KANNUR UNIVERSITY

(Abstract)

B.Sc Bioinformatics Programme-Scheme & Syllabus of Core/Complementary/Open Courses under Choice Based Credit Semester System for Under Graduate Programme-implemented with effect from 2009 admission-Orders Issued.

ACADEMIC BRANCH

U.O.No.Acad/C2/8965/2008(2) Dated, K.U.Campus. P.O,09- 07-2009.

Read: 1. Minutes of the meeting of the Board of Studies in Biotechnology (Cd) held on 28-05-2009.
2. Minutes of the meeting of the Faculty of Science held on 16-06-2009.
3. U.O No.Acad/C2/3838/2008 (i) dated 07-07-2009.
4. Letter dated nil from the Chairman, BOS in Biotechnology (Cd).

ORDER

1.The Board of Studies in Biotechnology (Cd) vide paper read(1) above has prepared and finalised the Scheme and Syllabus of Bioinformatics Core/Complementary/Open Courses under Choice Based Credit Semester System for implementation from 2009 admission.

2. The recommendations of the Board in restructuring the syllabus is considered by the Faculty of Science vide paper read (2) and recommended for the approval of the Academic Council.

3. The Regulations for Choice based Credit Semester System is implemented in this University vide paper read (3).

4. The Chairman, BOS in Biotechnology (Cd) vide paper read (4) above, forwarded the restructured scheme and syllabus of Bioinformatics Core/Complementary/Open Courses under Choice Based Credit Semester System, prepared by the Board of Studies in Biotechnology (Cd) for implementation with effect from 2009 admission.

5. The Vice Chancellor, after examining the matter in detail, and in exercise of the powers of the Academic Council as per section 11(1) of Kannur University Act 1996 and all other enabling provisions read together with, has accorded sanction ***to implement the scheme and syllabus of Bioinformatics Core/Complementary/Open Courses restructured in line with Choice Based Credit Semester System, with effect from 2009 admission,*** subject to ratification by the Academic Council.

6.The restructured scheme and syllabus of Core/Complementary/Open Courses under Bioinformatics Programme restructured in line with Choice Based Credit Semester System, implemented with effect from 2009 admission is appended.

7. The Scheme and Syllabus of Complementary Courses offered for this Programme will be available along with the syllabus of Core Courses of the Complementary subject.

8. The affiliated Colleges are not permitted to offer Complementary Courses in violation to the provisional/permanent affiliation granted by the University. Changes in Complementary Courses are permitted with prior sanction /revision in the affiliation order already issued in this regard.

9. If there is any inconsistency between the Regulations for CCSS and its application to the Scheme & Syllabus prepared, the former shall prevail.

10. Orders are issued accordingly.

Sd/-
REGISTRAR

To:

1. The Principals of Colleges offering Bioinformatics Programme

2. The Examination Branch (through PA to CE)

Copy To:

1. The Chairman, BOS Biotechnology (Cd)
2. PS to VC/PA to PVC/PA to Regr
3. DR/AR I Academic
4. Central Library
5. SF/DF/FC.

Forwarded/By Order

SECTION OFFICER

Appendix to U.O No Acad/C2/8965/2008(2) dated 09-07-2009.

K A N N U R U N I V E R S I T Y

COURSE STRUCTURE

&

SYLLABUS

FOR

UNDERGRADUATE PROGRAMME

IN

BIOINFORMATICS

CHOICE BASED CREDIT SEMESTER SYSTEM

w.e.f 2009 ADMISSION

COURSE STRUCTURE FOR UG PROGRAMME
BIOINFORMATICS

SEMESTER 1

No	Title of the Course	Contact hours /week	Credits
1	Common Course (English)	5	4
2	Common Course (English)	4	3
3	Common Course (Additional Language)	4	4
4	Core Course 1	4	3
5	Complementary 1 (Course I)	4	3
6	Complementary 2 (Course I)	4	3

SEMESTER 2

No	Title of the Course	Contact hours/week	Credits
1	Common Course (English)	5	4
2	Common Course (English)	4	3
3	Common Course (Additional Language)	4	4
4	Core Course 2	4	3
5	Complementary 1 (Course II)	4	3
6	Complementary 2 (Course II)	4	3

SEMESTER 3

No	Title of the Course	Contact hours/week	Credits
1	Common Course (English)	5	4
2	Common Course (Additional Language)	5	4
3	Core Course 3	2	3
4	Core Course 4	3	4
5	Complementary 1 (Course III)	5	3
6	Complementary 2 (Course III)	5	3

SEMESTER 4

No	Title of the Course	Contact hours/week	Credits
1	Common Course (English)	5	4
2	Common Course (Additional Language)	5	4
3	Core Course 5	2	3
4	Core Course 6 Practical I	3	4
5	Complementary 1 (Course IV)	5	3
6	Complementary 2 (Course IV)	5	3

SEMESTER 5

No	Title of the Course	Contact Hours / week	Credit
1	Open Course 1	2	2
2	Core Course 7	5	4
3	Core Course 8	5	4
4	Core Course 9	5	4
5	Core Course 10	3	2
6	Core Course 11 Practical II	5	4

SEMESTER 6

No	Title of the Course	Contact Hours / week	Credit
1	Open Course 2	2	2
2	Core Course 12	5	4
3	Core Course 13	5	4
4	Core Course 14	3	2
5	Core Course 15 Practical III	5	4
6	Core Course 16 Project	5	2

Scheme Bioinformatics(Core)

No	Semester	Course code	Title of the course	Hours/ week	Credit
1	I	1B01 BIF	Methodology and Perspective of Sciences	4	3
2	II	2B02 BIF	Informatics and Introduction to Bioinformatics	4	3
3	III	3B03 BIF	Introductory Statistics	2	3
4	III	3B04 BIF	Cell Biology	3	4
5	IV	4B05 BIF	Programming Concepts and C Language	2	3
6	IV	4B06 BIF	Bioinformatics Practical – I	3	4
7	V	5B07 BIF	Molecular Biology	5	4
8	V	5B08 BIF	Genetics	5	4
9	V	5B09 BIF	Biological Databases	5	4
10	V	5B10 BIF	Structural Bioinformatics - I	3	2
11	V	5B11 BIF	Bioinformatics Practical II	5	4
12	VI	6B12 BIF	Sequence Analysis	5	4
13	VI	6B13 BIF	Genomics and Proteomics	5	4
14	VI	6B14 BIF	Structural Bioinformatics - II	3	2
15	VI	6B15 BIF	Bioinformatics Practical – III	5	4
16	VI	6B16 BIF	Project Work	5	2

