KANNUR UNIVERSITY

(Abstract)

New Generation Course in St Pius x college - B.Sc. Life Science (Zoology) & Computational Biology (LRP) Programme Scheme & Syllabus and Pattern Question Papers of Core , General Awareness and Generic Elective Courses under CBCSS- OBE - with effect from 2020-21 admission- implemented orders issued

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ACADEMIC C SECTION

Acad/C2/16579/NGC/2021 Dated: 27.01.2021

Read:-1. G.O(Ms) No.389/2020/HEDN dated 05.11.2020

2. Minutes of the meeting of Syndicate held on 17.11.2020 vide item No.2020.550
3. U.O No. Acad.A3/389/NEW COURSES/ 2020-21 dated 23.12.2020
4. U.O No. Acad/C2/429/2017/Vol II dated 03.06.2019
5. Minutes of the meeting of Curriculum Syllabus Monitoring Committee held on 20.11.2020
6. U.O No. Acad/C2/2408/2020 dated 27.11.2020
7. Syllabus Submitted by the Convenor expert Committee dated 28.12.2020

ORDER

1. As per read (1) above, sanction was accorded by the Government to start New Generation UG/PG Courses in 15 Govt and Aided Colleges under Kannur University, during the academic year 2020-21.
2. The meeting of the Syndicate as per paper read (2) above resolved to start the newly Sanctioned UG & PG Programmes in Govt/Aided Colleges/University Departments from the academic year 2020-21.
3. Accordingly, provisional affiliation was granted for conducting the New Generation Courses B.Sc. Life Science (Zoology) & Computational Biology (LRP) Programme at St.Pius College, Rajapuram in the academic year 2020-21, as per paper read (3).
4. Further, the Curriculum Syllabus Monitoring Committee, as per paper read (5) above, resolved to follow the the existing Regulation for UG Programmes in affiliated colleges under CBCSS (OBE - Outcome Based Education System) implemented w.e.f 2019 admission as per read (4), for the New Generation Courses also. An expert committee was constituted for preparing the draft curriculum, Syllabus of New Generation Courses, by conducting two days workshop as per paper read (6).
5. Accordingly, the scheme, Syllabus & Pattern of Question Papers for B.Sc Life Science (Zoology) & Computational Biology with Microbiology, Computer Science as Complementary subjects prepared by the Expert Committee was submitted by the Convenor of Curriculum Syllabus Monitoring Committee, for implementation w.e.f 2020 admission at St. Pius X College, Rajapuram.
6. The Vice Chancellor after considering the matter in detail and in exercise of the power of the Academic Council conferred under Section 11(1) Chapter III of Kannur University Act 1996 accorded sanction to implement the Scheme, Syllabus and Pattern Question Papers of Core, General Awareness and Generic Elective Courses of B.Sc. Life Science (Zoology) & Computational Biology (LRP) Programme (CBCSS-OBE), at St. Pius X College, Rajapuram, with effect from 2020-21 admission, subject to reporting to the Academic Council.
7. The Scheme, Syllabus & Pattern of Question Papers of the B.Sc. Life Science (Zoology) & Computational Biology (LRP) programme are uploaded in the University website. (www.kannuruniversity.ac.in)
8. Orders are issued accordingly

Sd/-

BALACHANDRAN V K

DEPUTY REGISTRAR (ACAD)

For REGISTRAR

To: The Principal , St.Pius College, Rajapuram

Copy To: 1.The Examination Branch (through PA to CE)

2. PS to VC/PA to PVC/PA to Registrar

3. DR/AR-1 Academic

4. The Computer Programmer (for uploading in the website)

5. SF/DF/FC

Forwarded / By Order

SECTION OFFICER

KANNUR UNIVERSITY
CIVIL STATION P.O.
KANNUR
Pin-670 002
THAVAKKARA

KANNUR UNIVERSITY

SYLLABUS FOR

CORE, GENERAL AWARENESS COURSES & GENERIC ELECTIVE COURSES

FOR

B.Sc. LIFE SCIENCES (ZOOLOGY) & COMPUTATIONAL BIOLOGY WITH MICROBIOLOGY AND COMPUTER SCIENCE AS COMPLEMENTARY SUBJECTS

St. Pius X College, Rajapuram, Kasaragod 671532

KANNUR UNIVERSITY

VISION AND MISSION

Vision

To establish a teaching, residential and affiliating University and to provide equitable and just access to quality higher education involving the generation, dissemination and a critical application of knowledge with special focus on the development of higher education in Kasargode and Kannur Revenue Districts and the Manandavady Taluk of Wayanad Revenue District.

