

शासकीय कमला राजा कन्या स्नातकोत्तर स्वशासी महाविद्यालय,  
ग्वालियर (मध्य प्रदेश)



बॉयोइंफोरमेटिक विषय के अध्ययनमंडल  
द्वारा अनुमोदित बॉयोइंफोरमेटिक विषय के  
स्नातक (2016-2019) पाठ्यक्रम

अनुमोदन अकादमिक सत्र  
2016-2019

प्रस्तुतकर्ता

स्नातक अध्ययन केन्द्र

बॉयोइंफोरमेटिक विभाग

प्राप्तकर्ता

अकादमिक प्रकोष्ठ



वेबसाइट : [www.krkc.gwl.org](http://www.krkc.gwl.org) ईमेल : [krkc@rediffmail.com](mailto:krkc@rediffmail.com)

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कार्यालय प्राचार्य, शासकीय कमलाराजा कन्या स्नातकोत्तर स्वशास्त्री महाविद्यालय, खालियर

दिनांक 28 जून, 2016

Biocinformatics विभाग

अध्ययन मंडल की बैठक का कार्यवाही विवरण

नवीन सत्र 2016-17 हेतु Biocinformatics विषय से सम्बंधित

अध्ययन मण्डल की बैठक आज दिनांक 28 जून, 2016 को प्रातः 11:00 बजे

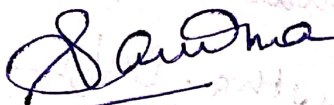
Botany विभाग में आयोजित की गई, जिसमें निम्नानुसार उपस्थिति रही -


1. डॉ. Sadhna Pandey. *Sadhna Pandey*  
28/6/16
2. डॉ. Kishore Shende. *Kishore Shende*  
28/6/16
3. डॉ. B. M. Kulkarni. *B. M. Kulkarni*
4. डॉ. Dr. Madhulaxmi Shrivastava. *Dr. Madhulaxmi Shrivastava*
5. डॉ. Dr. D. S. Rathore. *Dr. D. S. Rathore*  
28-6-16
6. डॉ. Dr. Preeti Kulkarni. *Dr. Preeti Kulkarni*  
P. Kulkarni  
28/6/16
7. डॉ. Prof. Nalini Saxena. *Prof. Nalini Saxena*  
Nalini Saxena  
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11. डॉ.
12. डॉ.

5. यदि विभाग में स्ववित्तीय योजना के तहत कोई पाठ्यक्रम/अतिरिक्त विषय/डिप्लोमा कोर्स/सर्टिफिकेट कोर्स प्रारंभ करने की योजना हो तो उसका विवरण एवं अनुशंसा।  
Certificate course in Concepts & application in Bioinformatics-
6. यदि अन्य कोई विषय हो तो उसका विवरण एवं अनुशंसा।

Educational visit to DADE,  
NCR, Lucknow

हस्ताक्षर अध्ययन मंडल अध्यक्ष एवं समस्त सदस्य

  
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Govt. Kamla Raja Girls PG [Autonomous] College, GWALIOR (M.P.)

Session: 2016-19

Syllabus of B.Sc. with Bioinformatics

Scheme of B.Sc. Semester Course

YEAR	SEMESTER	PAPER	Max. Marks
Ist	I semester	BI 101 : Basic of Bioinformatics	85+15
		BI 102 Practicals	50
	II Semester	BI 201: Concepts in Bioinformatics	85+15
		BI 202: Practicals	50
IIInd	III Semester	BI 301: Introduction to Computers and Programming	85+15
		BI 302: Practicals	50
	IV Semester	BI 401 : Structural Bioinformatics	85+15
		BI 402 :Practicals	50
IIIrd	V Semester	BI 501 : Biostatistics	85+15
		BI 502 :Practicals	50
	VI Semester	BI 601 : Mathematics	85+15
		BI 602 : Practicals	50

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**Govt. Kamla Raja Girls PG [Autonomous] College, GWALIOR (M.P.)**

Syllabus of B.Sc. with Bioinformatics  
Subject- Bioinformatics (as one subject)  
Session: 2016-19

**INTRODUCTION TO BIOINFORMATICS**

**Semester-I**

**Objectives:** To enable students to learn important databases and tools commonly employed to Bioinformatics.

**UNIT I:** Introduction

Definition, History, Branches of Bioinformatics, Aims, Scope & research Areas, Human genome project, Role of computer in Bioinformatics, Bioinformatics in India, BIO-IT-The Flourishing future. Application of bioinformatics.