Scheme Open Courses

No	Semester	Course Code	Title of the Course	Hours/ week	Credit
1	V	5D01 BIF	Molecular Modeling	2	2
2	V	5D02 BIF	PERL Programming	2	2
3	VI	6D01 BIF	Bioinformatics in Drug Design	2	2
4	VI	6D02 BIF	Application of PERL to Bioinformatics	2	2

Scheme Bioinformatics (Complementary)

No	Semester	Course Code	Title of the Course	Hours/ week	Credit
1	I	1C01BIF	Introduction to Bioinformatics	2	2
2	I	4C05 BIF	Bioinformatics Practical	2	*
3	II	2C02 BIF	Biological Databases	2	2
4	II	4C05 BIF	Bioinformatics Practical	2	*
5	III	3C03 BIF	Sequence Analysis	2	2
6	III	4C05 BIF	Bioinformatics Practical	2	*
7	IV	4C04 BIF	Structural Bioinformatics	2	2
8	IV	4C05 BIF	Bioinformatics Practical	2	4

1B01BIF - METHODOLOGY AND PERSPECTIVE OF SCIENCES

Hours/Week:4
Credits:3

Module I : Science and Science Studies

Types of knowledge: Practical, theoretical and scientific knowledge, Information:

What is science? What is not science? Laws of Science, Basis for scientific laws and factual truths.

Science as a human activity, scientific temper, empiricism, vocabulary of science, science disciplines. Revolutions in science, Science and Technology.

Module II : Methods and Tools of Science

Hypotheses: theories and laws in science, Observations, evidences and proofs. Peer reviews.

Posing a question; formulation of hypothesis; Hypothetico-deductive model, Inductive model. Significance of verification (proving), corroboration and falsification (disproving), auxiliary hypothesis, adhoc hypothesis.Revision of scientific theories and laws.

Importance of models, simulations and virtual testing. Mathematical methods versus Scientific methods.

Module III : Experimentation in Science

Design of an experiment; experimentation; observation; data collection; interpretation and deduction.Necessity of units and dimensions; repeatability and replication; Documentation of experiments, Record keeping. Connection between measurements and underlying theory.

Types of experiments. Experiments to test a hypothesis, to measure a variable or to gather data by preliminary and explorative experiments. Planning of experiments: Design, selection of controls, observational requirements, instrumental requirements.

Scientific Instruments; Sensory extension; choice and selection of instruments; sensitivity of instruments; Accuracy and precision, Types of instrumentation; Historical development and evolution of scientific instruments. Robotics. (*Only a general orientation of scientific instruments required*).

Making observations: direct and indirect observations, controlled and uncontrolled observations, human and machine observations. Examples of great experiments in science. (*To illustrate how various tools were applied to answer a question*).

Module IV : Data handling in ethics science

Documentation of experiments. Nature and Types of data – typical examples; Data acquisition; Treatment of data; Data interpretation, Significance of statistical tools in data interpretation, errors and inaccuracies, instrumental errors and variables, human errors (basic idea).

Data presentation: graphs, tables, histograms and pi diagrams.

Statistical testing of hypothesis, null hypothesis, Significance test – Statistics based acceptance or rejection of a hypothesis. Deduction of scientific correlation, patterns and trends.

Ethics in Science: Scientific information, Depositories of scientific information, primary, secondary and digital sources, Sharing of knowledge; transparency and honesty; danger of preconceived ideas.

Reporting of observational and experimental data, human bias, Biased observations, Influence of observer on observations, using and acknowledge observations by others. Publications and Patents. Plagiarism.

Reference Books

1.Gieryn, T.f. Cultural Boundaries of Science., Univ. Chicago Press, 1999.

2.Collins H. and T. Pinch. The Golem: What Everyone should know about Science ., Cambridge Univ Press, 1993

3.Hewitt, Paul G, Suzanne Lyons, *John* a. Suchocki-Wesley, 2007

4.Newton R G. The Truth of Science: New Delhi, 2nd edition Bass, Joel, E and et. al, Methods for Teaching Science as Inquiry, Allyn & Bacon, 2009.

2B02 BIF - INFORMATICS AND INTRODUCTION TO BIOINFORMATICS

Hours/Week:4
Credits:3

Module I – Overview of Information Technology Features of the modern personal computer and peripherals, computer networks & Internet, wireless technology, cellular wireless networks, introduction to mobile phone technology, introduction to ATM, purchase of technology, License, Guarantee, Warranty, overview of Operating Systems & major application software.

Module II – Knowledge Skills for Higher Education Data, information and knowledge, knowledge management – Internet access methods – Dial-up, DSL, Cable, ISDN, Wi-Fi – Internet as a knowledge repository, academic search techniques, creating cyber presence, case study of academic websites, open access initiatives, open access publishing models. Basic concepts of IPR, copyrights and patents, plagiarism, introduction to use of IT in teaching and learning, case study of educational software, academic services – INFLIBNET, NICNET, BRNET.

Module III – Social Informatics IT & Society-issue and concerns-digital divide, IT & development, the free software movement, IT industry; new opportunities and new threats, software piracy, cyber ethics, cyber crime, cyber threats, cyber security, privacy issues, cyber laws, cyber addictions, information overload, health issues – guide lines for proper usages of computers, internet and mobile phones, e-wastes and green computing, impact of IT on language & culture-localization issues – Unicode – IT and regional languages.

Module IV – Application e-Governance applications at national and state level, IT for national integration, overview of IT application in medicine, healthcare, business, commerce, industry, defense, law, crime detection, publishing, communication, resource management, weather forecasting, education, film and media, IT in service of disabled, futuristic IT-Artificial Intelligence, Virtual Reality, Bio-Computing.

ModuleV -Introduction to Bioinformatics History, definition, bioinformatics introduction, importance and uses of bioinformatics, information technology, biological data, databases, protein sequencing, nucleic acid sequencing, sequence to structure relationship.

Module VI-Human Genome Project History, Nucleic acids, Genes, Genomes; Contribution of various countries, about National Institutes of Human Genome Project (NHGRI); Introduction and need of Human Genome Project, rough and final draft of the Human Genome Project, Goals of the HGP, uses and applications; overview of genomics and proteomics.

References

1. Introduction to Bioinformatics: by T.K. Altwood, D.J. Parry-Smith and S. Phukan.
2. Bioinformatics: Sequence and Genome Analysis David. W. Mount.
3. Bioinformatics: Genes, Proteins, and Computers by C.A. Orengo, D.T. Jones and J.M. Thornton

3B03 BIF - INTRODUCTORY STATISTICS

Hours/Week:2
Credits:3

Module I- The meaning of Statistics. Scope of Statistics in Biological and Medical Sciences. Definition of population and sample. Collection of data: Primary and secondary data. Attributes and variables. Qualitative and quantitative data. Types of data: Ungrouped data, grouped data, discrete data and continuous data.