Mission

- To produce and disseminate new knowledge and to find novel avenues for application of such knowledge.
- To adopt critical pedagogic practices which uphold scientific temper, the uncompromised spirit of enquiry and the right to dissent.
- To uphold democratic, multicultural, secular, environmental and gender sensitive values as the foundational principles of higher education and to cater to the modern notions of equity, social justice and merit in all educational endeavours.
- To affiliate colleges and other institutions of higher learning and to monitor academic, ethical, administrative and infrastructural standards in such institutions.
- To build stronger community networks based on the values and principles of higher education and to ensure the region's intellectual integration with national vision and international standards.
- To associate with the local self-governing bodies and other statutory as well as non-governmental organizations for continuing education and also for building public awareness on important social, cultural and other policy issues.

PROGRAMME OUTCOMES (PO)

PO 1. Critical Thinking:

1. Acquire the ability to apply the basic tenets of logic and science to thoughts, actions and interventions.
2. Develop the ability to chart out a progressive direction for actions and interventions by learning to recognize the presence of hegemonic ideology within certain dominant notions.
3. Develop self-critical abilities and also the ability to view positions, problems and social issues from plural perspectives.

PO 2. Effective Citizenship:

1. Learn to participate in nation building by adhering to the principles of sovereignty of the nation, socialism, secularism, democracy and the values that guide a republic.
2. Develop and practice gender sensitive attitudes, environmental awareness, empathetic social awareness about various kinds of marginalisation and the ability to understand and resist various kinds of discriminations.
3. Internalise certain highlights of the nation's and region's history. Especially of the freedom movement, the renaissance within native societies and the project of modernisation of the post-colonial society.

PO 3. Effective Communication:

1. Acquire the ability to speak, write, read and listen clearly in person and through electronic media in both English and in one Modern Indian Language
2. Learn to articulate, analyse, synthesise, and evaluate ideas and situations in a well-informed manner.
3. Generate hypotheses and articulate assent or dissent by employing both reason and creative thinking

PO 4. Interdisciplinarity:

1. Perceive knowledge as an organic, comprehensive, interrelated and integrated faculty of the human mind.
2. Understand the issues of environmental contexts and sustainable development as a basic interdisciplinary concern of all disciplines.
3. Develop aesthetic, social, humanistic and artistic sensibilities for problem solving and evolving a comprehensive perspective.

PROGRAMME SPECIFIC OUTCOME FOR B.Sc. LIFE SCIENCES (ZOOLOGY) & COMPUTATIONAL BIOLOGY

PSO1: Understand the relevance of Zoological and Microbiological aspects in life sciences and computer science

PSO2: Understand the scope and applications of computational modelling and predictions in various aspects of life sciences

PSO3: Understand the relevance of research methods, bioethics in the implementations of the studies related with life sciences and computational biology

PSO4: Carry out standard laboratory techniques in the field of zoology, microbiology, Computer sciences and study the scope of computational modelling and prediction in various problems in life sciences.

B.Sc. LIFE SCIENCES (ZOOLOGY) & COMPUTATIONAL BIOLOGY PROGRAMME (LRP)