**UNIT II :** Introduction to database

Introduction to genomics & proteomic data, Post genomics era, Data acquisition – functions and purposes, Biological databases-relational and object orient concepts. Information retrieval, concepts of digital libraries, information retrieval from biological databases ENTREZ-SRS, Methods for presenting large quantities of data, sequence viewer, structure viewer, RASMOL, ligand explorer.

**UNIT III :** Introduction to Nucleic Data Bases

Primary & Secondary Data Base, gene banks, ENCB nucleotide, sequence data bank- DDBJ- RNA sequence data bases :16S& 23 rRNA, Mutation data bases, HIV sequence data base, NON CODE sequence submission tools, sequin, webin, sqkura, bank etc.

**UNIT IV :** Protein sequence data bases

Protein sequence data bases – PIR, SWISSPROT, UNIPROT-Tr EMBC, EXPASY,NCBI,Protein, Databases – PRF, UNIPARK-MIPS-O/P-protein sequence motif database, E blocks- eblocks- PROSITE, PROTEIN DOMAIN, databases, ADDA, INTERPRO, Pfame-protein

**UNIT V :** Introduction to structure data bases

PDB- PDBSum SCOP-CATH-MMDB-EMSD-SWISS-MODEL repository-ModBase-Protein MODEL portal, Eurocarb DB-DIP-BNND, STRNG

**Books Recommended:**

- 1 Orpita Basu & Simminder Kaur, Thakural \* Bioinformatics Databases, Tools, Algorithm,2007 Oxford University Press\*
- 2 Higgins,D.Willie, Taylor \* Bioinformatics: Sequence, Structure and Data bank, A Practical Approach,2000, 1st Ed, Oxford University Press

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- 3 Allwood T, David Parry Smith ; Introduction to bioinformatics, 2008  
Pearson Education, Singapore D.ED.
- 4 Murthy, C.S.V., 2016, Himalaya Publishing House

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**Govt. Kamla Raja Girls PG [Autonomous] College, GWALIOR (M.P.)**

Syllabus of B.Sc. with Bioinformatics  
Subject- Bioinformatics (as one subject)  
Session: 2016-19

**CONCEPTS IN BIOINFORMATICS**  
**Semester: II**

**Objectives:** To provide students with foundation in the important concepts of Bioinformatics.

**UNIT I:**

Introduction, sequence alignment, Scoring matrix , PAM BLOSUM, Gaps and Gap penalties, Different Gap weights, Biological significance of Gaps.

**UNIT II:**

Pairwise sequence alignment, DotPlot analysis, Dynamic programming, Needleman-Wunch algorithm, Smith-Waterman algorithm, Edit distance dynamic programming, Database similarity search, BLAST, FASTA.  
Multiple sequence alignment, sum of pairs, Divide and Conquer, Progressive and Iterative alignment, ClustaW, TCPFFEE, Profile methods, Gribskov profile, PSI\_BLAST.

**UNIT III:**

Phylogenetic relationships, Clustering and Phylogeny, Phylogenic analysis, Concept of Phylogenetic Tree, Methods of Phylogeny analysis, Distance and character based methods, Motif detection, Protein family databases.

**UNIT IV:**

Data mining, Introduction, Definition, Data mining problems, Cluster analysis, Data mining techniques, Tools and Methods. Management of Databases. DBMS, Difference between DBMS and file system.

**UNIT V**

Metabolic pathway database (KEGG pathway database), Concept of Metabolome and Metabolomics, Drug discovery and Design, Target identification , Target validation, Lead identification, Lead Optimization, Preclinical Pharmacology and Taxology, Chemoinformatics tools for drug discovery, Chemical structure representation(SMILE & SMART), Chimiical databases : CSD, ACD, WDI, Chembank, PUBCHEM.

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**Govt. Kamla Raja Girls PG [Autonomous] College, GWALIOR (M.P.)**

**Syllabus of B.Sc. with Bioinformatics  
Subject- Bioinformatics (as one subject)**

**Session: 2016-19**

**INTRODUCTION TO COMPUTERS AND PROGRAMMING  
Semester: III**

**Objective:** To equip students with fundamental knowledge and concepts of Computers and Basic Programming Skills.

**UNIT I: Introduction to Computers**

Overview and function of computers, Characteristics of computers, History of Computers, Evolution. Generation of Modern Computers, Classification of Computers, Micro-computers, Mini computers, Main Frame, Super computers, Special purpose computer ( Comparison in their memory, power, cost and Size), PC types, Tower, Desktop, Notebook, Laptops, Handheld, Palmtop, PDA, Types of Modern Computers, Workstations, Servers.