Module II -Graphical and Diagrammatic Representation: Histogram, ogives, simple bar diagrams, and stem and leaf chart. Frequency distribution. Inclusive and exclusive methods. Cumulative frequency distribution.

Module III Measures of Central Tendency Concept of measures of central tendency. Arithmetic mean, median, mode, quartiles, and weighted mean. Definitions and examples for ungrouped as well as grouped data. Properties of arithmetic mean

Module IV Measures of Dispersion Absolute and relative measures, range, quartile deviation, variance, and standard deviation. Coefficient of variation (with simple examples)

Module V Correlation Introduction, definition and types of correlation between two variables. Scatter diagram. Karl Pearson's coefficient of correlation and Spearman's rank correlation coefficient. Definition and examples for ungrouped data.

Module VI Probability Random experiments. Sample space, Event, Elementary event, Compound event, Impossible events, certain events, equally likely events, mutually exclusive events, and exhaustive events. Dependent and independent events. Definition of probability. Addition law of probability with illustration. Definition of conditional probability. Multiplicative law of probability with illustrative examples.

References

1. Marcello Pagano and Kimberlee Gauvreau, Principles of Biostatistics
2. Methi J. , Statistical Methods An Introductory Text. New Age international (p) Ltd.
3. Bhat. B. R. ,Srivenkatramana T. & Madhav Rao K. S. (1996) Statistics. A Beginners Text. Vol . I New Age International (p) Ltd.
4. Ithal U. B. And Naik B. U., Statistical MethodS I, Phadake Prakashan, Kolhapur.
5. Ithal U. B. And Naik B. U., Statistical MethodS II, Phadake Prakashan, Kolhapur.
6. Gupta S. C. And V. K. Kapoor Fundamentals of Mathematical Statistics. Sulthan Chand & sons

3B04 BIF - CELL BIOLOGY

Hours/Week:3
Credits:4

Module I Cell as a basic unit of living systems - The cell theory .Pre -cellular evolution - Artificial creation of cells.

Module II Broad classification of cell types: PPLOs, Bacteria, Eukaryotic microbes, Plant and animal cells - A detailed classification of cell types within an organism - Cell, tissue, organ and organism as different levels of organization of otherwise genetically similar cells

Module III Biochemical composition of cells - Proteins, lipids, carbohydrates, nucleic acids and the metabolic pool, Ultra structure of the cell membrane.

Module IV Structure and function of cell organelles - ultra structure of cell membrane, cytosol, golgi bodies, endoplasmic reticulum (rough and smooth), ribosomes - cytoskeletal structures (actin, microtubules etc.) - Mitochondria, chloroplasts, lysosomes, Peroxysomes, nucleus (nuclear membrane, nucleoplasm, nucleolus, chromatin)

Module V Chromosomes - chromatin reticulum, chromosome morphology, fine structure, chemical organizations - Organization of DNA- nucleoproteins - Histones and non histones ; Special types of chromosomes - salivary gland chromosomes and lamp brush chromosomes ; Mitosis and Meiosis, significance of mitosis and meiosis. Cell division and cell cycle (including cell synchrony and its applications)

Module VI Cell to cell interactions, Cell locomotion (amoeboid, flagellar and ciliar) -muscle and nerve cells Cell senescence and death, Cell differentiation in plants and animals

References

1. Cohn, N.S. (1964). Elements of Cytology Brace and World Inc., New Delhi.
2. Darington, C.D.(1965). Cytology, Churchill, London.
3. Darnell, J., Lodish, KL and Baltimore, D (1991). Molecular Cell biology, Scientific American books.
4. De Robertis, E.D.P. and Robertis, E.M.F.(1991). Cell and Molecular biology. Lea and Febiger, Washington.
5. Dobzhansky, B (1961).Genetks$_i$and The origin of species, Columbia University press,New York.
6. J Roy, S.C. and Kalyan Kumar De (1997). Cell Biology. New Central Book Agency,Calcutta

4B05 BIF- PROGRAMMING CONCEPTS AND 'C' LANGUAGE

Hours/Week:2
Credits:3

Module I - Introduction to Programming: Steps involving in problem solving, Problem definition, Algorithm, Characteristics, Notation of Algorithm, Flow-charts Definition, Symbol, Features, Running and Debugging the program. Computer languages - High level, low level, assembly level , compiler, interpreter.

Module II - Introduction to 'C' Language Historical background of 'C': Character set, Constants, Variables, Keywords and Comments, Instructions: Type declaration instruction, Arithmetic instruction, Integer and float conversion, Hierarchy of operations, Control instructions in C.

Module III - Control Structure Definition, Various types of control structure used in 'C ' and its various applications Decision control structure: The if statement if-else statement, Nested if-else and forms of if.

Module IV - Operators: Arithmetic, Logical, Relational, Bitwise, Increment, Decrement, Conditional operators. Loop Control structure: The while loop, for loop: Nesting of loops and multiple initializations in for loop, Odd loop: break statement, continue statement, do-while loop. Case control structure: Decision using switch, Tips and Traps, The goto statement

Module V - Functions and Pointers Introduction to function: Application of function, Passing Values, Scope and rule of functions, advanced features of function, Function declaration and prototype, call by values and call by reference, Pointer: Introduction, Pointer notation and Back to function call, Recursion.

Module VI - Arrays and Strings Importance of arrays in 'C', Array initialization, Bounds checking, passing array element to a function, Pointer and arrays, More than one dimension, three dimensional array. Strings: Basic concept of strings, Standard library function of string: strlen(), strcply(), srcat(), strcmp(), Two dimensional array of characters, Array of pointer to strings, Limitation of array of pointer to strings.

Reference:

1) Let us C- Y. C. Kanetkar
2) 'C' programming- Dennis Ritchie
3) Programming in C- Gottfried
4) C Application program and projects by Pramod Vasambekar.
5) Ansi C by Balgurusami.
6) Database System Concepts- Korth Silberschetz.
7) Commercial Application Development Using Developer 2000 by Ivan Bayross.
8) Structure Query Language- By Osborne.
9) Internet: An Introduction- Tata McGraw Hill Pub

4B06 BIF – Bioinformatics practical – I

Hours/Week:3
Credits:4

Programming in C language

1 Program to carry out basic arithmetic operations (+,-,*, /, %)

2 Program to find whether a given number is prime or not

3 Program to find the biggest of 2/3 numbers

4 Program to print a series of odd/even numbers

5 Program to find factorial of an integer

6 Program to check whether a string is palindrome or not

7 Arrange a series of numbers/strings in ascending/descending order

8 Program to find factorial of an integer using function recursion

9. program for matrix addition

10. program for matrix multiplication

11 program for string copying

12. string concatenation

13. File copying

5B07 BIF - MOLECULAR BIOLOGY

Hours/Week:5
Credits:4

Module 1 History and development of Molecular Biology. Nucleic acids- DNA and RNA as genetic materials. Structure of nucleic acids - nucleosides and nucleotides - DNA double helix. Nature of genetic code - deciphering genetic code - wobble hypothesis -universalities and exceptions.

