic disorder guide, gene and protein database guide, sample profile of gene and genetic disorders.

Unit V:

Related projects and future research- exact gene number, exact locations, and functions, non coding DNA types, amount, distribution, information content, and functions, coordination of gene expression, protein synthesis, and post-translational events, interaction of proteins in complex molecular machines and so on.

REFERENCES:

1. www.ornl.gov
2. http://www.genome.gov
3. www.ncbi.nlm.nih.gov
4. Jeffrey, R. B. Maxwell, J. M.1998. Access to the genome- the challenge to equality. University press.

DISSERTATION

BI-492 **Cr L T P**

22 0 0 44

Course Objective:

The students are expected to utilize their scheduled periods by undertaking the project that would be completed during the semester. Every student shall undertake a major Project. The major Project shall be undertaken in some biotechnology industry or laboratory of repute. Each student shall be assigned to a faculty who shall continuously monitor the progress of the Project in the concerned laboratory or industry. The faculty, in consultation with the concerned scientist of the industry/laboratory, shall decide the topic of the project. At the conclusion of the project the student shall submit a seminar and a dissertation. The dissertation shall be evaluated by the internal faculty/examiner. The student then shall have to appear for the viva voce examination.

GUIDELINES FOR PROJECT FILE

Research experience is as close to a professional problem-solving activity as anything in the curriculum. It provides exposure to research methodology and an opportunity to work closely with a faculty guide. It usually requires the use of advanced concepts, a variety of experimental techniques, and state-of-the-art instrumentation. Research is genuine exploration of the unknown that leads to new knowledge which often warrants publication. But whether or not the results of a research project are publishable, the project should be communicated in the form of a research report written by the student. Sufficient time should be allowed for satisfactory completion of reports, taking into account that initial drafts should be critiqued by the faculty guide and corrected by the student at each stage. The File is the principal means by which the work carried out will be assessed and therefore great care should be taken in its preparation.

In general, the File should be comprehensive and include:

• A short account of the activities that were undertaken as part of the project;

• A statement about the extent to which the project has achieved its stated goals.

• A statement about the outcomes of the evaluation and dissemination processes engaged in as part of the project;

• Any activities planned but not yet completed as part of the project, or as a future initiative directly resulting

from the project;

• Any problems that have arisen that may be useful to document for future reference.

Report Layout

The report should contain the following components:

Title or Cover Page.

The title page should contain the following information: Project Title; Student's Name; Course; Year; Supervisor's Name.

Acknowledgements (optional)

Acknowledgment to any advisory or financial assistance received in the course of work may be given.

Abstract

A good "Abstract" should be straight to the point; not too descriptive but fully informative. First paragraph should state what was accomplished with regard to the objectives. The abstract does not have to be an entire summary of the project, but rather a concise summary of the scope and results of the project

Table of Contents

Titles and subtitles are to correspond exactly with those in the text.

Introduction

Here a brief introduction to the problem that is central to the project and an outline of the structure of the rest of the report should be provided. The introduction should aim to catch the imagination of the reader, so excessive details should be avoided.

Materials and Methods

This section should aim at experimental designs, materials used. Methodology should be mentioned in details including modifications if any.

Results and Discussion

Present results, discuss and compare these with those from other workers, etc. In writing these section, emphasis should be given on what has been performed and achieved in the course of the work, rather than discuss in detail what is readily available in text books. Avoid abrupt changes in contents from section to

section and maintain a lucid flow throughout the thesis. An opening and closing paragraph in every chapter could be included to aid in smooth flow.

Note that in writing the various secions, all figures and tables should as far as possible be next to the associated text, in the same orientation as the main text, numbered, and given appropriate titles or captions. All major equations should also be numbered and unless it is really necessary never write in "point" form.

Conclusion

A conclusion should be the final section in which the outcome of the work is mentioned briefly.

Future prospects

Appendices

The Appendix contains material which is of interest to the reader but not an integral part of the thesis and any problem that have arisen that may be useful to document for future reference.

References / Bibliography

This should include papers and books referred to in the body of the report. These should be ordered alphabetically on the author's surname. The titles of journals preferably should not be abbreviated; if they are, abbreviations must comply with an internationally recognized system. Examples :

For research article:

Voravuthikunchai SP, Lortheeranuwat A, Ninrprom T, Popaya W, Pongpaichit S, Supawita T. (2002) Antibacterial activity of Thai medicinal plants against enterohaemorrhagic *Escherichia coli* O157: H7. *Clin Microbiol Infect* , **8** (suppl 1): 116–117.

For book:

Kowalski,M.(1976) Transduction of effectiveness in *Rhizobium meliloti*. SYMBIOTIC NITROGEN FIXATION PLANTS (editor P.S. Nutman IBP), **7**: 63-67

ASSESSMENT OF THE PROJECT FILE

Essentially, marking will be based on the following criteria: the quality of the report, the technical merit of the project and the project execution. Technical merit attempts to assess the quality and depth of the intellectual efforts put into the project. Project execution is concerned with assessing how much work has been put in. The File should fulfill the following ***assessment objectives:***

Range of Research Methods used to obtain information

Execution of Research

Data Analysis

Analyze Quantitative/ Qualitative information Control Quality

Draw Conclusions

Examination Scheme:

Dissertation: 100

Viva Voce: 100

Total: 200

Reference for further information:

Clifford Hawkins and Marco Sorgi; Research: How to Plan, Speak and write about it; Narosa Publishing House, New Delhi 1994