WORK AND CREDIT DISTRIBUTION STATEMENT

Semester	Course Title (Core code suggestion ZCB)	Credits	Hours per week	Total Credits	Total Hours
I	Common Course I English	4	5	19	25
	Common Course II English	3	4		
	Additional common course I	4	4		
	Complementary Elective course-I (Microbiology)	2	4		
	Complementary Elective course-I (Computer Science)	2	2		
	Complementary Elective Course Computer Science Practical-I	-	2		
	Core Course I: Biochemistry and Biophysics	4	4		
II	Common Course III English	4	5	19	25
	Common Couse IV English	3	4		
	Additional Common Course II	4	4		
	Complementary Elective course-II (Microbiology)	2	4		
	Complementary Elective course-II (Computer Science)	2	2		
	Complementary Elective Course Computer Science Practical-I	-	2		
	Core Course II: Fundamentals of Computational Biology & Bioinformatics	4	4		
III	General Awareness course I: Cell Biology and Genetics	4	4	15	25
	General Awareness Course II: Algorithms and Statistical Methods in Bioinformatics	4	4		
	Complementary Elective course-III (Microbiology)	2	3		
	Complementary Elective Course Microbiology Practical-I	-	2		
	Complementary Elective course-III (Computer Science)	2	3		
	Complementary Elective Course Computer Science Practical-I	-	2		
	Core Course III: Molecular Biology	3	3		
	Core Course IV: Zoology Practical-I	-	4		
IV	General Awareness Course III: Evolution	4	4	27	25
	General Awareness Course IV: Genomics and Proteomics	4	4		

	Complementary Elective Course -IV (Microbiology)	2	3		
	Complementary Elective Course- IV (Computer Science)	2	3		
	Complementary Elective Course Practical-I (Computer Science)	4	2		
	Complementary Elective Course Practical-I (Microbiology)	4	2		
	Core Course V: Bio-molecular Modeling and Simulation	3	3		
	Core Course VI: Computational Biology Practical-I	4	4		
V	Core Course VII: Animal Physiology	3	3	15	25
	Core Course VIII: Developmental Biology	3	3		
	Core Course IX: Chemo informatics & Computational Medicinal Chemistry	4	4		
	Core Course X: Computer Aided Drug Discovery	3	3		
	Core Course XI: Zoology Practical II	-	5		
	Core Course XII: Computational Biology Practical II	-	5		
	Generic Elective Course (for other Departments)	2	2		
VI	Core Course XIII: Environmental Science and Biodiversity	4	4	25	25
	Core Course XIV: Health and Immunoinformatics	4	4		
	Core Course XV: Research Methodology and Bioethics	5	5		
	Core Course XVI: Zoology Practical III	5	5		
	Core Course XVII: Computational Biology Practical III	5	5		
	Core Course XVIII: Project work	2	2		
Total				**120**	**150**

B.Sc. LIFE SCIENCES (ZOOLOGY) & COMPUTATIONAL BIOLOGY CORE COURSES WORK AND CREDIT DISTRIBUTION

COURSE CODE (Suggestion ZCB)	COURSE TITLE	SEMESTER	HOURS PER WEEK	CREDIT	EXAM HRS
1B01 ZCB	Biochemistry and Biophysics	I	4	4	3
2B02 ZCB	Fundamentals of Computational Biology & Bioinformatics	II	4	4	3
3B03 ZCB	Molecular Biology	III	3	3	3
3B04 ZCB	Zoology Practical-I	III	4	-	-
4B05 ZCB	Biomolecular Modeling and Simulation	IV	3	3	3
4B06 ZCB	Computational Biology Practical-I	IV	4	4	3 HRS X 2 DAYS/ BATCH
5B07 ZCB	Animal Physiology	V	3	3	3
5B08 ZCB	Developmental Biology	V	3	3	3
5B09 ZCB	Chemoinformatics & Computational Medicinal Chemistry	V	4	4	3
5B10 ZCB	Computer Aided Drug Discovery	V	3	3	3
5B11 ZCB	Zoology Practical II	V	5	-	-
5B12 ZCB	Computational Biology Practical II	V	5	-	-
6B13 ZCB	Environmental Science and Biodiversity	VI	4	4	3
6B14 ZCB	Health and Immunoinformatics	VI	4	4	3
6B15 ZCB	Research Methodology and Bioethics	VI	5	5	3
6B16 ZCB	Zoology Practical III	VI	5	5	3 HRS X 2 DAYS/ BATCH
6B17 ZCB	Computational Biology Practical III	VI	5	5	3 HRS X 2 DAYS/ BATCH