Module II Properties of DNA - Absorbance - ionic interaction - denaturation and renaturation - sedimentation.DNA replication in prokaryotes & eukaryotes - semi conservative replication- replication fork- rolling model. .Enzymes involved in nucleic acid synthesis.

Module III Structure of genes in prokaryotes & eukaryotes- definition - molecular structure. Fine structure of gene- muton - recon – cistron. Organisation of transcriptional unit - leader sequences - promoter sequences - terminator sequences - introns and exons - transcription factors.Transcription in prokaryotes & eukaryotes.Types of transcribed RNAs.RNA processing - methyl capping, polyadenylation & splicing of m RNA-mRNA editing.Processing of rRNA and tRNA.Translation in prokaryotes & eukaryotes - Ribosome structure and function –polysome. Gene Expression - one gene one polypeptide hypothesis - Operon concept.Negative and positive regulation of operon- lac, his and trp operon - catabolic repression

Module IV Eukaryotic gene expression. Gene expression in yeast. Gene expression in protozoan parasites, Gene regulation in eukaryotes - regulation at transcriptional level Gene regulation in eukaryotes -regulation at translational levelGene regulation in eukaryotes - post translational modifications Developmental & environmental regulation of gene expression Insertion elements & transposones, Gene organization & expression in mitochondria & chloroplasts.

Module V Gene mutations - Types of DNA mutations-point, frameshift etc. deletion, inversion, translocation etc. - mutator genes, hot spots , Physical and chemical mutagens DNA repair – photo activation - excision repair -post replication repair , recombination repair, Oncogenes

Reference

1.Molecular Biology of the Gene -Lewin
2.Molecular biology Watson

5B08 BIF – GENETICS

Hours/Week:5
Credits:4

Module I - Mendelian Laws of Inheritance Gene interactions - incomplete dominance - Mirabilis, co-dominance-coat colour in cattle, lethal genes-Albinism and coat colour in mice, Interaction of genes-comb pattern in poultry, complementary genes- flower colour in lathyrus, Epistasis- fruit colour in summer squashes, Duplicate genes with cumulative effect- fruit shape in summer squashes, Inhibitory factor- Leaf colour in Paddy, Pleiotropism

Module II - Quantitative Inheritance: General characters - skin colour in man, ear size in corn-transgressive variation. Multiple alleles: Albino series in Rabbits- ABO blood group in man- self sterility in tobacco

Module III - Sex determination in Plants and Animals: ex linkage ; non-disjunction as a proof of chromosomal theory of inheritance. Linkage and crossing over- mechanism of crossing over-proof of crossing over-two point and three point test cross- interference and coincidence-Linkage maps, Sex linked inheritance - eye colour in Drosophila, Hemophilia in man-Holanclric inheritance- sex limited and sex influenced characters

Module IV - Structural and Numerical Aberration Involving Chromosomes Hereditary defects-Kleinfelter, Turner and Down syndromes, Mutations- spontaneous and induced; chemical and physical mutagens; induced, mutation in plants, animals and microbes for economic benefit of man

Module V - Basic Microbial Genetics Conjugation, transduction, transformation; isolation of auxotrophs, replica plating techniques, analysis of mutations in biochemical pathways, one gene-one enzyme hypothesis

Module VI - Extra Chromosomal Inheritance Mitochondrial and chloroplast genetic systems. Population genetics; Hardy-Weinberg equilibrium, gene and genotypic frequencies.

References

1. De Robertis, E.D.P. and Robertis, E.M.F.(1991). Cell and Molecular biology. Lea and Febiger, Washington.
2. Dobzhansky, B (1961).Genetksiand The origin of species, Columbia University press, New York.
3. Gardner, E.J. and Snustad, D.P.(1984). Principles of Genetics. John Wiley, New York.
4. Lewin, B. (1994) Genes, Oxford University Press, London.
5. Lewis, W.H. (1980) Polyploidy. Plenum Press, New York.
6. Sharma, A.K. and Sharma, a. (1980). Chromosome technique : theory and practice. Aditya Books, NewDelhi.
7. Sinnot, E.W., Dunn, L.C. and Dobzhansky, T.(1958). Principles of Genetics, McGraw Hill, New York.

5B09 BIF - BIOLOGICAL DATABASES

Hours/Week:5
Credits:4

Module I- Basic Concepts Basic concept of open access bibliographic resources related to Life Sciences, the significance and need for such resources, the major content of the databases, how to search and use these resources/databases with special reference to Pub Med.

Module II -Organization of Data Contents and formats of database entries, retrieval of data using text-based search tools, sources of data (e.g. sequencing projects, individual scientists, patent offices etc.), method for deposition of data to databases.

Module III - Important Biological Databases Nucleic acid sequence databases: GenBank, EMBL, DDBJ, Protein sequence databases: SWISS-PROT, TrEMBL, PIR_PSD, Genome Databases at NCBI, EBI, TIGR, SANGER.

Module IV – Genome Databases Viral Genomes, Archeal and Bacterial Genomes, Eukaryotic genomes with special reference to model organisms (Yeast, Drosophila, C. elegans, Rat, Mouse) Human, plants such as Arabidopsis thaliana, Rice, etc.

Module V – Structural and Related Databases PDB, NDB, CCSD, Prosite, PRODOM, Pfam, PRINTS, CATH, SCOP, DSSP, FSSP, DALI

References

1. Introduction to Bioinformatics – Attwood & Parry-Smith, Pearson Education
2. Bioinformatics- A beginner's guide by Jean-Michel Claverie, John Wiley & Sons.
3. Structural Bioinformatics by Philip E. Bourne and Helge Weissing, Wiley
4. Bioinformatics-Methods and applications, Rastogi,S.C. Mendiratta, N. and Rastogi P, Prentice-Hall of IndiaPvt. Ltd, New Delhi
5. Essential Bioinformatics-Jin Xiong, Cambridge University Press
6. Bioinformatics – Sequence and Genome anlysis, Mount DW, Cold Spring Harbour Laboratory Press, New York
7. Bioinformatics - BaxevanisAD & Quellette BFF, John Wiley & Sons Inc.

