SAURASHTRA UNIVERSITY, RAJKOT

Accredited Grade "A" by NAAC (CGPA 3.05)

COURSE STRUCTURE & SYLLABUS

FOR

UNDERGRADUATE PROGRAMME

IN

BIOINFORMATICS

Semester III & IV

(Faculty of Science)

[As per Choice Based Credit System (CBCS) as recommended by UGC]

Effective from June - 2020

Annexure – "B"

SAURASHTRA UNIVERSITY
SCIENCE FACULTY

Subject: **BIOINFORMATICS**

Sr. No.	Level	Semester	Course Group	Course (Paper) Title	Course (Paper) No.	Credit	Internal Marks	External Marks	Practical /Viva Marks	Total Marks	Course (Paper) Unique Code
01	UG	03	Core	Bioinformatics Databases	BI-301	6	30	70	50	150	1603 2200 0103 0100
02	UG	03	Core	Algorithms in Bioinformatics	BI-302	6	30	70	50	150	1603 2200 0103 0200
03	UG	03	Core	Programming in C	BI-303	6	30	70	50	150	1603 2200 0103 0300
04	UG	03	Core	Genetic Engineering	BI-304	6	30	70	50	150	1603 2200 0103 0400
05	UG	03	Core	Medicinal Chemistry	BI-305	6	30	70	50	150	1603 2200 0103 0500
06	UG	04	Core	Structural & Applied Bioinformatics	BI-401	6	30	70	50	150	1603 2200 0104 0100
07	UG	04	Core	Immunology and Immunotechnology	BI-402	6	30	70	50	150	1603 2200 0104 0200
08	UG	04	Core	Web Technology	BI-403	6	30	70	50	150	1603 2200 0104 0300
09	UG	04	Core	Object oriented Programming using JAVA	BI-404	6	30	70	50	150	1603 2200 0104 0400
10	UG	04	Core	Cheminformatics	BI-405	6	30	70	50	150	1603 2200 0104 0500

SKELETON OF COMPLETE COURSE CONTENT OF UNDER GRADUATE BIOINFORMATICS SEMESTER III & IV

SEMESTER	PAPER NO. & CODE	TITLE OF THE PAPER	CREDIT
III	BI-301 (Theory)	Bioinformatics Databases	4
	BI-301 (Practical)	-do-	2
	BI-302 (Theory)	Algorithms in Bioinformatics	4
	BI-302 (Practical)	-do-	2
	BI-303 (Theory)	Programming in C	4
	BI-303 (Practical)	-do-	2
	BI-304 (Theory)	Genetic Engineering	4
	BI-304 (Practical)	-do-	2
	BI-305 (Theory)	Medicinal Chemistry	4
	BI-305 (Practical)	-do-	2
IV	BI-401 (Theory)	Structural & Applied Bioinformatics	4
	BI-401 (Practical)	-do-	2
	BI-402 (Theory)	Immunology and Immunotechnology	4
	BI-402 (Practical)	-do-	2
	BI-403 (Theory)	Web Technology	4
	BI-403 (Practical)	-do-	2
	BI-404 (Theory)	Object oriented Programming using JAVA	4
	BI-404 (Practical)	-do-	2
	BI-405 (Theory)	Cheminformatics	4
	BI-405 (Practical)	-do-	2

Annexure – "C"

FACULTY OF SCIENCE

Syllabus

Subject: **BIOINFORMATICS**

Course (Paper) Name & No.: Bioinformatics Databases (BI-301)

Course (Paper) Unique Code: 1603 2200 0103 0100

External Exam Time Duration: 2 Hours and 30 minutes

Name of Program	Semester	Course Group	Credit	Internal Marks	External Marks	Practical /Viva Marks	Total Marks
Bachelor of Science	03	Core	6	30	70	50	150

Course Objective:

- To uncover basics of Bioinformatics databases

COURSE STRUCTURE FOR UG PROGRAMME
BIOINFORMATICS- 301
SEMESTER- III

Semester	Course	Title	Hours /week	Credit	Exam duration	Internal marks	External marks	Total marks
III	BI-301 (Theory)	Bioinformatics Databases	5	4	2.5 hrs	30	70	100
III	BI-301 (Practical)	Bioinformatics Databases	3	2	One day per batch	15	35	50
Total credits				6	Total marks			150

General instructions

1. The medium of instruction will be English for theory and practical courses
2. There will be 5 lectures / week / theory paper / semester.
3. Each lecture will be of 55 mins.
4. There will be 1 practical / week / paper / batch. Each practical will be of 3 periods
5. Each semester theory paper will be of “five” units. There will be 40 hrs. of theory teaching / paper / semester.
6. Each Theory Paper / Semester will be of 100 Marks. There will be 30 marks for internal evaluation and 70 marks for external evaluation. Each Practical Paper / Semester will be of 50 Marks with 15 marks for internal and 35 marks fo,r external evaluation. So, Total Marks of Theory and Practical for each Paper will be 150. (100 + 50 = 150)

SKELETON OF THEORY EXAMINATION PAPER -EXTERNAL
(SEMESTER –III)

Total five questions. One question from each unit. Each question having equal weightage of 14 Marks		
a) Four One mark questions (All compulsory)	4 x 1= 4 Marks	14 Marks
b) Answer specifically- (attempt any one out of two)	1 x 2= 2 Marks	
c) Short Questions - (attempt any one out of two)	1 x 3= 3 Marks	
d) Answer in detail – (attempt any one out of two)	1 x 5= 5 Marks	

General Instructions

1. Time duration of each theory paper will be of two and half hours.
2. Total marks of each theory paper will be 70 marks.
3. There will be internal option for all the questions (as shown in table above)
4. All questions are compulsory

BI.301 Bioinformatics Databases

(Theory)

Unit I: Bioinformatics database management

- Data management in Bioinformatics
- Omics Data Management and Annotation
- Data integration in biological research: an overview
- Data integration in the era of omics: current and future challenges
- Integrated Bio-Search: challenges and trends for the integration, search and comprehensive processing of biological information

Unit II: Bioinformatics database management and Bioinformatics databases-1

- Big Biological Data: Challenges and Opportunities
- The big challenges of big data
- Big data bioinformatics
- Bioinformatics clouds for big data manipulation
- The database issue of Nucleic Acids Research and an updated molecular biology database collection (from the recent year published in Nucleic Acids Research journal)
- Nucleotide Sequence Databases: (Database needs to be covered from the latest database issue of Nucleic Acids Research journals)
    - International Nucleotide Sequence Database Collaboration (BioProject & BioSample),
    - Coding and non-coding DNA (Entrez Gene), Gene structure, introns and exons, splice sites (JuncDB), Transcriptional regulator sites and transcription factors (JASPAR)

Unit III: Bioinformatics databases-2 (Database needs to be covered from the latest database issue of Nucleic Acids Research journals)

- RNA sequence databases (5S Ribosomal RNA Database, GtRDB - Genomic tRNA Database)
- Protein sequence databases: Protein properties (BindingDB, Cybase) Protein localization and targeting (PSORTdb), Protein sequence motifs and active sites (InterPro), Protein domain databases; protein classification (SMART), Databases of individual protein families (Gene3D)
- Structure Databases: Small molecules (PubChem, chEBI & chEMBL), Carbohydrates (Carbohydrate Structure Database (CSDB)), Nucleic acid structure (NDB)
- Metabolic and Signaling Pathways: Enzymes and enzyme nomenclature (HMDB), Metabolic pathways (KEGG PATHWAY Database, KNApSAcK, BioCyc), Protein-protein interactions (STRING)

Unit IV: Bioinformatics databases-2 (Database needs to be covered from the latest database issue of Nucleic Acids Research journals)

