

UNIVERSITY OF MUMBAI
No.UG/444 of 2009

CIRCULAR:-

The Directors/Heads of the recognized Science Institutions concerned and the Principals of the affiliated Colleges in Science are hereby informed that the recommendation made by the Faculty of Science at its meeting held on 3rd August, 2009 has been accepted by the Academic Council at its meeting held on 17th September, 2009 vide item No.4.12 and subsequently approved by the Management Council at its meeting held on 25th September, 2009 vide item No.21 and that, in accordance therewith, the Advanced Diploma Course in Bioinformatics (Add-on-Course) has been introduced from the academic year 2009-2010.

Further that in exercise of the powers conferred upon the Management Council under Section 54(1) and 55(1) of the Maharashtra Universities Act, 1994, it has made **Ordinances 5890 and 5891 and Regulations 8184, 8185, 8186, 8187, 8188, 8189 and 8190** including syllabus for the Advanced Diploma Course in Bioinformatics (Add-on-Course) is as per Appendix and that the same has been brought into force with effect from the academic year 2009-2010.

MUMBAI-400 032
1st December, 2009

PRIN. K. VENKATARAMANI
REGISTRAR

To,

The Directors/Heads of the recognized Science Institutions concerned and the Principals of the affiliated colleges in Science.

A.C./4.12/17.09.2009

M.C./21/25.09.2009

No. UG/444-A of 2009, MUMBAI-400 032

1st December, 2009

Copy forwarded with compliments for information to :

- 1) The Dean, Faculty of Science.
- 2) The Controller of Examinations.
- 3) The Co-ordinator, University Computerization Center.

(D. H. KATE)



UNIVERSITY OF MUMBAI



ORDINANCES, REGULATIONS AND SYLLABUS FOR THE ADVANCED DIPLOMA COURSE IN BIOINFORMATICS

(Add-on course)

**(To be introduced with effect from the academic
year 2009-2010)**

CAREER ORIENTED ADD ON ADVANCED DIPLOMA COURSE IN BIOINFORMATICS

ADVANCED DIPLOMA COURSE IN BIOINFORMATICS
A candidate seeking admission to the Advanced Diploma

Course should have passed the Career Oriented Add-on Certificate and Diploma Course in Bioinformatics of 26 credits.

- Minimum 1 Year
- 13 Credits (Total 300 Hours)

Rs.4,000/-

30 – 40 Students Per Batch

6 Credits (90 Hours)

3 Credits (90 Hours)

4 Credits (120 Hours)

Examination

Total Marks

250

Theory

Paper I : 50 Marks

Paper II : 50 Marks

Practical

Practical I (Experiments, Journal And Viva) : 50 Marks

Practical II (Experiments, Journal And Viva) : 50 Marks

Project

Report : 40 Marks

Presentation: 10 Marks

Each student will have a project of 8 Credits (120 hours) during the course per year. The student will prepare a report on the same. The report duly signed by the candidate and the supervisor under whom the work was carried out, will be submitted for evaluation by the examiner during the examination, during which the candidate will also make a presentation on the same.

Passing Criteria 40% Marks in Theory and Practicals

Students can be given Grades -

A Grade Above 75%

B Grade 60 – 74%

C Grade 40 – 59%

Eligibility, No. of Seats, Distribution of Credits to theory, practical, projects, passing and grading criteria are according to the guidelines given by UGC in the XIth plan.

Infrastructure Requirement

- Classrooms and laboratory space for conducting lectures and practical
- A computer lab with needed softwares, internet facility and uninterrupted power supply to conduct on line bioinformatics practical. No. of computers should be proportional to the students (1 : 2).

Staff Requirement

1. A coordinator who will be responsible for the smooth conduct of the course. Co-ordinator of the course may be paid an Honorarium of Rs.5000/- per year out of the seed money.
2. A lab assistant cum computer technician who is a computer literate.
3. Lectures and practical can be conducted by the core faculty or visiting faculty having expertise in concerned field. Guest Faculty / Internal Faculty may be remunerated @Rs.250/- per lecture of 1 hr. duration.