5B10 BIF – STRUCTURAL BIOINFORMATICS – I

Hours/Week:3
Credits:2

Module I – Structure of Proteins Principles of protein structure; anatomy of proteins – Hierarchical organization of protein structure - Primary. Secondary, Supersecondary, Tertiary and quaternary structure; Internal coordinates of proteins; Theory, Derivation and significance of Ramachandran Map,

Module II – Structure of Nucleic Acids DNA and RNA: types of base pairing – Watson-Crick and Hoogstein; types of double helices A,B,Z and their geometrical as well as structural features; structural and geometrical parameters of each and their comparison

Module III – Intermolecular Interactions Protein-protein interactions, protein –DNA interactions, DNA binding proteins, Types of interactions of DNA with proteins and small molecules. Different forces involved in the interactions.

5B11 BIF – BIOINFORMATICS PRACTICAL – II

Hours/Week:5
Credits:4

1. Literature mining using pubmed central
2. Literature mining using Medline
3. Browse the ExPASy sites and write information received in your record.
4. To retrieve metabolic pathways using KEGG PATHWAY Database
5. To retrieve metabolic pathways using Reactom
6. Retrieving Protein and DNA Sequences using Entrez at NCBI
7. Retrieving Protein and DNA Sequences using SRS at EBI
8. Web browsing at SwisProt
9. Web browsing at PIR PSD
10. Web browsing at UniProtKB
11. Nucleotide BLAST – Search nucleotide database using nucleotide query
12. Protein BLAST – Search Protein database using protein query
13. BLAST – X : Search Protein database using a translated nucleotide query
14. Multiple Sequence Alignment – CLUSTALW
15. Details of PDB files

6B12 BIF – SEQUENCE ANALYSIS

Hours/Week:5
Credits:4

Module I -Various file formats for Bio-molecular Sequences: GenBank, FASTA, GCG, MSF, NBRF-PIR. Basic concepts of sequence similarity, identity and homology, definitions of homologues, orthologues, paralogues.

Module II - Scoring Matrices: Basic concept of a scoring matrix, Matrices for nucleic acid and proteins sequences, PAM and BLOSUM series, principles based on which these matrices are derived. Differences between distance & similarity matrix

Module III - Sequence-based Database Searches: What are sequence-based database searches, BLAST and FASTA algorithms, Various versions of basic BLAST and FASTA, Use of these methods for sequence analysis including the on-line use of the tools and interpretation of results.

Module IV - Pairwise Sequence Alignments: Basic concepts of sequence alignment, Needleman & Wuncsh, Smith & Waterman algorithms for pairwise alignments, use of pairwise alignments for analysis of Nucleic acid and protein sequences and interpretation of results

Module V - Multiple Sequence Alignments: Need for MSA, basic concepts of various approaches for MSA (e,g. progressive, hierarchical etc.). Algorithm of CLUSTALW and Pileup and their application for sequence analysis (including interpretation of results), concept of dendograms and its interpretation.

Module VI - Taxonomy and Phylogeny: Basic concepts in systematic, taxonomy and phylogeny; molecular evolution; nature of data used in Taxonomy and Phylogeny, Definition and description of phylogenetic trees and various types of trees.

Module VII- Sequence Patterns and Profiles: Basic concept and definition of sequence patterns, motifs and profiles, various types of pattern representations viz. consensus, regular expression (prosite-type) and profiles; profile-based database searches using PSI-BLAST, analysis and interpretation of profile-based searches.

References

1. Introduction to Bioinformatics – Attwood & Parry-Smith, Pearson Education
2. Bioinformatics- A beginner's guide by Jean-Michel Claverie, John Wiley & Sons.
3. Structural Bioinformatics by Philip E. Bourne and Helge Weissing, Wiley
4. Bioinformatics-Methods and applications, Rastogi,S.C. Mendiratta, N. and Rastogi P, Prentice-Hall of IndiaPvt. Ltd, New Delhi
5. Essential Bioinformatics-Jin Xiong, Cambridge University Press
6. Bioinformatics – Sequence and Genome anlysis, Mount DW, Cold Spring Harbour Laboratory Press, New York
7. Bioinformatics - BaxevanisAD & Quellette BFF, John Wiley & Sons Inc.

6B13 BIF - GENOMICS AND PROTEOMICS

Hours/Week:5
Credits:4

Module I Introduction To Genomics: Genomes Biological Techniques in Genomics Mapping Populations Genetic Markers

Module II Genetic Mapping, Family Studies Complex Traits Genetic Maps Identification of DNA polymorphism The importance of SNPs DNA typing; Pharmacogenomics.

Module III Physical Mapping: Cytogenetics Chromosome painting and FISH, Micro-dissection and Flow sorting. Gene Isolation Long Range and Global Physical Mapping Integration of Genetic and Physical Maps Isolation of genes from genomic DNA; by cDNA; exon traps; gene prediction. Transient expression of Transgenes DGGE in mutation
Detection.

Module IV DNA Sequencing: Sequencing Strategies Templates Chemistries Labelling and Detection Future Methods.

Module V Functional Analysis With cDNA, DNA Chips, Expression Analysis Bioinformatics For Large Data Sets,

Module VI Proteomics: 2-D GelsES And MALDI-TOF MS Antibody Applications Future Prospects

References

1. Introduction to Bioinformatics – Attwood & Parry-Smith, Pearson Education
2. Bioinformatics- A beginner's guide by Jean-Michel Claverie, John Wiley & Sons.
3. Structural Bioinformatics by Philip E. Bourne and Helge Weissing, Wiley
4. Bioinformatics-Methods and applications, Rastogi,S.C. Mendiratta, N. and Rastogi P, Prentice-Hall of IndiaPvt. Ltd, New Delhi
5. Essential Bioinformatics-Jin Xiong, Cambridge University Press
6. Bioinformatics – Sequence and Genome anlysis, Mount DW, Cold Spring Harbour Laboratory Press, New York
7. Bioinformatics - BaxevanisAD & Quellette BFF, John Wiley & Sons Inc.

6B14 BIF - STRUCTURAL BIOINFORMATICS – II

Hours/Week:3
Credits:2

Module I – Protein Structure Prediction Basic principles on protein structure prediction, Chou Fasman and GOR methods, Ab initio structure prediction. Theoretical basis of the methods for structure prediction (sequence similarity / identity of target protein with proteins of known structure, fundamental principles of protein folding etc.) and choice of appropriate prediction approach; basic principles and protocol of Homology Modeling.