- Genomics Databases (non-vertebrate): Genome annotation terms, ontologies and nomenclature (GO), Taxonomy and identification (EBI Metagenomics), Viral genome databases (NCBI Viral genomes), Prokaryotic genome databases (HAMAP), Unicellular eukaryotes genome databases (GeneDB), Fungal genome databases (FungiDB), Invertebrate genome databases (FlyAtlas)
- Human and other Vertebrate Genomes: Model organisms and comparative genomics (Ensembl & RefSeq), Human genome databases, maps and viewers (UCSC Genome Browser), Human ORFs (ENCODE Project at UCSC)
- Human Genes and Diseases: General human genetics databases (GeneCards), General polymorphism databases (HapMap Project), Cancer gene databases (Candidate Cancer Gene Database), Gene-, system- or disease-specific databases (GWASdb)

Unit V: Bioinformatics databases-3 (Database need to be covered from the database issue of Nucleic Acids Research journals)

- Microarray Data and other Gene Expression Databases (ArrayExpress, GEO - Gene Expression Omnibus)
- Proteomics Resources (PRIDE)
- Other Molecular Biology Databases: Drugs and drug design (DrugBank), Molecular probes and primers (IMGT/PRIMER-DB)
- Organelle databases: Mitochondrial genes and proteins (HmtDB - Human Mitochondrial DataBase)
- Plant databases: General plant databases (PlantGDB), Rice (RetrOryza)
- Immunological databases (AntigenDB)
- Review of natural product databases, Databases of Natural product (Super Natural)

BI.301 Bioinformatics Databases

(Practical)

Based on theory syllabus

References:

- Zoe Lacroix and TernceCritchlow, Bioinformatics – Managing Scientific Data, Morgan, Kaufmann publishers, 2003
- Brandenburg, A., Gmuender, H., and Wittenberger, T.: 'In Silico Approaches: Data Management – Bioinformatics': 'Predictive Toxicology' (Wiley-VCH Verlag GmbH & Co. KGaA, 2014), pp. 33-52
- Harel A, Dalah I, Pietrokovski S, Safran M, Lancet D. Omics data management and annotation. Methods Mol Biol. 2011;719:71-96. doi: 10.1007/978-1-61779-027-0_3. PubMed PMID: 21370079.

- Lapatas, V., Stefanidakis, M., Jimenez, R. C., Via, A., & Schneider, M. V. (2015). Data integration in biological research: an overview. Journal of Biological Research, 22(1), 9. http://doi.org/10.1186/s40709-015-0032-5
- Gomez-Cabrero, D., Abugessaisa, I., Maier, D., Teschendorff, A., Merkenschlager, M., Gisel, A., Ballestar, E., Bongcam-Rudloff, E., Conesa, A., and Tegnér, J.: 'Data integration in the era of omics: current and future challenges', BMC Systems Biology, 2014, 8, (2), pp. I1
- Li Y, Chen L. Big biological data: challenges and opportunities. Genomics Proteomics Bioinformatics. 2014 Oct;12(5):187-9. doi: 10.1016/j.gpb.2014.10.001. PubMed PMID: 25462151; PubMed Central PMCID: PMC4411415.
- Marx V. Biology: The big challenges of big data. Nature. 2013 Jun 13;498(7453):255-60. doi: 10.1038/498255a. PubMed PMID: 23765498.
- Greene CS, Tan J, Ung M, Moore JH, Cheng C. Big data bioinformatics. J Cell Physiol. 2014 Dec;229(12):1896-900. doi: 10.1002/jcp.24662. Review. Erratum in: J Cell Physiol. 2016 Jan;231(1):257. PubMed PMID: 24799088.
- Dai, L., Gao, X., Guo, Y., Xiao, J., and Zhang, Z.: 'Bioinformatics clouds for big data manipulation', Biology Direct, 2012, 7, (1), pp. 43
- Rigden DJ, Fernández-Suárez XM, Galperin MY. The 2016 database issue of Nucleic Acids Research and an updated molecular biology database collection. Nucleic Acids Res. 2016 Jan 4;44(D1):D1-6. doi: 10.1093/nar/gkv1356. PubMed PMID: 26740669; PubMed Central PMCID: PMC4702933.
- http://www.oxfordjournals.org/our_journals/nar/database/cap/
- Arthur M. Lesk, Introduction to Bioinformatics, Oxford University Press, New Delhi, 2003.
- David W. Mount, Bioinformatics – Sequence and Genome analysis, 2nd edition, Cold Spring Harbor Laboratory Press, New York.
- Baxevanis and B.F. Ouellette. Bioinformatics: A practical Guide to the Analysis of Genes and Proteins, Wiley- Interscience, Hoboken, NJ, 2005.
- M.Campbell & L. J. Heyer, Discovering Genomics, Proteomics & Bioinformatics, CSHL Press, 2003.
- S.R. Pennington & M.J. Dunn, Proteomics – from protein sequence to function, BIOS Scientific Publishers, 2002.
- Xie T, Song S, Li S, Ouyang L, Xia L, Huang J. Review of natural product databases. Cell Prolif. 2015 Aug;48(4):398-404. doi: 10.1111/cpr.12190. Epub 2015 May 25. Review. PubMed PMID: 26009974.

Annexure – "C"

FACULTY OF SCIENCE

Syllabus

Subject: **BIOINFORMATICS**

Course (Paper) Name & No.: Algorithms in Bioinformatics (BI-302)

Course (Paper) Unique Code: 1603 2200 0103 0200

External Exam Time Duration: 2 Hours and 30 minutes

Name of Program	Semester	Course Group	Credit	Internal Marks	External Marks	Practical /Viva Marks	Total Marks
Bachelor of Science	03	Core	6	30	70	50	150

Course Objective:

- To understand basic Advance algorithms in Bioinformatics

COURSE STRUCTURE FOR UG PROGRAMME
BIOINFORMATICS- 302
SEMESTER- III

Semester	Course	Title	Hours /week	Credit	Exam duration	Internal marks	External marks	Total marks
III	BI-302 (Theory)	Algorithms in Bioinformatics	5	4	2.5 hrs	30	70	100
III	BI-302 (Practical)	Algorithms in Bioinformatics	3	2	One day per batch	15	35	50
Total credits				6	Total marks			150

General instructions

1. The medium of instruction will be English for theory and practical courses
2. There will be 5 lectures / week / theory paper / semester.
3. Each lecture will be of 55 mins.
4. There will be 1 practical / week / paper / batch. Each practical will be of 3 periods
5. Each semester theory paper will be of "*five*" units. There will be 50 hrs. of theory teaching / paper / semester.
6. Each Theory Paper / Semester will be of 100 Marks. There will be 30 marks for internal evaluation and 70 marks for external evaluation. Each Practical Paper / Semester will be of 50 Marks with 15 marks for internal and 35 marks for external evaluation. So, Total Marks of Theory and Practical for each Paper will be 150. (100 + 50 = 150)

SKELETON OF THEORY EXAMINATION PAPER -EXTERNAL
(SEMESTER- III)

Total five questions. One question from each unit. Each question having equal weightage of 14 Marks		
a) Four One mark questions (All compulsory)	4 x 1= 4 Marks	14 Marks
b) Answer specifically- (attempt any one out of two)	1 x 2= 2 Marks	
c) Short Questions - (attempt any one out of two)	1 x 3= 3 Marks	
d) Answer in detail – (attempt any one out of two)	1 x 5= 5 Marks	

General Instructions

1. Time duration of each theory paper will be of two and half hours.
2. Total marks of each theory paper will be 70 marks.
3. There will be internal option for all the questions (as shown in table above)
4. All questions are compulsory

BI.302 Algorithms in Bioinformatics

(Theory)

Unit-1 Basic of Algorithms and Algorithm Design

- Algorithms for basic problems
- Sorting & Searching algorithm
- Algorithm analysis, Algorithm's complexity, input size, running time, memory requirements, worst-case and average-case, order of growth, Big Oh Notation, Big Omega Notation

Unit-2 Some basic concept and definition

- Learning, model, inference, utility
- Different kinds of models and inference
- Generalization and bias, Rule induction
- Concept learning, Version space

Unit-3 Learning sets of rules

- Neural networks
- Basic principles, Feedforward & Backward nets
- Backpropagation, Instance based learning
- Distance metrics, Nearest neighbor, Case based reasoning

Unit-4 Bayesian statistics

- Bayesian inference
- Probabilistic expert systems
- Conditional probability, Prior probability,
- Bayes theorem, Naïve Bayesian classifier