**UNIT II: Computer components and Number System**

Components of a computer, Input devices, Output device, CPU, Memories (RAM and ROM), Secondary storage devices, Hard Disk, Magnetic tapes, Zip drives, Digital tapes, CD-ROM, DVD, BluRay, Number system , introduction, Decimal , Binary, Octal, Hexadecimal number systems and their inter conversion.

**UNIT III: Operating system (OS) and software Development**

Hardware and Software definitions, Introduction to O/S, Functions, Classification real time, single user single task, single user multi task, Basic description about DOS, WINDOWS, Windows server NT/2000, UNIX/LINUX, MVS, Overview of Software development. Software development phases, problem definition, analysis, algorithm design and representation, coding and debugging (simple description about each phase).

**UNIT IV: Flow charts, Pseudo codes and Programming Languages**

Basic flowchart symbols and their meaning, Pseudo codes, definition and importance, Syntax and Semantics, Programming approaches, Procedural, Object oriented programming languages, Definition, categories, low level languages, Machine language, Assembly language, Advantages and disadvantages, High level languages, Advantages and disadvantages, Interpreters, Compilers and Translators, Overview of compilation process, Types of High level languages. Introduction to Pearl.

**UNIT V: Multimedia and Internet**

Multimedia, Introduction, Characteristics, Elements and Applications, The internet and its resources, World Wide Web(WWW), Associated tools, services, resources and

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various terminologies, An overview of Computer viruses, virus definitions, symptoms, transmission, danger and general precautions.

**Recommended Books:**

1. Glenn Brookshear J., "Computer Science: An Overview", 2011 11<sup>th</sup> ed, Addison Wesley Publishers.
2. Alexis Leon & Mathews Leon, "Fundamentals of Information Technology". 2009, 2<sup>nd</sup> ed, Vikas Publishing House Pvt. Ltd.
3. Rajaraman V, " Fundamentals of Computer", 2004, 4<sup>th</sup> ed, Prentice Hall India Pvt. Ltd.
4. Francis Glasborrow & Roberta Allen, " A Beginner's Introduction to Computer Programming", 2003, John Wiley and Sons.
5. Anurag Seetha, " Introduction to Computers and Information Technology", 2005 Ram Prasad and Sons Bhopal
6. Basandra S.K., " Commputer Today", 2011, 1<sup>st</sup> ed, Ga

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Syllabus of B.Sc. with Bioinformatics  
Subject- Bioinformatics (as one subject)  
Session: 2016-19

**STRUCTURAL BIOINFORMATICS  
SEMESTER IV**

**Objectives:** To understand the levels of structural organization of macro molecules and experimental methods of structural determination. To know the approaches for structural analysis.

**UNIT I: Macromolecular structure**

Nucleic acids – DNA and RNA, Protein-Primary, secondary, tertiary and quaternary structures, Amino acids, Ramchandran plot.

**UNIT II: Macromolecular Interactions**

Protein-Protein, Protein- Nucleic acid, Protein- Carbohydrates, Structure of Ribosome.

**UNIT III: Principles of Protein folding**

Overview of experimental techniques to study macro molecular structure, Methods to study 3D structure – X-ray, NMR, Cryo electron microscopy, Microarray., MALDI-TOF.

**UNIT IV:**

Proteomics, Homology modelling, Protein tertiary structure, Prediction, Methodology

**UNIT V: Genomics**

Introduction, Genome mapping, assembly annotative and comparison, Comparative Genomics, Free of life and some completed Genomics, Drug research in the era of Genome sequencing.

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Syllabus of B.Sc. with Bioinformatics  
Subject- Bioinformatics (as one subject)

Session: 2016-19

**BIOSTATISTICS  
Semester V**

**Objectives:** To review the basic concepts of statistics relevant to biology data handling.

**UNIT I: Introduction**

Biostatistics: Definition, standard terms, population sample, unit, variable, parameters, limitations and uses of statistics.

**UNIT II: Data Collection**

Data and its collection, classification of data, purpose of classification, advantages, types of classification, Tabulation of data, Objectives of tabulation, rules of tabulation, Difference between classification and Tabulation, Diagrammatic presentation of data, Line diagram, Bar diagram, Percentage bar diagram, Pie diagram, Graphical representation of data, Histogram, Frequency curve, frequency polygon, Olives.