6B18 ZCB	Project Work	VI	2	2	-

B.Sc. LIFE SCIENCES (ZOOLOGY) & COMPUTATIONAL BIOLOGY GENERAL AWARENESS COURSES WORK AND CREDIT DISTRIBUTION

COURSE CODE (Suggested course code)	COURSE TITLE	SEMESTER	HOURS PER WEEK	CREDIT	EXAM HRS
3A11ZCB	Cell Biology and Genetics	**III**	4	4	3
3A12ZCB	Algorithms and Statistical Methods in Bioinformatics	**III**	4	4	3
4A13ZCB	Evolution	**IV**	4	4	3
4A14ZCB	Genomics and Proteomics	**IV**	4	4	3

B.Sc. LIFE SCIENCES (ZOOLOGY) & COMPUTATIONAL BIOLOGY GENERIC ELECTIVE COURSES WORK AND CREDIT DISTRIBUTION

Each department shall offer a pool of five generic elective course at a time, transaction through guidance mode. Students of other departments can choose any one of the generic elective courses from the pool of five courses. All departments (whether it is a core department or complementary department can offer the course in semester V)

COURSE CODE (Suggested course code)	COURSE TITLE	SEMESTER	HOURS /WEEK	CREDIT	EXAM HOURS
5D01ZCB	First Aid	**V**	2	2	2
5D02ZCB	Wildlife Conservation and Management	**V**	2	2	2
5D03ZCB	Apiculture	**V**	2	2	2
5D04ZCB	Introduction to Artificial Intelligence	**V**	2	2	2
5D05ZCB	Introduction to Big Data Analysis	**V**	2	2	2

EVALUATION: THEORY

DISTRIBUTION OF CONTINUOUS INTERNAL ASSESSMENT MARKS FOR THEORY (10 MARKS FOR EACH CORE THEORY COURSE)

COMPONENTS	MARKS	REMARKS
COMPONENT 1 Written class test	5	Minimum two tests, best of the two shall be taken
COMPONENT 2 Seminar and Assignment	Assignment-3 Seminar-2	

EVALUATION: PRACTICAL

DISTRIBUTION OF CONTINUOUS INTERNAL ASSESSMENT MARKS FOR CORE PRACTICAL (20 MARKS FOR EACH PRACTICAL COURSE)

COMPONENT	MARKS	REMARKS
Lab involvement	5	Attendance, laboratory skill
Record	5	
Lab examination/ viva	10	

EVALUATION: PROJECT

DISTRIBUTION OF CONTINUOUS INTERNAL ASSESSMENT MARKS FOR PROJECT (5 MARKS)

COMPONENT	MARK	REMARKS
Involvement	2	Include sample collection, preparatory session, punctuality, Timely presentation of the dissertation
Presentation	2	
Viva	1	

DISTRIBUTION OF EXTERNAL ASSESSMENT MARKS FOR PROJECT

(20 MARKS)

COMPONENT	MARK
Relevance of the topic, Objectives, Methodology and Review of Literature	4
Presentation, Quality of Analysis, Findings	6
Viva	10

CORE COURSES
Core Course I
BIOCHEMISTRY AND BIOPHYSICS

SEMESTER	COURSE CODE	HOURS PER WEEK	CREDIT	EXAM HRS
I	1B01 ZCB	4	4	3

Course outcomes

CO1. Understand the importance of Bio molecules

CO2. Familiar with various biochemical pathways

CO3. Develop knowledge about equipment like microscopes, spectrophotometers, centrifuges etc.

UNIT I

Water

Molecular structure & dipolar nature, dissociation– concept of pH, buffers- Handerson - Hasselbalch equation

UNIT II

Macromolecules-Proteins, Carbohydrates and Lipids

Basic structure and classification of amino acids –glucogenic, ketogenic, essential, semi essential, non-essential amino acids and proteogenic amino acids. Structural levels of proteins – primary, secondary, tertiary and quaternary structure. Classification of proteins - fibrous and globular proteins, simple and conjugated proteins. Biological importance of proteins and amino acids. Classification of carbohydrates. Biological functions of carbohydrates. Classification – Simple lipids, waxes, phospholipids (lecithin, cephalin), glycolipids (cerebrosides, gangliosides), steroids (cholesterol) and prostaglandins. Biological importance of lipids

UNIT III

Enzymes

Classification and Nomenclature (IUB) – 6 major classes. Mechanism of enzyme action (lock and key & induced fit hypothesis); factors influencing the velocity of enzyme action- effect of pH, temperature, enzyme and substrate concentration; regulation of enzyme action- activation and inhibition (competitive, non-competitive, allosteric and feedback); Michaelis-Menten equation; Km and Vmax values. Isozymes.