Unit-5 Rule based expert systems

- Graphical models/Markov graphs
- Inference in polytrees
- General learning difficulties
- Algorithm for learning probabilistic networks

BI.302 Algorithms in Bioinformatics

(Practical)

Based on theory syllabus

References:

- Fundamental concepts of Bioinformatics: Dan E Krane and Michael L.Raymer-Pearson Education
- Bioinformatics A Beginners Guide: Claverie and Notredame- Wiley Dreamtech India PVT ltd 2003
- An introduction to bioinformatics algorithms: Wel C Jones and Pavel A. Pevnezer- Ane Books, New Delhi

Annexure – "C"

FACULTY OF SCIENCE

Syllabus

Subject: **BIOINFORMATICS**

Course (Paper) Name & No.: Programming in C (BI-303)

Course (Paper) Unique Code: 1603 2200 0103 0300

External Exam Time Duration: 2 Hours and 30 minutes

Name of Program	Semester	Course Group	Credit	Internal Marks	External Marks	Practical /Viva Marks	Total Marks
Bachelor of Science	03	Core	6	30	70	50	150

Course Objective:

- To understand basic of Computer Language C

COURSE STRUCTURE FOR UG PROGRAMME
BIOINFORMATICS- 303
SEMESTER- III

Semester	Course	Title	Hours /week	Credit	Exam duration	Internal marks	External marks	Total marks
III	BI-303 (Theory)	Programming in C	5	4	2.5 hrs	30	70	100
III	BI-303 (Practical)	Programming in C	3	2	One day per batch	15	35	50
Total credits				6	Total marks			150

General instructions

1. The medium of instruction will be English for theory and practical courses
2. There will be 5 lectures / week / theory paper / semester.
3. Each lecture will be of 55 mins.
4. There will be 1 practical / week / paper / batch. Each practical will be of 3 periods
5. Each semester theory paper will be of "*five*" units. There will be 50 hrs. of theory teaching / paper / semester.
6. Each Theory Paper / Semester will be of 100 Marks. There will be 30 marks for internal evaluation and 70 marks for external evaluation. Each Practical Paper / Semester will be of 50 Marks with 15 marks for internal and 35 marks for external evaluation. So, Total Marks of Theory and Practical for each Paper will be 150. (100 + 50 = 150)

SKELETON OF THEORY EXAMINATION PAPER -EXTERNAL
(SEMESTER- III)

Total five questions. One question from each unit. Each question having equal weightage of 14 Marks		
a) Four One mark questions (All compulsory)	4 x 1= 4 Marks	14 Marks
b) Answer specifically- (attempt any one out of two)	1 x 2= 2 Marks	
c) Short Questions - (attempt any one out of two)	1 x 3= 3 Marks	
d) Answer in detail – (attempt any one out of two)	1 x 5= 5 Marks	

General Instructions

1. Time duration of each theory paper will be of two and half hours.
2. Total marks of each theory paper will be 70 marks.
3. There will be internal option for all the questions (as shown in table above)
4. All questions are compulsory

BI.303 Programming in C
(Theory)

UNIT 1

- Introduction to Computer Programming languages and Pre-programming techniques
- Algorithms development, Concept of Flowcharts and Dry run
- Overview of C: Introduction, History and Features of C language
- Basic structure of C program

UNIT 2

- C Character Set; C Tokens: Keywords and Identifiers, Constants, Variables in C
- Data Types and Type Casting; Storage classes in C
- Different Operators and expressions
- Preprocessors in C: #include and #define
- Managing Input and Output operations

UNIT 3

- Decision making and branching (Conditional Statements) –Simple if, if...else, nested if-else, else if ladder, switch..case, Conditional Operator, Goto statement
- Decision making and Looping: for, while, do..while loops and Nesting of loops; Use of break and continue statements
- String-handling operations: Reading and Writing a Character, Reading and Writing a String, Comparing and Concatenating Strings
- Arrays: Concept of Single (1-D) and Two Dimensional (2-D) arrays; Initialization and working with 1-D and 2-D numeric and string arrays

UNIT 4

- Function: Advantages of function, Function Types: Library and User-Defined Functions (UDF), Elements of UDF, Categories of UDF, Arrays and Functions
- Recursion; Scope, Visibility and Lifetime of Variables
- Structures: Defining a Structure, Declaring Structure variables, Accessing Structure members, Structure initialization, memory allocation
- Array of structure, Array within structure
- Union

UNIT 5

- Pointers: Understanding, Declaring Pointers, Accessing Variables through Pointers, Pointer Arithmetic
- Pointers and Arrays
- Pointers and Functions
- Files: Defining and Opening Files, Closing Files, Input/Output Operations on Files

BI.303 Programming in C
(Practical)

Based on theory syllabus

Reference Books:

- ANSI C : E. Balaguruswamy-BPB
- Let us C: Yashvant Kanetkar, BPB
- C: How to Program, Deitel & Deital, Pearson Education
- Programming with ANSI C and TURBO C, Pearson Education

Annexure – "C"

FACULTY OF SCIENCE

Syllabus

Subject: **BIOINFORMATICS**

Course (Paper) Name & No.: Genetic Engineering (BI-304)

Course (Paper) Unique Code: 1603 2200 0103 0400

External Exam Time Duration: 2 Hours and 30 minutes

Name of Program	Semester	Course Group	Credit	Internal Marks	External Marks	Practical /Viva Marks	Total Marks
Bachelor of Science	03	Core	6	30	70	50	150

Course Objective:

- To help the students to learn about different enzymes and vectors used in cloning. To learn principles of nucleic acid isolation and purification. To emphasizes on various transfection methods. To study various PCR application in genetic engineering. To learn DNA sequencing methods and molecular marker techniques. To learn various expression-based screening and characterization method.

COURSE STRUCTURE FOR UG PROGRAMME
BIOINFORMATICS- 304
SEMESTER- III

Semester	Course	Title	Hours /week	Credit	Exam duration	Internal marks	External marks	Total marks
III	BI-304 (Theory)	Genetic Engineering	5	4	2.5 hrs	30	70	100
III	BI-304 (Practical)	Genetic Engineering	3	2	One day per batch	15	35	50
Total credits				6	Total marks			150

General instructions

1. The medium of instruction will be English for theory and practical courses
2. There will be 5 lectures / week / theory paper / semester.
3. Each lecture will be of 55 mins.
4. There will be 1 practical / week / paper / batch. Each practical will be of 3 periods
5. Each semester theory paper will be of "*five*" units. There will be 50 hrs. of theory teaching / paper / semester.
6. Each Theory Paper / Semester will be of 100 Marks. There will be 30 marks for internal evaluation and 70 marks for external evaluation. Each Practical Paper / Semester will be of 50 Marks with 15 marks for internal and 35 marks for external evaluation. So, Total Marks of Theory and Practical for each Paper will be 150. (100 + 50 = 150)

SKELETON OF THEORY EXAMINATION PAPER -EXTERNAL
(SEMESTER- III)

Total five questions. One question from each unit. Each question having equal weightage of 14 Marks		
a) Four One mark questions (All compulsory)	4 x 1= 4 Marks	14 Marks
b) Answer specifically- (attempt any one out of two)	1 x 2= 2 Marks	
c) Short Questions - (attempt any one out of two)	1 x 3= 3 Marks	
d) Answer in detail – (attempt any one out of two)	1 x 5= 5 Marks	

General Instructions

1. Time duration of each theory paper will be of two and half hours.
2. Total marks of each theory paper will be 70 marks.
3. There will be internal option for all the questions (as shown in table above)
4. All questions are compulsory

BI.304 Genetic Engineering
(Theory)

UNIT 1

- Introduction and Steps involve in Genetic engineering
- Molecular Techniques in Genetic Engineering: Agarose Gel Electrophoresis, Pulse field gel electrophoresis, PAGE, SDS-PAGE, 2D-PAGE
- Basics of Nucleic acid blotting: Northern, Southern and Western
- Isolation and purification of DNA (genomic and plasmid) and RNA
- Restriction enzymes – host-controlled restriction and modification, Types of RE with examples (Blunt and Sticky end), methylation sensitivity of restriction enzymes, star activity of restriction enzymes