Module II – Introduction to X-ray Crystallography Crystal system, Bragg's law, diffraction of crystals, structure factor, atomic scattering factor, crystallization, data collection, structure solution and refinement, Structure validation.

Module III - Basics of NMR spectroscopy, shielding constant and chemical shift, Application of NMR spectroscopy in protein structure determination.

Module IV – Structure Visualization Tools Knowledge of Programs such as SPDBV, Rasmol, webmole, Cn3D, VMD, molmol, chime.

References

1. Introduction to Bioinformatics – Attwood & Parry-Smith, Pearson Education
2. Bioinformatics- A beginner's guide by Jean-Michel Claverie, John Wiley & Sons.
3. Structural Bioinformatics by Philip E. Bourne and Helge Weissing, Wiley
4. Bioinformatics-Methods and applications, Rastogi,S.C. Mendiratta, N. and Rastogi P, Prentice-Hall of IndiaPvt. Ltd, New Delhi
5. Essential Bioinformatics-Jin Xiong, Cambridge University Press
6. Bioinformatics – Sequence and Genome anlysis, Mount DW, Cold Spring Harbour Laboratory Press, New York
7. Bioinformatics - BaxevanisAD & Quellette BFF, John Wiley & Sons Inc.
8. Evolutionary computations in Bioinformatics – Fogel & Corne, Morgan Kafman publishers
9. Introduction to Protein structure by Brandel C. and Tooze, J.
10. Structure and Mechanism in Protein science – Fersht WH freeman & Co
11. Protein folding – Creighton TE (ed) WH Freeman & Co.

6B15 BIF - BIOINFORMATICS PRACTICAL III

Hours/Week:5
Credits:4

1. ProtParam - Physico-chemical parameters of a protein sequence (amino-acid and atomic compositions, isoelectric point, extinction coefficient, etc.)
2. Compute pI/Mw - Compute the theoretical isoelectric point (pI) and molecular weight (Mw) from a UniProt Knowledgebase entry or for a user sequence
3. ScanSite pI/Mw - Compute the theoretical pI and Mw, and multiple hosphorylation states
4. HelixWheel / HelixDraw - Representations of a protein fragment as a helical wheel
5. Use visualization tools like Swiss-PdbViewer, Jmol, MolMol, PyMol, Rasmol, VMD
6. Download protein and DNA from PDB and display using above programs and analyze the structural features
7. APSSP - Advanced Protein Secondary Structure Prediction Server
8. GOR - The GOR (Garnier-Osguthorpe-Robson) method uses both information theory and Bayesian statistics for predicting the secondary structure of protein.
9. Homology modeling - SWISS-MODEL - An automated knowledge-based protein modelling server
10. Threading - Phyre (Successor of 3D-PSSM) - The PHYRE automatic fold recognition server for predicting the structure and/or function of your protein sequence
11. Ab initio - HMMSTR - Prediction of protein structure from sequence Assessing tertiary structure prediction
12. PROCHECK - Verification of the stereochemical quality of a protein structure
13. What If - Protein structure analysis program for mutant prediction, structure verification, molecular graphics

6B16 BIF – PROJECT WORK

Carry out a small research project on any topic related to Bioinformatics and submit a brief dissertation at the end of 6th semester. The dissertation will be valued by external examiners

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Chairman,BOS Biotechnology(Cd).

K A N N U R U N I V E R S I T Y

COURSE STRUCTURE

&

SYLLABUS

FOR

BIOINFORMATICS

(COMPLEMENTARY)

CHOICE BASED CREDIT SEMESTER SYSTEM

w.e.f 2009 ADMISSION

Scheme Bioinformatics(Complementary)

No	Semester	Course code	Title of the course	Hours/ week	Credit
1	I	1C01BIF	Introduction to Bioinformatics	2	2
2	I	4C05 BIF	Bioinformatics Practical	2	*
3	II	2C02 BIF	Biological Databases	2	2
4	II	4C05 BIF	Bioinformatics Practical	2	*
5	III	3C03 BIF	Sequence Analysis	2	2
6	III	4C05 BIF	Bioinformatics Practical	2	*
7	IV	4C04 BIF	Structural Bioinformatics	2	2
8	IV	4C05 BIF	Bioinformatics Practical	2	4

1C01 BIF – INTRODUCTION TO BIOINFORMATICS

Hours/Week:2
Credits:2

Module I. Introduction- Background, various definitions of Bioinformatics. History of Bioinformatics, Introduction and need of Human Genome Project, rough and final draft of the Human Genome Project, Goals of the HGP

Module II. Internet and intranet- definition, history of internet, intranet, role of internet and intranet in Bioinformatics, World Wide Web.

Module III. Introduction to HTML- Introduction tags and attributes, types of HTML tags. HTML tags-head, body, meta, font, heading, anchor, img, hr, align, listing, forms, frames, tables.

Module IV. Introduction to SQL -
(a) sql commands-alter, update, drop, delete, order by, distinct, rename, inbuilt functions
(b) sql constraints - check, unique, not null, default, primary key/foreign key
(c) Introduction to index and types of index.

References

1. Introduction to Bioinformatics: by T.K. Altwood, D.J. Parry-Smith and S. Phukan.
2. Bioinformatics: Sequence and Genome Analysis David. W. Mount.
3. Bioinformatics: Genes, Proteins, and Computers by C.A. Orengo, D.T. Jones and J.M. Thornton

2C02 BIF - BIOLOGICAL DATABASES

Hours/Week:2
Credits:2

Module I. Basic concept of open access bibliographic resources related to Life Sciences, the significance and need for such resources, the major content of the databases, how to search and use these resources/databases with special reference to PubMed

Module II Important biological databases: Nucleic acid sequence databases: GenBank, EMBL, DDBJ, Protein sequence databases: SWISS-PROT, TrEMBL, PIR_PSD, Genome Databases at NCBI, EBI

Module III Genome databases: Viral Genomes, Archeal and Bacterial Genomes, Eukaryotic genomes with special reference to model organisms (Yeast, Drosophila, C. elegans, Rat, Mouse) Human, plants such as Arabidopsis thaliana, Rice, etc.

Module IV Structural and related databases: PDB, NDB, CCSD, Prosite, PRODOM, Pfam, PRINTS, CATH, SCOP, DSSP, FSSP, DALI

References

1. Bioinformatics-Methods and applications, Rastogi,S.C. Mendiratta, N. and Rastogi P, Prentice-Hall of IndiaPvt. Ltd, New Delhi
2. Essential Bioinformatics-Jin Xiong, Cambridge University Press
3. Bioinformatics – Sequence and Genome anlysis, Mount DW, Cold Spring Harbour Laboratory Press, New York
4. Bioinformatics - BaxevanisAD & Quellette BFF, John Wiley & Sons Inc.