Unitized Question Paper Pattern

Theory Question Paper Pattern

Question 1	From Unit 1	10 Marks
Question 2	From Unit 1	10 Marks
Question 3	From Unit 2	10 Marks
Question 4	From Unit 2	10 Marks
Question 5	From Unit 1 And Unit 2	10 Marks
Total		50 Marks

Practical Question Paper Pattern

Question 1	One Major Expt.	15 Marks
Question 2	One Major Expt.	15 Marks
Or		
Question 2 A	Minor Expt.	8 Marks
Question 2 B	Minor Expt.	7 Marks
Question 3	Journals	10 Marks
Question 4	Viva	10 Marks
Total		50 Marks

**CAREER ORIENTED ADD ON ADVANCED DIPLOMA COURSE IN BIOINFORMATICS
SYLLABUS**

PAPER I

Unit I - Advanced Bioinformatics :

20 Lectures

Unit I - Protein structure prediction:

- Introduction
- Protein Identification and Characterization
- Primary Structure Analysis and Prediction
- Secondary Structure Analysis and Prediction
- Motifs, Profiles, Pattern and Fingerprint search
- Methods of Sequence-based Protein Prediction
- *Ab Initio* Approach for Protein Prediction
- Methods of 2-D Structure Prediction
- Protein Function Prediction
- Protein Function from a DNA Sequence
- Assignment of Protein Structures to Genome
- Divergence of function: orthologues and paralogues

Unit I - Native Structure Prediction and Protein Folding Prediction

- Homology Modeling
 - Swiss model
 - DaLi
- Threading
 - Jpred and PHD
- Neural NET
- *Ab Initio* Methods
 - ROSETTA

Protein-Protein Interactions

Unit I - Protein Structure and Drug Discovery

- Introduction
- Protein Stability and Folding
 - The Sasisekharan-Ramakrishnan-Ramchandran plot.
 - The sidechains
 - Protein stability and denaturation
 - Protein folding
- Application of Hydrophobicity
- Superposition of Structures, and Structural Alignments
- DALI (Distance-Matrix Alignment)

- Evolution of Protein Structures
- Classifications of Protein Structures
 - SCOP
- Drug Discovery and Development

Unit I - Microarrays Design, Data Acquisition and Analysis

- cDNA Arrays
- Oligo Arrays
- Data Analysis Methodologies
 - Normalization
- Principal Component Analysis
- Hierarchical Clustering
- Self-Organizing Maps
- Supervised Methods
- Support Vector Machines
- Application of Microarrays
- Issues with Using Microarrays
- MAGE
-

Unit II - Drug Discovery – Technology and Strategies : 25 Lectures

- Introduction
- Cell Cycle: Key to Drug Discovery
- Drug Discovery: Technologies and Strategies
- Strategy to Identify Possible Drug Target Molecules

Unit II - Computer Aided Drug Design

- Introduction
- Introduction to Drug Design
- Drug Design Approaches
- Computer-aided Drug Designing Methods
- ADME Property Prediction

Unit II - Molecular modeling and Drug Design

- Introduction to the concepts of molecular modeling.
 - Molecular structure and Internal energy
 - Application of molecular graphics
 - Energy minimization of small Molecules
 - Empirical representation of molecular energies
 - Use of force fields and the molecular mechanics method

- Local and global Energy minima- An introduction
- The techniques of molecular dynamics and Monte Carlo
 - Simulation for Conformational analysis
 - *Ab initio* and semi empirical method
- Macromolecular modeling.
 - Design of ligands for known macromolecular target sites
 - Drug – receptor interaction. SAR/QSAR studies
 - 2-D and 3-D data base searching
 - pharmacophore identification and novel drug design
 - Finding new drug targets to treat disease, new drug targets for cancer
 - Structure-based drug design, enzyme inhibition strategies

Unit II - Numerical methods and energy optimization techniques

- Errors involved in the construction of mathematical of the real physical process
- Errors in the numerical approximation of the mathematical Model (truncation errors)
- Errors in the actual computation using a computer (round off errors)
- Minimization or Maximization of Functions:
 - Golden Section Search in One Dimension, Parabolic Interpolation and Brent's Method in One dimension, One – Dimensional Search with First Derivatives.
 - Downhill Simplex Method in Multidimensions
 - Direction Set (Powell's) Methods in Multidimensions
 - Conjugate Gradient Methods in Multidimensions
- Randomized Minimization Techniques:
 - Monte-Carlo Minimization

- Simulated Annealing
- Genetic Algorithms
- Fourier Transform:
 - Fourier Transform of Discretely Sampled Data, Fast Fourier Transform (FFT)
- Integration of Ordinary Differential Equations:
 - Runge -Kutta Method, adaptive stepsize control for Runge - Kutta
 - Modified Midpoint Method, and other related methods. Methods to solve stiff equations.