UNIT 2

- Ligases – Ecoli DNA ligase, T4 DNA ligase
- Linkers and Adaptors
- Restriction and modification enzymes- polynucleotide kinase, phosphatases, DNA polymerases, terminal transferase, DNAses-Exonuclease I, Exonucelase III
- Cloning vectors – Introduction to cloning vectors, plasmid biology, plasmid vectors (pBR322 and pUC), phage biology, phage vectors (M13)
- Cloning vectors – Cosmid, Phagmid, YAC, BAC, Shuttle vector and Expression vectors

UNIT 3

- Construction of Genomic libraries and cDNA libraries
- Introduction of DNA into cells using Gene transfer techniques: Biological Methods (Bactofection and Transduction),
- Introduction of DNA into cells using Gene transfer techniques: Chemical Methods (Calcium phosphate, DEAE dextran and Cationic Lipid)
- Introduction of DNA into cells using Gene transfer techniques: Physical or Mechanical Methods (Electroporation, Microinjection, Particle Bombardment, Sonoporation, Laser induced and Bead transfection)
- Analysis of cloned DNA – Probe, Detection of Nucleic Acid Sequence by Radioactive and Non-radioactive labeling

UNIT 4

- First Generation DNA Sequencing: Sanger method
- PCR - Polymerase chain reactions: Primer design, heat stable polymerases, types of PCR and application
- Site Directed Mutagenesis: Deletion Mutagenesis, cassette mutagenesis and Oligonucleotide directed mutagenesis PCR- mediated in vitro mutagenesis
- Molecular Markers: RFLP, RAPD, AFLP, SSR, SNP, EST

Unit 5:

- Molecular Markers: Micro satellite & Mini satellite, Restriction Mapping
- Chromosome walking and jumping
- Molecular Diagnostics-High throughput screening.
- Interaction based screening: yeast two-hybrid system
- Screening and characterization of clones Expression systems and their applications

BI.304 Genetic Engineering
(Practical)

Based on theory syllabus

Reference Books:

- Levin B 1994. Genes V Oxford University Press.
- RN.Old and SB. Primrose 1994. Principles of gene manipulation IV edition, Blackwell pub. Ny.
- Molecular cloning – A Laboratory manual 1993. sambrook etal.
- R-DNA – W.H. Freeman & co. NY. 1992 – by Woston JD, M. Gilman J. Witkowski and M.Zoller.
- **Gene Cloning**: An Introduction. by **T. A. BROWN**; Chapman and Hall, 1990; 2nd Edition
- Biotechnology – BD Singh, Kalayani Publishers.
- **Elements of Biotechnology - P. K. Gupta, Rastogi Publications.**

Annexure – "C"

FACULTY OF SCIENCE

Syllabus

Subject: **BIOINFORMATICS**

Course (Paper) Name & No.: Medicinal Chemistry (BI-305)

Course (Paper) Unique Code: 1603 2200 0103 0500

External Exam Time Duration: 2 Hours and 30 minutes

Name of Program	Semester	Course Group	Credit	Internal Marks	External Marks	Practical /Viva Marks	Total Marks
Bachelor of Science	03	Core	6	30	70	50	150

Course Objective:

- To understand the structure, functions of small molecules & drugs

COURSE STRUCTURE FOR UG PROGRAMME
BIOINFORMATICS- 305
SEMESTER- III

Semester	Course	Title	Hours /week	Credit	Exam duration	Internal marks	External marks	Total marks
III	BI-305 (Theory)	Medicinal Chemistry	5	4	2.5 hrs	30	70	100
III	BI-305 (Practical)	Medicinal Chemistry	3	2	One day per batch	15	35	50
Total credits				6	Total marks			150

General instructions

1. The medium of instruction will be English for theory and practical courses
2. There will be 5 lectures / week / theory paper / semester.
3. Each lecture will be of 55 mins.
4. There will be 1 practical / week / paper / batch. Each practical will be of 3 periods
5. Each semester theory paper will be of "*five*" units. There will be 50 hrs. of theory teaching / paper / semester.
6. Each Theory Paper / Semester will be of 100 Marks. There will be 30 marks for internal evaluation and 70 marks for external evaluation. Each Practical Paper / Semester will be of 50 Marks with 15 marks for internal and 35 marks for external evaluation. So, Total Marks of Theory and Practical for each Paper will be 150. (100 + 50 = 150)

SKELETON OF THEORY EXAMINATION PAPER -EXTERNAL (SEMESTER- III)

Total five questions. One question from each unit. Each question having equal weightage of 14 Marks		
a) Four One mark questions (All compulsory)	4 x 1= 4 Marks	14 Marks
b) Answer specifically- (attempt any one out of two)	1 x 2= 2 Marks	
c) Short Questions - (attempt any one out of two)	1 x 3= 3 Marks	
d) Answer in detail – (attempt any one out of two)	1 x 5= 5 Marks	

General Instructions

1. Time duration of each theory paper will be of two and half hours.
2. Total marks of each theory paper will be 70 marks.
3. There will be internal option for all the questions (as shown in table above)
4. All questions are compulsory

BI.305 Medicinal Chemistry
(Theory)

Unit I: Drug Targets: Pharmacodynamics and pharmacokinetics
- Drugs and drug targets: an overview
- Enzymes as drug targets
- Receptors as drug targets
- Nucleic acids as drug targets
- Miscellaneous drug targets
- Pharmacokinetics and related topics

Unit II: Drug discovery, design, and development
- Drug discovery: finding a lead
- Drug design: optimizing target interactions

Unit III: Drug discovery, design, development, and tools of the trade
- Drug design: optimizing access to the target
- Getting the drug to market: Preclinical and clinical trials, Patenting and regulatory affairs, Chemical and process development

Unit IV: Selected topics in medicinal chemistry-1
- Action and resistance mechanisms of antibiotics: A guide for clinicians
- Antimicrobial Resistance and the Alternative Resources with Special Emphasis on Plant-Based Antimicrobials-A Review
- Synergistic interactions of phytochemicals with antimicrobial agents: Potential strategy to counteract drug resistance
- The multi-faceted potential of plant-derived metabolites as antimicrobial agents against multidrug-resistant pathogens
- Antiviral agents: Viruses and viral diseases, Life cycle of viruses, Vaccination
- Antiviral drugs used against DNA viruses
- Antiviral drugs acting against RNA viruses: flu virus, cold virus
- Expanding the activity spectrum of antiviral agents
- Drug repurposing for new, efficient, broad spectrum antivirals

Unit V: Selected topics in medicinal chemistry-2
- Cancer: an introduction
- Drugs acting directly on nucleic acids: Alkylating and metallating agents, Antisense therapy
- Drugs acting on enzymes-antimetabolites: Dihydrofolate reductase inhibitors, Inhibitors of DNA polymerases
- Drugs acting on structural proteins: Agents which inhibit tubulin polymerization
- Miscellaneous enzyme inhibitors: Histone deacetylase inhibitors
- Multi-Targeted Anticancer Agents
- Dual or multi-targeting inhibitors: The next generation anticancer agents
- Chirality in metal-based anticancer agents
- The cholinergic system and Agonists at the cholinergic receptor
- Design of acetylcholine analogues: Steric shields, Electronic effects, Combining steric and electronic effects

- Clinical uses for cholinergic agonists: Muscarinic agonists, Nicotinic agonists
- Antagonists of the muscarinic cholinergic receptor: Actions and uses of muscarinic antagonists, Muscarinic antagonists
- Antagonists of the nicotinic cholinergic receptor: Applications of nicotinic antagonists, Nicotinic antagonists
- Anticholinesterase drugs: Carbamates, Organophosphorus compounds
- Anticholinesterases as 'smart drugs'

BI.305 Medicinal Chemistry
(Practical)

Based on theory syllabus

Reference Books:

- An Introduction to Medicinal Chemistry 5th edition 2013 by Graham L. Patrick (ISBN: 978–0–19–969739–7)
- Drugs: From discovery to approval 2nd ed by Rick NG. Wiley Blackwell (2009)
- Burger's Medicinal Chemistry and Drug discovery. Volume 2, Drug Discovery and development.6th Edition. Ed Donald J AbrahamWiley-Interscience.
- Essentials of Medical Pharmacology, 6the Edition (Hardcover) by Tripathi Kd. Publisher: Jaypee Brothers (2008)
- Kapoor G, Saigal S, Elongavan A. Action and resistance mechanisms of antibiotics: A guide for clinicians. J Anaesthesiol Clin Pharmacol. 2017 Jul-Sep;33(3):300-305. doi: 10.4103/joacp.JOACP_349_15. Review. PubMed PMID: 29109626
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- Ayaz M, Ullah F, Sadiq A, Ullah F, Ovais M, Ahmed J, Devkota HP. Synergistic interactions of phytochemicals with antimicrobial agents: Potential strategy to counteract drug resistance. Chem Biol Interact. 2019 Aug 1;308:294-303. doi: 10.1016/j.cbi.2019.05.050. Epub 2019 May 31. Review. PubMed PMID: 31158333.
- Shin J, Prabhakaran VS, Kim KS. The multi-faceted potential of plant-derived metabolites as antimicrobial agents against multidrug-resistant pathogens. Microb Pathog. 2018 Mar;116:209-214. doi: 10.1016/j.micpath.2018.01.043. Epub 2018 Jan 31. Review. PubMed PMID: 29407230.
- Ianevski A, Andersen PI, Merits A, Bjørås M, Kainov D. Expanding the activity spectrum of antiviral agents. Drug Discov Today. 2019 May;24(5):1224-1228. doi: 10.1016/j.drudis.2019.04.006. Epub 2019 Apr 10. Review. PubMed PMID: 30980905.
- García-Serradilla M, Risco C, Pacheco B. Drug repurposing for new, efficient, broad spectrum antivirals. Virus Res. 2019 Apr 15;264:22-31. doi: 10.1016/j.virusres.2019.02.011. Epub 2019 Feb 19. Review. PubMed PMID: 30794895.
- Zheng W, Zhao Y, Luo Q, Zhang Y, Wu K, Wang F. Multi-Targeted Anticancer Agents. Curr Top Med Chem. 2017 Nov 20;17(28):3084-3098. doi: 10.2174/1568026617666170707124126. Review. PubMed PMID: 28685693.
- Raghavendra NM, Pingili D, Kadasi S, Mettu A, Prasad SVUM. Dual or multi-targeting inhibitors: The next generation anticancer agents. Eur J Med Chem. 2018 Jan 1;143:1277-1300. doi: 10.1016/j.ejmech.2017.10.021. Epub 2017 Oct 10. Review. PubMed PMID: 29126724.
- Wang Y, Huang H, Zhang Q, Zhang P. Chirality in metal-based anticancer agents. Dalton Trans. 2018 Mar 28;47(12):4017-4026. doi: 10.1039/c8dt00089a. Epub 2018 Feb 26. Review. PubMed PMID: 29479608.

Annexure – "C"

FACULTY OF SCIENCE

Syllabus

Subject: **BIOINFORMATICS**

Course (Paper) Name & No.: Structural & Applied Bioinformatics (BI-401)

Course (Paper) Unique Code: 161603 2200 0104 0100

External Exam Time Duration: 2 Hours and 30 minutes

Name of Program	Semester	Course Group	Credit	Internal Marks	External Marks	Practical /Viva Marks	Total Marks
Bachelor of Science	04	Core	6	30	70	50	150

Course Objective:

- To uncover structure of Biomolecules through computational approach & applied Bioinformatics

COURSE STRUCTURE FOR UG PROGRAMME
BIOINFORMATICS- 401
SEMESTER- IV

Semester	Course	Title	Hours /week	Credit	Exam duration	Internal marks	External marks	Total marks
IV	BI-401 (Theory)	Structural & Applied Bioinformatics	5	4	2.5 hrs	30	70	100
IV	BI-401 (Practical)	Structural & Applied Bioinformatics	3	2	One day per batch	15	35	50
Total credits				6	Total marks			150

General instructions

1. The medium of instruction will be English for theory and practical courses
2. There will be 5 lectures / week / theory paper / semester.
3. Each lecture will be of 55 mins.
4. There will be 1 practical / week / paper / batch. Each practical will be of 3 periods
5. Each semester theory paper will be of “five” units. There will be 40 hrs. of theory teaching / paper / semester.
6. Each Theory Paper / Semester will be of 100 Marks. There will be 30 marks for internal evaluation and 70 marks for external evaluation. Each Practical Paper / Semester will be of 50 Marks with 15 marks for internal and 35 marks for external evaluation. So, Total Marks of Theory and Practical for each Paper will be 150. (100 + 50 = 150)

SKELETON OF THEORY EXAMINATION PAPER -EXTERNAL (SEMESTER- IV)

Total five questions. One question from each unit. Each question having equal weightage of 14 Marks		
a) Four One mark questions (All compulsory)	4 x 1= 4 Marks	14 Marks
b) Answer specifically- (attempt any one out of two)	1 x 2= 2 Marks	
c) Short Questions - (attempt any one out of two)	1 x 3= 3 Marks	
d) Answer in detail – (attempt any one out of two)	1 x 5= 5 Marks	

General Instructions

1. Time duration of each theory paper will be of two and half hours.
2. Total marks of each theory paper will be 70 marks.
3. There will be internal option for all the questions (as shown in table above)
4. All questions are compulsory

BI.401 Structural & Applied Bioinformatics
(Theory)

Unit I: Data collection, analysis, and visualization.

- Defining bioinformatics and structural bioinformatics
- Fundamentals of protein, DNA & RNA structure
- Computational aspects of high-throughput crystallographic macromolecular structure determination
- Macromolecular structure determination by NMR spectroscopy, electron microscopy in the context of structural systems biology
- Search and sampling in structural bioinformatics
- Molecular visualization

Unit II: Data representation, databases, data integrity and comparative features

- The PDB format, MMCIF formats, and other data formats
- The worldwide protein data bank, the nucleic acid database
- Other structure-based databases
- Structural quality assurance
- The impact of local accuracy in protein and RNA structures: validation as an active tool
- Structure comparison and alignment
- Protein structure evolution and the SCOP and CATH domain structure database

Unit III: Structural and functional assignment

- Secondary structure assignment
- Identifying structural domains in proteins
- Inferring protein function from structure
- Structural annotation of genomes

Macromolecular interactions

- Electrostatic interactions
- Prediction of protein–nucleic acid interactions
- Prediction of protein–protein interactions from evolutionary information

Unit IV: Structure prediction

- CASP and other community-wide assessments to advance the field of structure prediction
- Prediction of protein structure in 1D: secondary structure, membrane regions, and solvent accessibility
- Homology modeling, Fold recognition methods, de novo protein structure prediction: methods and application
- RNA structural bioinformatics

Therapeutic discovery

- Structural bioinformatics in drug discovery
- B-Cell epitope prediction

Future challenges in Structural Bioinformatics

- Methods to classify and predict the structure of membrane proteins

- Protein motion: Simulation
- The significance and impacts of protein disorder and conformational variants
- Protein designability and engineering
- Structural genomics of protein superfamilies

Unit V: Applied Bioinformatics

- Commercial Bioinformatics
- Bioinformatics Companies & Research Institutes – India & International
- Genome, transcriptome and proteome: the rise of omics data and their integration in biomedical sciences
- Applied fields of Bioinformatics (Basic Concepts): Immunoinformatics & Neuroinformatics, Clinical Bioinformatics, Nanoinformatics
- Web Resources for Stem Cell Research
- Overview of Intellectual Property Rights (IPR) & Patents
- Overview of Biosafety & Bioethics

BI.401 Structural & Applied Bioinformatics (Practical)