**UNIT III: Central Tendency and Probability**

Mean, Mode, Median and their merits, Mean deviation, measures of dispersion, Range, Standard deviation and its relative measures,

Probability, Distribution, Basics of Binomial, Poisson and Normal distribution and their applications to Biology.

**UNIT IV: Correlation and regression analysis**

Concepts of correlation, coefficient of correlation, Types of correlation, Scatter diagram or Dot diagram method, Kar Pearson's coefficient of correlation, Spearman's rank correlation coefficient, Probable error in correlation.

Regression, meaning, linear regression, regression coefficient and its properties, Regression equations, Fitting, Prediction, Difference between correlation and regression.

**UNIT V: Statistical analysis**

Test of significance, Null hypothesis, alternative hypothesis, simple hypothesis and composite hypothesis, two types of errors, single tail and two tailed test, Large sample test, Test of significance of a single mean and difference between two means, Student's "t" test, test of significance of a single mean and difference between means when  $n_1=n_2$  and  $n_1 \neq n_2$ , Chi square test for goodness of fitness, Analysis of variance,

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meaning, assumptions, one way classification and two way classification (simple problems)

**Recommended Books:-**

1. Zar, J.H. "Biostatistical Methods", 2009, 5<sup>th</sup> ed, Prentice Hall Publication
2. Gurumani N, "Introduction to Biostatistics", 2004, 1<sup>st</sup> ed, MJP Publishers Chennai
3. Sunder Rao, P.S.S. & Richards, J. "An Introduction to Biostatistics", 2003, 3<sup>rd</sup> ed, CMC
4. Denial W.W. "Biostatistics- A Foundation for analysis in the Health Sciences", 1999, 1<sup>st</sup> ed, John Wiley & Sons.
5. Bishop O.N., "Statistics for Biology", 3<sup>rd</sup> ed, Prentice Hall Press

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Syllabus of B.Sc. with Bioinformatics  
Subject- Bioinformatics (as one subject)

Session: 2016-19

**MATHEMATICS FOR BIOLOGICAL SCIENCES**

**Semester: VI**

**Objectives:** To review the basic concepts of mathematics relevant to biology.

**UNIT I: Series**

Basic series and series AP, standard AP, Sum of first n terms of AP, GP, standard GP, sum of n terms in GP, geometric mean, HP, Basic logarithmic and exponential series.

**UNIT II: Vectors and Matrices**

Sets, inverse of a matrix, matrix method, Cramer's rule, vectors, addition and subtraction, dot product, cross product, gradient, divergence, curl.

**UNIT III: Basic Calculus**

Differentiation and Integration, concept of limit, continuity, differentiation, maxima and minima, introduction to partial differentiation, integral calculus, definite integral.

**UNIT IV: Numerical Computation**

Errors in computer arithmetic, normalization, polynomial interpolation, solution of non-linear equations, Errors, convergence of solutions, iterative methods for system of linear equations, Numerical differentiation and integration.

**UNIT V: Trigonometry and Analytical Geometry**

Trigonometric ratios, De Moivre's theorem, the general equation of a straight line, slope of a line, intercept of a line, angle between two lines, intersection of two lines, The general equation of a circle.

**Recommended Books:-**

1. Boas M.L. "Mathematical Methods in the Physical Sciences", 2005, 3<sup>rd</sup> ed, Wiley Publication.
2. Prasad G., "text book of Differential Calculus", 2003, 4<sup>th</sup> ed, Poothishala Publications.
3. Prasad G., "text book of Integral Calculus", 2003, 3<sup>rd</sup> ed, Poothishala Publications.
4. Ayers F, "Matrices and Vectors", 1962, 1<sup>st</sup> ed, Schaum Outline Series Publishing Co.
5. Schwartz, J.T. "Introduction to Matrices and Vectors", 2001, Courier.

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**Career oriented Program**  
**Certificate Course In Bioinformatics**

**Preamble:**

Bioinformatics is the newly branch in the field of life sciences. It is information technology applied to the management and analysis of biological data with the aid of computers. It is the science of using information to understand biology. It is a field in which biological information collected, compared, studies and analyses to find the interrelation between them for solving structural, functional and evolutionary problems using computational technologies. The biological information stored in various databases is available online through internet. Bioinformatics refers to the creation and advancement of databases.