Practical I

1. Use of Molecular Modelling Package and force field calculation using AMBER, CHARMM and GROMOS.
2. Potential energy calculation of regular structures- Collagen, triple helix, DNA double helix. Their visualization in wire frame, stick model and space filling model.
3. Homology modeling
4. Docking: protein-protein, protein-nucleic acid and protein- small molecules.
5. Writing programs related to 3D structural data analysis
6. Calculation of Phi and Psi angles.
7. Comparison of 3D structures of protein.

Unit I - Data Integration and Management

Introduction to database systems :

20 Lectures

- Data abstraction, data models, instances and schemes.
- ER model, entity and entity sets, relationships and relationship sets, ER diagrams, reducing ER diagrams to tables. Network data model basic concepts, hierarchical data model basic concepts
- Multimedia databases basic concepts and applications. Indexing and hashing, ISAM, B+ tree indexed files, B tree indexed files, static hash functions, dynamic hash functions, text databases, cluster analysis, nearest neighbor search, search using stem numbers, search using text signatures.
- Introduction to distributed database processing.
- Oracle, SQL, Relational database design, oracle architecture, oracle objecttables, views, indexes, sequences, synonyms, snapshots, clusters.
- Database – table space, data files, blocks, extents, segments
- Oracle background processes, PMON, SMON, LWGR, CKPT, oracle instance, startup, shutdown/init. Ora.control files, oracle memory management – SGA, rollback segments, redo logs/archival, transaction control and locking/dead lock, security, grants, roles, privileges.
- Oracle reports – reports features, full integration with forms and graphics, data model and layout editors.
- Layout objects – frames, fields, boiler plate, anchor, interface Components, report formats, example reports, single query, Multi query, matrix, master-detail etc., user defined columns, PL/SQL interface/ triggers, packaged procedure, Calling report from a

form. Menu – default menus, custom menus, menu objects, menu module, main menu, individual menus, sub menus, menu items, menu editor, PL/SQL in menu modules, menu security.

• Visual Basic:

- An introduction to computers and Visual Basic Problem solving
- Fundamentals of programming in VB General procedures
- Decisions
- Repetition
- Arrays Sequential files
- Sequential and Random Access files
- Introduction to Graphics
- Additional control and objects
- Database management
- Object oriented programming
- Communicating with other applications

Unit II - Perl Programming:

25 Lectures

- Introduction and Installation
- An overview of PERL, Tools for PERL programming, BIO PERL
- Data types: Arithmetic and Logical operators
- Conditionals and Loops
- List and Arrays
- Working with files
- Regular Expression and Pattern Matching
- Hashes
- Functions and Subroutines
- Advanced features in Perl: Advanced functions and operators, files and Directories, System Interaction, Using Perl's command line tool, References and Structures, Using Modules

- Using Perl for CGI
- Application of Perl :
 - Transcription
 - Translation
 - Finding the repeat sequence
 - Finding Motifs
 - Inter conversions of different sequence file formats
 - Generation Random DNA
 - Analysis of DNA sequence
 - Separating and annotation
 - Parsing annotation arising
 - PDB file
 - Parsing BLAST output