Based on theory syllabus

References

- Jenny Gu (Editor), Philip E. Bourne (Editor), Structural Bioinformatics (ISBN: 978-0-470-18105-8), 2nd Edition, February 2009, Wiley-Blackwell
- Wei T, Peng X, Ye L, Wang J, Song F, Bai Z, Han G, Ji F, Lei H. Web resources for stem cell research. Genomics Proteomics Bioinformatics. 2015 Feb;13(1):40-5. doi: 10.1016/j.gpb.2015.01.001. Review. PubMed PMID: 25701763; PubMed Central PMCID: PMC4411488. Primrose and Twyman R.M: Principles of Genome analysis: Blackwell publication
- Backert L, Kohlbacher O. Immunoinformatics and epitope prediction in the age of genomic medicine. Genome Med. 2015 Nov 20;7:119. doi: 10.1186/s13073-015-0245-0. Review. PubMed PMID: 26589500; PubMed Central PMCID: PMC4654883.
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- Bellazzi, R., Masseroli, M., Murphy, S., Shabo, A., & Romano, P. (2012). Clinical Bioinformatics: challenges and opportunities. BMC bioinformatics, 13(Suppl 14), S1.
- Panneerselvam S, Choi S. Nanoinformatics: emerging databases and available tools. Int J Mol Sci. 2014 Apr 25;15(5):7158-82. doi: 10.3390/ijms15057158. Review. PubMed PMID: 24776761; PubMed Central PMCID: PMC4057665.

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- Baxevanis A.D & Ouellette B.F.F: Bioinformatics-A Practical guide to the analysis of Genes and Proteins: *John Wiley & Sons, INC. Publication*
- Andrade M.A: Bioinformatics & Genomes-Current Perspectives: *Horizon Scientific press*
- Lesk. A.M: Introduction to Bioinformatics: *Oxford Press.*
- Mount. D.W: Bioinformatics sequence and Genome Analysis: *Cold spring Harbor Laboratory Press.*
- Higgins. D and Taylor.W: Bioinformatics – Sequence, structure and databanks: *Oxford University press.*
- Nelson.D.L and Cox.M.M : Lehninger- Principles of Biochemistry: *Mac Milan Worth Publication.*
- Stryer: Biochemistry: *W.H. Fedman & co.*
- Orengo.C.A, Jones.D.T, J.M.Thornton: Bioinformatics – Genes, Proteins & Computers: *BIOS Scientific Publishers Ltd.*
- Ralph Rapley and Stuart Harbron: Molecular Analysis and Genome Discovery: *John Wiley & Sons Ltd*
- Campbell. M. K: Biochemistry, 3rd edition: *Harcourt Brace college Publishers*
- Manzoni C, Kia DA, Vandrovcova J, Hardy J, Wood NW, Lewis PA, Ferrari R. Genome, transcriptome and proteome: the rise of omics data and their integration in biomedical sciences. Brief Bioinform. 2018 Mar 1;19(2):286-302. PubMed PMID: 27881428

Annexure – "C"

FACULTY OF SCIENCE

Syllabus

Subject: **BIOINFORMATICS**

Course (Paper) Name & No.: Immunology and Immunotechnology (BI-402)

Course (Paper) Unique Code: 1603 2200 0104 0200

External Exam Time Duration: 2 Hours and 30 minutes

Name of Program	Semester	Course Group	Credit	Internal Marks	External Marks	Practical /Viva Marks	Total Marks
Bachelor of Science	04	Core	6	30	70	50	150

Course Objective:

- To identify the cellular and molecular basis of immune responsiveness. An understanding of humoral and cellular immunity and their relative significances. To understand the antigens and antibodies interactions. To learn Autoimmune and Hypersensitivity reactions. To understand the immunity during organ transplantation and infectious diseases.

COURSE STRUCTURE FOR UG PROGRAMME
BIOINFORMATICS- 402
SEMESTER- IV

Semester	Course	Title	Hours /week	Credit	Exam duration	Internal marks	External marks	Total marks
IV	BI-402 (Theory)	Immunology and Immunotechnology	5	4	2.5 hrs	30	70	100
IV	BI-402 (Practical)	Immunology and Immunotechnology	3	2	One day per batch	15	35	50
Total credits				6	Total marks			150

General instructions

1. The medium of instruction will be English for theory and practical courses
2. There will be 5 lectures / week / theory paper / semester.
3. Each lecture will be of 55 mins.
4. There will be 1 practical / week / paper / batch. Each practical will be of 3 periods
5. Each semester theory paper will be of "*five*" units. There will be 50 hrs. of theory teaching / paper / semester.
6. Each Theory Paper / Semester will be of 100 Marks. There will be 30 marks for internal evaluation and 70 marks for external evaluation. Each Practical Paper / Semester will be of 50 Marks with 15 marks for internal and 35 marks for external evaluation. So, Total Marks of Theory and Practical for each Paper will be 150. (100 + 50 = 150)

SKELETON OF THEORY EXAMINATION PAPER -EXTERNAL (SEMESTER- IV)

Total five questions. One question from each unit. Each question having equal weightage of 14 Marks		
a) Four One mark questions (All compulsory)	4 x 1= 4 Marks	14 Marks
b) Answer specifically- (attempt any one out of two)	1 x 2= 2 Marks	
c) Short Questions - (attempt any one out of two)	1 x 3= 3 Marks	
d) Answer in detail – (attempt any one out of two)	1 x 5= 5 Marks	

General Instructions

1. Time duration of each theory paper will be of two and half hours.
2. Total marks of each theory paper will be 70 marks.
3. There will be internal option for all the questions (as shown in table above)
4. All questions are compulsory

BI.402 Immunology and Immunotechnology
(Theory)

UNIT 1

- Historical overview of Immunology, Introduction to Immunity and Immunogen
- Types of Immunity – Natural, Acquired and Herd
- Innate Immune response and its role in protection
- Adaptive Immune response – Humoral and cellular component of the Immune response
- Theory of Immunity: selective theory, instructional theories and clonal selection theory

UNIT 2

- Hematopoiesis, Cells of the Immune System
- Organs of the Immune System: Primary and Secondary Lymphoid Organs
- Primary response and generation of memory
- Antigen: Immunogenicity versus Antigenicity, Factors that influence immunogenicity, Biological System contributes to Immunogenicity
- Epitopes, Haptens, Adjuvants, Affinity and Avidity

UNIT 3

- Antibody - Structure of Immunoglobulin, Chemical and Enzymatic Methods Revealed Basic Antibody, Light Chain, Heavy chain, Antigen determinants on Immunoglobulin
- Immunoglobulin Classes: IgA, IgG, IgM, IgD and IgE, Biological Activities
- Genetic events in synthesis of Ig Chains: Organization & Synthesis of Light chain genes & Heavy chain genes, Class & Isotope Switching
- Antigen and Antibody Interactions – *in vivo*: Lattice hypothesis, Precipitation and Agglutination
- Antigen and Antibody Interactions – *in vitro*: Single and Double Diffusion, RIA, ELISA, Rocket Electrophoresis, Immunofluorescence Technique, Flow Cytometry

UNIT 4

- MHC: MHC molecules and organization of their genes, Structure and function of MHC gene products, MHC-restriction, Antigen processing and presentation
- T – cell and B – cell receptors
- Cytokines: Properties of Cytokines, Cytokine Receptors, Function of Cytokines
- The Complement Systems - mode of activation: classical, alternate and lectin pathway, biological functions
- Hypersensitivity reactions: I, II, III and IV

UNIT 5

- Monoclonal Antibodies: Production by Hybridoma Technology & Applications
- Vaccines – Characteristics of a good Vaccine, Types of Vaccines
- Transplantation Immunology: Graft rejection, Evidence & Mechanism of Graft rejection, Prevention of Graft rejection, HLA typing, Immunosuppressive Drugs and Graft versus Host (GVH) reaction
- Autoimmune Diseases – Mechanism of Autoimmune Disease, Organ Specific (Graves' disease) and Systemic Autoimmune Disease (Rheumatoid Arthritis)
- Immune response to Infectious Diseases: Viral (Rabies, AIDS), Bacterial (Tuberculosis, Typhoid), Protozoan (Malaria, Amoebiasis)

BI.402 Immunology and Immunotechnology (Practical)

Based on theory syllabus

References:

- Immunology – 5 th edition – J.Kuby, R. A. Goldsby , J. Kindt, B.A. Osborne – W.H. Freeman and Company, New York
- Immunology by I.M. Roitt, J. Brostoff and D.K. Male (1993) Gower medical publishing, London.
- Immunology – A short course by E. Benzamini, G. Sunshine and Leskpwitz, Willy – Liss 1996.