In the recent years in this age of internet and sequenced genome, we have more information at our finger tips than ever before. Organizing this entire data and combating information overload is becoming more and more important. The advent of genetic engineering vastly increased size of information.

**Scope:**

Protein sequencing, Nucleic acid sequencing and their analysis.

- Find proteins, their activity, interactions, modifications and functions.
- Elucidation of function of a molecule based on its structure.
- Gene expression, analysis, prediction and establish genomic library.
- Find homology for studying evolutionary relationship among different species.
- Molecular modelling and molecular dynamics methods to study structure from sequence.

**Intake capacity:** 20 Students

**Eligibility:** B.Sc./M.Sc. degree in Science ( Physical, Mathematical, Chemical, Life Sciences),

**Course Fee:** Rs. 3000 + Examination Fee

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## Course Structure:

### Paper I Bioinformatics and Approach

#### Module I: Overview of applications of Biotechnology and Microbiology

History of Biotechnology, Recombinant DNA technology and its applications in agriculture, environment and health.

Applications of Microbiology, Human Genome Project

#### Module II: Introduction to Bioinformatics

Definition, history and current prospective, Interfaces of Bioinformatics. Applications of Bioinformatics, Information technology and Bioinformatics, Role of Computers

#### Module III: Biological databases

Introduction, Types of data and databases, Genomic database, Gene Bank, EMBL, DDBJ, Protein databases, Open access and open sources, PUB MED, Biomed Central, NCBI, EBI, Expasy, RCSB, Bioinformatics glossary.

#### Module IV: Genomic databases.

Viral genome database, genome online database (GOLD), Microbial genome database (MBGD), Genome browser, ENSEMBL, VEGA, Genome browser, Database search engines-ENTREZ, SRS, Sequence similarity bas search engine, BLAST, BLAST

#### Module V: Computer fundamentals and applications

History, Input and Output device, memory devices, communication technology, networking services, LAN, WAN and MAN, uses of internet and multimedia.

### Paper II Concept of Bioinformatics, Bioethics and IPR

#### Module I: Structural Bioinformatics

Structure of DNA/RNA,

Proteins, Primary, Secondary, Tertiary structure.

#### Module II: Techniques of Molecular Structure Determination

NMR, Crystallography, CD, MALDI-TOF, Gel electrophoresis

#### Module III: Sequence alignment

Basic concept of sequence similarity,

Pairwise sequence alignment, multiple sequence alignment, Gap penalties

#### Module IV: Genomics

Introduction, Genome mapping, Comparative Genomics, Tree of Life, Drug research in post genomic era, Genome sequencing.

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## Module V: Bioethics and IPR

Regularity procedure, Good laboratory practices, Regulation for DNA, research and Biological material, Biosafety and Bioethics, Rules for import and Export of GMO and GM-food.

IPR, Definition, forms, patents, copyrights, trademarks, designs, Importance in Indian scenario, Laws in India for IPR protection

### **Books /References**

1. Introduction to Bioinformatics, Atwood T.K. and Smith, D.J.
2. An Introduction to Computational Biochemistry, C. Stain Tsai, A. John, Wiley and Sons, Inc. Publications.
3. Bioinformatics; Methods and Applications; Genomics, Proteomics and Drug Discovery, Rastogi S.C., Mendiratta and Rastogi P.
4. Bioinformatics; A practical Guide to the analysis of genes and proteins; edited by Andreas D. Baxeavanis and Francis Oulelette.
5. <http://www.ncbi.nlm.nih.gov>
6. Developing Bioinformatics Computer Skill, Cynthi Gibas and Per Jambeck

### **BIOINF LAB.**

1. Computer basic knowledge; hardware, connection cables, typing, window XP/7/8. Internet browsers, search engines.
2. LAN connection, setting up the IP address, network security.
3. Internet surfing and searching information, downloading and installing software ( Acrobat Reader etc)
4. Hands on training with Microsoft Word, Excel
5. Creation of Computer presentation with MS Power Point.
6. Introduction to C language and Oracle for creation of database.
7. Introduction to literature database at NCBI and querying the PUBMED database using the ENTREZ search engine.
8. Getting the amino acid sequences by exploring and querying the protein sequence database.
9. Getting the gene sequences by exploring and querying the nucleic acid databases.
10. 3-D Protein structure visualization and measurement of bond length, bond angles and torsional angles using RasMol.
11. Secondary and tertiary structural analysis.

### **Project Work :**

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