Introduction to BIO MARK UP languages

1. HTML-

Introduction, Frames, Forms, Tables, CSS

2. XML-

Introduction, Document type, definition XSD, XSLT, DOM

3. CML-

Introduction, Validation file, Jchem Paint, Applications

4. BSML-

Introduction, Validation file, Genome XML Viewer
Applications

Practical II

1. Development of home page using HTML and XML.

2. Writing the programs in Perl for solving the problems in Biotechnology:
3. Programs for Transcription. (DNA to RNA sequence)
4. Programs for Translation. (RNA to Protein Sequences)
5. Programs for finding Open Reading Frame.
6. Programs for finding consensus Sequence.
7. Programs for finding Triplet Codon
8. Structure prediction by Chou-Fasman method.
9. Torsional Angle calculation.
10. Interconversion of different sequence file Format.
11. Database programming:
 - Database Manipulation using SQL command.
 - Small Database designing, normalization and implementation
 - Small Biological database designing, normalization and implementation
12. Visual basic programming:
 - Simple Screen Design.
 - Various controls.
 - Simple animation.
 - Input/output & drag/drop.
 - Message boxes.
 - Database access.
 - Drop down menu
 - Menu example

Reference Books:

1. Molecular modeling principles and applications; By Andrew R Leach Wiley (2004)
2. Foundations of Systems Biology by Hiroaki Kitano ; MIT Press (2000)
3. A Primer of Genome Science, 2nd Edition by Greg Gibson, Spencer V. Muse; Sinauer Associates Released: 01 December, 2004
4. Fundamental Concepts of Bioinformatics, by Dan E. Krane, Michael L. Raymer; Benjamin Cummings, Released: 12 September, 2002
5. Bioinformatics: A Practical Guide to the Analysis of Genes and Proteins, Third Edition; by Andreas D. Baxevanis, B. F. Francis Ouellette, Wiley-Interscience, Released: 15 October, 2004
6. An Introduction to Bioinformatics Algorithms (Computational Molecular Biology); by Neil C. Jones, Pavel A. Pevzner, The MIT Press, Released: 01 August, 2004
7. Microarray Bioinformatics, by Dov Stekel, Cambridge University Press; Released: 08 September, 2003
8. Structural Bioinformatics (Methods of Biochemical Analysis, V. 44); by Philip E. Bourne, Helge Weissig, Wiley-Liss, Released: 07 February, 2003
9. Bioinformatics: Sequence, Structure and Databanks: A Practical Approach; by Des Higgins, Willie Taylor, Oxford University Press, Released: 15 October, 2000
10. Support Vector Machines: Theory and Applications (Studies in Fuzziness and Soft Computing, by Lipo Wang, Springer, Released: August, 2005
11. Bioinformatics. Hidden Markov Models of Bioinformatics (Computational Biology); by Timo Koski, Kluwer Academic Publishers, Released: 01 May, 2002

12. Sequence and Genome Analysis by David W. Mount - Cold Spring Harbor Laboratory ;2004
13. Fundamental Concepts of Bioinformatics by Dan E. Krane, Michael L. Raymer; Benjamin Cummings Released: 12 September, 2002
14. Raymer; Benjamin Cummings Released: 12 September, Perl in nutshell -Ellen silver -Oreilly publications(1999)
15. Perl cookbook -Tom Christiansen - Oreilly publications(1999)
16. Perl in 24 hours -Clinton pierce - SAMS(2000)
17. Solution and examples for Perl Programmers by Nathan Torkington and Tom Christiansen
18. Network Programming with Perl 1st Edition by Lincoln Stein.
19. HTML Unleashed - Rick Darnell, SAMS publication (2003)
20. HTML & XHTML: The Complete Reference IV edition (Osborne Complete Reference) -Thomas Powell; Tata Mcgraw Hill publishing company limited (2002)
21. HTML for the World Wide Web with XHTML and CSS: Visual Quick Start Guide, Fifth Edition - Elizabeth Castro(2003)
22. HTML and XML for Beginners 1st edition (2000) - Michael Morrison
Microsoft Press
23. XML in nutshell -Elliott Rusty Harold-Oreilly 2001
24. Introductory methods of numerical analysis Prentice hall of India by Sastry S.S
25. Numerical methods for Engineers with personal computer applications by Chopra S.C Raman and P. Canale.
26. International student Edition numerical methods in science and engineering by Venkatraman M.K
27. Complete reference Visual basic by Tata McGraw Hill publication.
28. Database system concepts by Hanery korth and Abraham.
29. Parallel and distributed databases by Wilteach et al.
30. Introduction to database systems by J.M. Martin.

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