Annexure – "C"

FACULTY OF SCIENCE

Syllabus

Subject: **BIOINFORMATICS**

Course (Paper) Name & No.: Web Technology (BI-403)

Course (Paper) Unique Code: 1603 2200 0104 0300

External Exam Time Duration: 2 Hours and 30 minutes

Name of Program	Semester	Course Group	Credit	Internal Marks	External Marks	Practical /Viva Marks	Total Marks
Bachelor of Science	04	Core	6	30	70	50	150

Course Objective:

- To understand basic of web designing and databases connectivity

COURSE STRUCTURE FOR UG PROGRAMME
BIOINFORMATICS- 403
SEMESTER- IV

Semester	Course	Title	Hours /week	Credit	Exam duration	Internal marks	External marks	Total marks
IV	BI-403 (Theory)	Web Technology	5	4	2.5 hrs	30	70	100
IV	BI-403 (Practical)	Web Technology	3	2	One day per batch	15	35	50
Total credits				6	Total marks			150

General instructions

1. The medium of instruction will be English for theory and practical courses
2. There will be 5 lectures / week / theory paper / semester.
3. Each lecture will be of 55 mins.
4. There will be 1 practical / week / paper / batch. Each practical will be of 3 periods
5. Each semester theory paper will be of "*five*" units. There will be 50 hrs. of theory teaching / paper / semester.
6. Each Theory Paper / Semester will be of 100 Marks. There will be 30 marks for internal evaluation and 70 marks for external evaluation. Each Practical Paper / Semester will be of 50 Marks with 15 marks for internal and 35 marks for external evaluation. So, Total Marks of Theory and Practical for each Paper will be 150. (100 + 50 = 150)

SKELETON OF THEORY EXAMINATION PAPER -EXTERNAL (SEMESTER- IV)

Total five questions. One question from each unit. Each question having equal weightage of 14 Marks		
a) Four One mark questions (All compulsory)	4 x 1= 4 Marks	14 Marks
b) Answer specifically- (attempt any one out of two)	1 x 2= 2 Marks	
c) Short Questions - (attempt any one out of two)	1 x 3= 3 Marks	
d) Answer in detail – (attempt any one out of two)	1 x 5= 5 Marks	

General Instructions

1. Time duration of each theory paper will be of two and half hours.
2. Total marks of each theory paper will be 70 marks.
3. There will be internal option for all the questions (as shown in table above)
4. All questions are compulsory

BI.403 Web Technology
(Theory)

Unit I: Introduction to WWW (World Wide Web) and Internet

- Fundamental of HTML, Basic Tag and Attribute, The Formatting Tags, The List Tags
- Link Tag, inserting special characters, adding images and Sound), Forms
- **HTML 5 & Syntax**
- HTML5 Document Structure, (section, article, aside, header, footer, nav, dialog,
- figure), Attributes of HTML 5, Web Form (date time, date, month, week, time, number,
  range, email, url), Audio / Video
- Canvas

Unit II: **Cascading Style Sheet**

- Introduction to CSS, Types of Style Sheet, Class & ID Selector
- CSS Font Properties, CSS Text Properties.CSS Background Properties, CSS List Properties, CSS Margin Properties
  PHP Basics
- Introduction to PHP, PHP configuration in IIS and Apache web server
- PHP variable, static and global, Form processing, get and post methods, PHP operator

Unit III: **Decision Making Statements in PHP**

- Conditional structure, looping structure, Arrays, Functions: User Defined Functions, Variable Length Argument Function
- **Built in Functions:** Variable functions, Array function, String function, Math function, Date function, File handling function, miscellaneous functions.

Unit IV: Introduction to RDBMS using Oracle

- **Introduction to DBMS:** Introduction to RDBMS, Importance of ER Diagrams in Relational model, Normalization
- **Introduction to SQL:**SQL Commands and Data Types, Operators and Expressions
- **Managing Tables and Data & Data Control:** Creating, altering and Dropping tables, Data Manipulations Commands: Insert, update, Different types of constraints, Select statements with WHERE, GROUP BY and HAVING, ORDER BY, DISTINCT. Special operators like IN , ANY ,ALL , BETWEEN ,EXISTS, LIKE, Built in Functions

Unit V: Introduction to MYSQL and Interfacing with Databases through PHP

- Working with MYSQL data, Connecting to MYSQL with PHP
- Creating, viewing, Modifying, Fetching, data from tables and displaying in proper format.

BI.403 Web Technology
(Practical)

Based on theory syllabus

References:

- RamezElmasri, Shamkant B. Navathe, Fundamentals of database systems, third edition
- Raghu Ramakrishnan, Johannes Gehrke, *Database Management System*, McGraw Hill, 3rd Edition 2003
- Ivan Bayross, SQL.PL/SQL The programming – Language of Oracle, BPB Publications.
- VikramVaswani, The Complete Reference MySQL, Tata McGraw-Hill, New Delhi, 2002
- Mastering HTML 4: Ray & Ray- BPB
- Advances Programming in Web Design: V. K Jain-Cyber Tech Publications
- PHP Bible, second edition, Tim Converse, Joyce Park
- PHP manual

Annexure – "C"

FACULTY OF SCIENCE

Syllabus

Subject: **BIOINFORMATICS**

Course (Paper) Name & No.: Object oriented Programming using JAVA (BI-404)

Course (Paper) Unique Code: 1603 2200 0104 0400

External Exam Time Duration: 2 Hours and 30 minutes

Name of Program	Semester	Course Group	Credit	Internal Marks	External Marks	Practical /Viva Marks	Total Marks
Bachelor of Science	04	Core	6	30	70	50	150

Course Objective:

- To understand basic JAVA & develop program using JAVA

COURSE STRUCTURE FOR UG PROGRAMME
BIOINFORMATICS- 404
SEMESTER- IV

Semester	Course	Title	Hours /week	Credit	Exam duration	Internal marks	External marks	Total marks
IV	BI-404 (Theory)	Object oriented Programming using JAVA	5	4	2.5 hrs	30	70	100
IV	BI-404 (Practical)	Object oriented Programming using JAVA	3	2	One day per batch	15	35	50
Total credits				6	Total marks			150

General instructions

1. The medium of instruction will be English for theory and practical courses
2. There will be 5 lectures / week / theory paper / semester.
3. Each lecture will be of 55 mins.
4. There will be 1 practical / week / paper / batch. Each practical will be of 3 periods
5. Each semester theory paper will be of "*five*" units. There will be 50 hrs. of theory teaching / paper / semester.
6. Each Theory Paper / Semester will be of 100 Marks. There will be 30 marks for internal evaluation and 70 marks for external evaluation. Each Practical Paper / Semester will be of 50 Marks with 15 marks for internal and 35 marks for external evaluation. So, Total Marks of Theory and Practical for each Paper will be 150. (100 + 50 = 150)

SKELETON OF THEORY EXAMINATION PAPER -EXTERNAL (SEMESTER- IV)

Total five questions. One question from each unit. Each question having equal weightage of 14 Marks		
a) Four One mark questions (All compulsory)	4 x 1= 4 Marks	14 Marks
b) Answer specifically- (attempt any one out of two)	1 x 2= 2 Marks	
c) Short Questions - (attempt any one out of two)	1 x 3= 3 Marks	
d) Answer in detail – (attempt any one out of two)	1 x 5= 5 Marks	

General Instructions

1. Time duration of each theory paper will be of two and half hours.
2. Total marks of each theory paper will be 70 marks.
3. There will be internal option for all the questions (as shown in table above)
4. All questions are compulsory

BI.404: Object oriented Programming using JAVA
(Theory)