3C03 BIF - SEQUENCE ANALYSIS

Hours/Week:2
Credits:2

Module I. Scoring matrices: Basic concept of a scoring matrix, Matrices for nucleic acid and proteins sequences, PAM and BLOSUM series, principles based on which these matrices are derived. Differences between distance & similarity matrix

Module II Sequence-based Database Searches: What are sequence-based database searches, BLAST and FASTA algorithms, Use of these methods for sequence analysis including the on-line use of the tools and interpretation of results.

Module III Pairwise sequence alignments: Basic concepts of sequence alignment, Needleman & Wuncsh, Smith & Waterman algorithms for pairwise alignments, use of pairwise alignments for analysis of Nucleic acid and protein sequences and interpretation of results

Module IV Multiple sequence alignments: Basic concepts of various approaches for MSA. CLUSTALW and its application for sequence analysis (including interpretation of results), concept of dendograms and its interpretation.

Module V Taxonomy and phylogeny: Basic concepts in systematic, taxonomy and phylogeny; molecular evolution; nature of data used in Taxonomy and Phylogeny, Definition and description of phylogenetic trees and various types of trees

References

1. Bioinformatics-Methods and applications, Rastogi,S.C. Mendiratta, N. and Rastogi P, Prentice-Hall of IndiaPvt. Ltd, New Delhi
2. Essential Bioinformatics-Jin Xiong, Cambridge University Press
3. Bioinformatics – Sequence and Genome anlysis, Mount DW, Cold Spring Harbour Laboratory Press, New York
4. Bioinformatics - BaxevanisAD & Quellette BFF, John Wiley & Sons Inc.
5. Evolutionary computations in Bioinformatics – Fogel & Corne, Morgan Kafman publishers

4C04 BIF - STRUCTURAL BIOINFORMATICS

Hours/Week:2
Credits:2

Module I. Structure of Proteins: Principles of protein structure; anatomy of proteins – Hierarchical organization of protein structure - Primary. Secondary, Supersecondary, Tertiary and quaternary structure; Internal coordinates of proteins; Theory, Derivation and significance of Ramachandran Map.

Module II Protein structure prediction: Basic principles on protein structure prediction, Chou Fasman and GOR methods. Basic principles and protocol of Homology Modeling.

Module III Structure of Nucleic acids: DNA and RNA: types of base pairing – Watson-Crick and Hoogstein; types of double helices A,B,Z and their geometrical as well as structural features; structural and geometrical parameters of each and their comparison.

Module IV Structure visualization and molecular modeling tools: Knowledge of Programs such as SPDBV, Rasmol, Cn3D, VMD, molmol, chime.

References

1. Introduction to Bioinformatics – Attwood & Parry-Smith, Pearson Education
2. Bioinformatics- A beginner's guide by Jean-Michel Claverie, John Wiley & Sons.
3. Structural Bioinformatics by Philip E. Bourne and Helge Weissing, Wiley
4. Bioinformatics-Methods and applications, Rastogi,S.C. Mendiratta, N. and Rastogi P, Prentice-Hall of IndiaPvt. Ltd, New Delhi
5. Bioinformatics - BaxevanisAD & Quellette BFF, John Wiley & Sons Inc.
6. Evolutionary computations in Bioinformatics – Fogel & Corne, Morgan Kafman publishers
7. Introduction to Protein structure by Brandel C. and Tooze, J.
8. Structure and Mechanism in Protein science – Fersht WH freeman & Co
9. Protein folding – Creighton TE (ed) WH Freeman & Co.

4C05- BIOINFORMATICS PRACTICAL

Hours/Week:8
Credits:4

(Spread over four semesters and examination will be conducted at the end of 4th semester)

1. Browse the ExPASy sites and write information received in your record.
2. Retrieving Protein and DNA Sequences using Entrez at NCBI
3. Retrieving Protein and DNA Sequences using SRS at EBI
4. Web browsing at SwisProt
5. Web browsing at PIR PSD
6. Web browsing at UniProtKB
7. Nucleotide BLAST – Search nucleotide database using nucleotide query
8. Protein BLAST – Search Protein database using protein query
9. BLAST – X: Search Protein database using a translated nucleotide query
10. Multiple Sequence Alignment – CLUSTALW
11. ProtParam - Physico-chemical parameters of a protein sequence (amino-acid and atomic compositions, isoelectric point, extinction coefficient, etc.)
12. Use visualization tools like Swiss-PdbViewer, Jmol, MolMol, PyMol, Rasmol, VMD
13. Download protein and DNA from PDB and display using above programs and analyze the structural features
14. APSSP - Advanced Protein Secondary Structure Prediction Server
15. GOR - The GOR (Garnier-Osguthorpe-Robson) method uses both information theory and Bayesian statistics for predicting the secondary structure of protein.
16. Homology modeling - SWISS-MODEL - An automated knowledge-based protein modelling server

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KANNUR UNIVERSITY

COURSE STRUCTURE

&

SYLLABUS

FOR

OPEN COURSES

(BIOINFORMATICS)

With effect from 2009 Admission

under

Choice Based Credit Semester System

Scheme Open Courses

No	Semester	Course Code	Title of the course	Hours/ week	Credit
1	V	5D01 BIF	Molecular Modeling	2	2
2	V	5D02 BIF	PERL Programming	2	2
3	VI	6D01 BIF	Bioinformatics in Drug Design	2	2
4	VI	6D02 BIF	Application of PERL to Bioinformatics	2	2

5D01 BIF - MOLECULAR MODELING

Hours/Week:2
Credits:2

Module I - Introduction to the Concept of Molecular Modeling
Molecular structure and internal energy, application of molecular graphics, energy minimization of small molecules, empirical representation of molecular energies, uses of force field, the molecular mechanics method, local and global energy minima

Module II – Molecular Dynamics
The techniques of molecular dynamics and Monte Carlo simulations analysis, Ab Initio, DFT and semiempirical method

Module III - Macromolecular Modeling
Homology modeling, Basic principles for fold recognition, 1D profiles and threading approaches, secondary structure prediction, basic principles of ab initio structure prediction

References

1. Structural Bioinformatics by Philip E. Bourne and Helge Weissing, Wiley
2. Bioinformatics-Methods and applications, Rastogi,S.C. Mendiratta, N. and Rastogi P, Prentice-Hall of IndiaPvt. Ltd, New Delhi
3. Evolutionary computations in Bioinformatics – Fogel & Corne, Morgan Kafman publishers
4. Introduction to Protein structure by Brandel C. and Tooze, J.
5. Structure and Mechanism in Protein science – Fersht WH freeman & Co
6. Protein folding – Creighton TE (ed) WH Freeman & Co.
7. Basic pharmacology – Cox F, Butterworths
8. Pharmacology &Pharmacotherapeutics – Sataskar, Bhandakan & ainapur, Popu;ar Prakashan Mumbai
9. Principles of Medicinal chemistry – William O & Foye BI , Waverks Pvt. Ltd
10. Medicinal Chemistry – Patrick G, Viva Books Pvt Ltd.