UNIT 1: Basics

- Introduction to Java Programming Language: History and features, JDK and its components, byte code and JVM
- Data types and Operators
- Selection Statement: IF, IF…ELSE, ELSE IF LADDER, SWITCH...CASE
- Loop statements: while, do…while, for, labeled for
- Jumping statements: break, continue

UNIT 2: Class Fundamentals

- Defining classes, Creating objects
- Constructor
- Inheritance
- Polymorphism
- overloading and overriding of methods
- visibility control and modifier

UNIT 3: Packages, Multithreading and Exception handling

- Java API packages, Creating and using packages
- Applications of packages
- Multithreading programming
- Applications of threads, synchronization, dead lock
- Handling exceptions: try...catch, try...multiple catch, finally, throw, throws
- Creating user defined exception

UNIT 4: Input and Output

- Concept of Streams
- Difference between Character streams and Byte streams
- Character Streams
- (Reader,Writer,BufferedReader,InputStreamReader, OutputStreamReader,FileReader, FileWriter,Bufferwriter,PrintWriter)
- ByteStreams
- OtherClasses

UNIT 5: Applet & Swing

Applet:

- Introduction to Applet, life cycle
- Applet context class, passing parameters to applet
- Graphics class and various methods in an applet
- Event handling, AWT controls

Swing:

- Introduction to Swing
- Swing vs AWT, container class
- Swing components (Japplet, JButton, JCheckbox, Jcheckboxgroup, JChoice, JTextfield, JTextarea, Jlist, JScrollbar, Jpanel, JFrame, Jmenu, Jmenubar, JMenuitem, Jpasswordfield, JRadiobutton
- Application development using Swing

BI.404: Object oriented Programming using JAVA (Practical)

Based on theory syllabus

Reference Books:

- Programming with Java: E. Balaguruswamy- TMH Publications
- The Complete reference Java 2 – Herbert Schildt and Patrick Naughton
- Teach Yourself Java: Joseph O' Neil, TMH publications

Annexure – "C"

FACULTY OF SCIENCE

Syllabus

Subject: **BIOINFORMATICS**

Course (Paper) Name & No.: Cheminformatics (BI-405)

Course (Paper) Unique Code: 1603 2200 0104 0500

External Exam Time Duration: 2 Hours and 30 minutes

Name of Program	Semester	Course Group	Credit	Internal Marks	External Marks	Practical /Viva Marks	Total Marks
Bachelor of Science	04	Core	6	30	70	50	150

Course Objective:

- To understand Cheminformatics and drug designing

COURSE STRUCTURE FOR UG PROGRAMME
BIOINFORMATICS- 405
SEMESTER- IV

Semester	Course	Title	Hours /week	Credit	Exam duration	Internal marks	External marks	Total marks
IV	BI-405 (Theory)	Cheminformatics	5	4	2.5 hrs	30	70	100
IV	BI-405 (Practical)	Cheminformatics	3	2	One day per batch	15	35	50
Total credits				6	Total marks			150

General instructions

1. The medium of instruction will be English for theory and practical courses
2. There will be 5 lectures / week / theory paper / semester.
3. Each lecture will be of 55 mins.
4. There will be 1 practical / week / paper / batch. Each practical will be of 3 periods
5. Each semester theory paper will be of "*five*" units. There will be 50 hrs. of theory teaching / paper / semester.
6. Each Theory Paper / Semester will be of 100 Marks. There will be 30 marks for internal evaluation and 70 marks for external evaluation. Each Practical Paper / Semester will be of 50 Marks with 15 marks for internal and 35 marks for external evaluation. So, Total Marks of Theory and Practical for each Paper will be 150. (100 + 50 = 150)

SKELETON OF THEORY EXAMINATION PAPER -EXTERNAL (SEMESTER- IV)

<table>
<tr><td colspan="3">Total five questions. One question from each unit. Each question having equal weightage of 14 Marks</td></tr>
<tr><td>a) Four One mark questions (All compulsory)</td><td>4 x 1= 4 Marks</td><td rowspan="4">14 Marks</td></tr>
<tr><td>b) Answer specifically- (attempt any one out of two)</td><td>1 x 2= 2 Marks</td></tr>
<tr><td>c) Short Questions - (attempt any one out of two)</td><td>1 x 3= 3 Marks</td></tr>
<tr><td>d) Answer in detail – (attempt any one out of two)</td><td>1 x 5= 5 Marks</td></tr>
</table>

General Instructions

1. Time duration of each theory paper will be of two and half hours.
2. Total marks of each theory paper will be 70 marks.
3. There will be internal option for all the questions (as shown in table above)
4. All questions are compulsory

BI.405 Cheminformatics
(Theory)

UNIT I: Introduction to Cheminformatics & Chemical Databases

- Introduction to Cheminformatics: Development of the Field, The Basis of Chemoinformatics and the Diversity of Applications, Databases, Fundamental Questions of a Chemist, Drug Discovery, Additional Fields of Application
- Applications of Chemoinformatics in Drug Discovery
- Representation of chemical Structures
- Overview of small molecule databases (Database needs to be covered from the latest database issue of Nucleic Acids Research journals): Any three best databases
- Overview of Drugs and drug design databases (Database needs to be covered from the latest database issue of Nucleic Acids Research journals): Any two best databases
- Resources for Chemical, Biological, and Structural Data on Natural Products
- Free Marine Natural Products Databases for Biotechnology and Bioengineering

UNIT II: Structure and Ligand Based Drug Discovery-1

- Computational/in silico methods in drug target and lead prediction
- Computational approaches in target identification and drug discovery
- Using reverse docking for target identification and its applications for drug discovery
- Tools for in silico target fishing
- A review of ligand-based virtual screening web tools and screening algorithms in large molecular databases in the age of big data
- In Silico Target Druggability Assessment: From Structural to Systemic Approaches
- Modern Computational Strategies for Designing Drugs to Curb Human Diseases: A Prospect

UNIT III: Structure and Ligand Based Drug Discovery-2

- A Structure-Based Drug Discovery Paradigm
- Virtual Screening Techniques in Drug Discovery: Review and Recent Applications
- Recent Advances in Scaffold Hopping
- Scaffold hopping from natural products to synthetic mimetics by holistic molecular similarity
- Computational Methodologies in the Exploration of Marine Natural Product Leads
- Polypharmacology by Design: A Medicinal Chemist's Perspective on Multitargeting Compounds Repurposing
- Web-Based Tools for Polypharmacology Prediction
- Molecular Docking: Shifting Paradigms in Drug Discovery

UNIT IV: Structure and Ligand Based Drug Discovery-3

- Molecular docking: current advances and challenges
- An Overview of Scoring Functions Used for Protein-Ligand Interactions in Molecular Docking.
- Virtual Screening Techniques in Drug Discovery: Review and Recent Applications
- Benchmarking of different molecular docking methods for protein-peptide docking
- Concepts and Core Principles of Fragment-Based Drug Design
- Computational Fragment-Based Drug Design: Current Trends, Strategies, and Applications

- Bridging Molecular Docking to Molecular Dynamics in Exploring Ligand-Protein Recognition Process: An Overview
- Molecular Dynamics Simulation for All
- Molecular mechanics

UNIT V: Applied Cheminformatics

- Quantitative Structure-Activity Relationship (QSAR): Modeling Approaches to Biological Applications.
- QSAR-Based Virtual Screening: Advances and Applications in Drug Discovery
- The Pharmacophore Concept and Its Applications in Computer-Aided Drug Design.
- *In Silico* Approaches for Predictive Toxicology
- *In silico* ADME-Tox modeling: progress and prospects
- *In silico* toxicology protocols
- Recent applications of deep learning and machine intelligence on in silico drug discovery: methods, tools and databases
- Advancing Drug Discovery via Artificial Intelligence

BI.405 Cheminformatics (Practical)

Based on theory syllabus

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- Overview of small molecule databases: http://www.oxfordjournals.org/nar/database/subcat/4/11
- Overview of Drugs and drug design databases: http://www.oxfordjournals.org/nar/database/subcat/11/35
- Database issue of Nucleic Acids Research journals: http://www.oxfordjournals.org/nar/database/c/
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