5D02 BIF - PERL PROGRAMMING

Hours/Week:2
Credits:2

Module I Biology and Computer Science
the organization of dna the organization of proteins in silico limits to computation

Module II Getting started with perl
Alow and long learning curve, perl's benefits, installing perl on your computer, how to run perl programs, text editors, finding help

Module III The art of programming
Individual approaches to programming, edit-run-revise (and save), an environment of programs, programming strategies, the programming process

Module IV Sequences and strings
Representing sequence data, a program to store a dna sequence, concatenating DNA fragments, transcription: DNA to RNA using the perl, documentation, calculating the reverse complement in proteins, files and arrays, reading proteins in files, arrays, scalar and list context

Module V Motifs and loops
Flow control code layout finding motifs counting nucleotides exploding strings into arrays, operating on strings, writing to files.

Suggested Readings

James Tisdall, 200I "Beginning Perl for Bioinformatics", O'Reilly & Associates.
, (200I) Learning Perl, 3rd Edition.

6D01 BIF - BIOINFORMATICS IN DRUG DESIGN

Hours/Week:2
Credits:2

Module 1 – Introduction to Drugs Definition of drugs, Absorption, distribution, Metabolism and excretion of drugs. Drug targets : Receptors, enzymes, structural proteins and nucleic acids as the drug targets.

Module II – Drug design using Bioinformatics Design of ligands for known macromolecular target sites, drug-receptor interactions, Classical SAR/QSAR studies and their implications to the 3D modeler, pharmacophore identification and novel drug design, High through put combinatorial approaches, structure based drug design, enzyme inhibition strategies.

References

1. Structural Bioinformatics by Philip E. Bourne and Helge Weissing, Wiley
2. Bioinformatics-Methods and applications, Rastogi,S.C. Mendiratta, N. and Rastogi P, Prentice-Hall of IndiaPvt. Ltd, New Delhi
3. Evolutionary computations in Bioinformatics – Fogel & Corne, Morgan Kafman publishers
4. Introduction to Protein structure by Brandel C. and Tooze, J.
5. Structure and Mechanism in Protein science – Fersht WH freeman & Co
6. Protein folding – Creighton TE (ed) WH Freeman & Co.
7. Basic pharmacology – Cox F, Butterworths
8. Pharmacology &Pharmacotherapeutics – Sataskar, Bhandakan & ainapur, Popu;ar Prakashan Mumbai
9. Principles of Medicinal chemistry – William O & Foye BI , Waverks Pvt. Ltd
10. Medicinal Chemistry – Patrick G, Viva Books Pvt Ltd.

6D02BIF - APPLICATION OF PERL TO BIOINFORMATICS

Hours/Week:2
Credits:2

Module I Subroutines and bugs
Subroutines, scoping and subroutines command-line arguments and arrays passing data to subroutines, modules and libraries of subroutines, fixing bugs.

Module II Mutations and randomization
Random number generators a program using randomization a program to simulate DNA mutation generating random DNA, analyzing DNA

Module III The genetic code
Hashes data structures and algorithms for biology the genetic code, translating DNA into proteins reading dna from files in FASTA format reading frames

Module IV Restriction maps and regular expressions
Regular expressions, restriction maps and restriction enzymes, perl operations

Module V Gene Bank
Gene bank files, gene bank libraries, separating sequence and annotation parsing, annotations indexing

Module VI Protein data bank
Files and folders, PDB files, parsing PDB files, controlling other programs

Module VII BLAST
Obtaining BLAST String, Matching and Homology, BLAST Output Files,
Parsing BLAST Output, Presenting Data, Bioperl

Suggested Readings

James Tisdall, 200I "Beginning Perl for Bioinformatics", O'Reilly & Associates.
, (200I) Learning Perl, 3rd Edition.

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KANNUR UNIVERSITY

(Abstract)

B.Sc Bioinformatics Programme– Model Question Papers for ***I Semester*** examinations- Core &Complementary Courses- implemented with effect from 2009 Admission –Orders issued.

ACADEMIC BRANCH

U.O.No.Acad/C2/8965/2008(2) Dated, K.U.Campus.P.O, 28-10-2009.

Read:1. U.O.No.Acad/C2/3838/2008 (i) dated 07-07-2009.
2. U.O No.Acad/C2/8965/2008 (2) dated 09-07-2009.
3.Letter dated 01-10-2009 from the Chairman, Board of Studies in Biotechnology (Cd).

O R D E R

1. As per the paper read first above,Choice Based Credit Semester System is introduced in this University with effect from 2009 admission.

2. As per the paper read second above, the Scheme and Syllabus of B.Sc Bioinformatics Programme (Core and Complementary Courses) under this scheme are implemented in this University.

3. As per paper read third above, the Chairman, Board of Studies in Biotechnology (Cd) has forwarded the Model Question Papers for I Semester B.Sc Bioinformatics examination (Core & Complementary Courses) for implementation with effect from 2009 admission, under Choice Based Credit Semester System .

4. The Vice-Chancellor, after considering the matter in detail, and in exercise of the powers of the Academic Council, as per Section 11 (1) of Kannur University Act, 1996 and all other enabling provisions read together with, has accorded sanction ***to implement the Model Question Papers for I Semester B.Sc Bioinformatics examinations (Core & Complementary Courses) under CCSS, submitted by the Chairman, Board of Studies in Biotechnology (Cd) with effect from 2009 admission,*** subject to report to the Academic Council.

5. The implemented Model Question Papers are appended.

6. Orders are therefore issued accordingly.

Sd/-
REGISTRAR

To:

1. The Principals of Colleges offering Bioinformatics Core& Complementary Courses.

Copy to:
1. The Examination Branch (through PA to CE).
2. The Chairman, Board of Studies in Biotechnology(Cd)
3. PS to VC/PA to PVC/PA to Registrar.
4. DR/AR-I (Academic).
5. SF/DF/FC

Forwarded/By Order

SECTION OFFICER