UNIT – IV

Metabolism

Basal metabolism Energy metabolism- (a) Carbohydrate metabolism – glycolysis, glycogenolysis, glycogenesis, gluconeogenesis, Pentose Phosphate pathway, (b) Protein metabolism- deamination, transamination, decarboxylation, transmethylation. (c) Lipid metabolism – oxidation of glycerol and fatty acids; Biosynthesis of fatty acids; Krebs cycle (structural details NOT expected for all); Electron Transport System (ETS) and oxidative phosphorylation; chemiosmotic hypothesis

UNIT V

Tools and Techniques: (Principle and applications-Brief account),

Microscopy –Phase contrast microscope, Fluorescent microscope, Electron microscope (TEM & SEM). Separation Techniques- Chromatography- paper, column and thin layer chromatography, mention HPLC, Centrifugation – different types of centrifuge – differential and density gradient centrifugation, mention ultracentrifuge. Electrophoresis –- polyacrylamide Gel Electrophoresis (PAGE) and, Agorose Gel Electrophoresis. Autoradiography, Colorimeter, Spectrophotometer, NMR spectrophotometry

REFERENCES

1. Fundamentals of Biochemistry, J.L. Jain, S. Chand publications,2004.
2. Lehninger's Principles of Biochemistry (2000) by Nelson, Davidl. And Cox, M. M. Macmillan/ Worth, NY.
3. Harper's Biochemistry Robert K. Murray, Daryl K. Granner, Peter A. Mayes, Victor W. Rodwell, 24th edition, Prentice Hall International. Inc.
4. Principles of Biochemistry, Geoffrey L. Zubay, 3rd edition William W. Parson, Dennis E. Vance, W. C. Brown Publishers, .
5. Biochemistry, Lubert Stryer, 4th edition, W.H. Freeman & Co,1995.
6. Roy K N: A Text Book of Biophysics; New Central Book Agency

Marks including choice:

Unit	Marks
I	5
II	15
III	10
IV	15
V	15

About the Pattern of Questions:

Part A - Short answer (6 questions x Mark 1each = 6)
Answer all questions (6 questions x Mark 1each = 6)
Part B - Short Essay (8 questions x Marks 2 each = 16)
Answer any 6 questions (6 questions x Marks 2 each = 12)
Part C - Essay (6 questions x Marks 3 each = 18)
Answer any 4 questions (4 questions x Marks 3 each = 12)
Part D - Long Essay (4 questions x Marks 5 each = 20)
Answer any 2 questions (2 questions x Marks 5 each = 10)

Total marks including choice - 60
Maximum marks of the course – 40

Core Course II
FUNDAMENTALS OF COMPUTATIONAL BIOLOGY & BIOINFORMATICS

SEMESTER	COURSE CODE	HOURS PER WEEK	CREDIT	EXAM HRS
II	2B02 ZCB	4	4	3

Course Outcome

CO 1. Understand the basic concepts in Bioinformatics/Computational biology and its applications in various fields

CO2 Understand biological databases available online and sequence alignment using bioinformatics tools

CO3.Understand algorithms used for the computational calculations

CO4. Understand the concepts of genes, genomes and Human Genome Project.

UNIT I

Bioinformatics-Definition, History, Scope and Applications. Opportunities in Bioinformatics. Emerging areas of Bioinformatics

UNIT II

Biological databases-nucleotide and protein sequence databases- secondary database, Specialized database, Protein Structure Database- PDB, Genomic Databases, metabolic pathway database- KEGG. Database Search Tools- Entrez, SRS

UNIT III

Sequence alignment: Pair-wise sequence alignment, Dotplot. Global and local alignment: methods, Dynamic Programming- Local and Global Alignment, Needleman Wunsch Algorithm, Smith Waterman Algorithm, scoring matrices (PAM, BLOSUM). Database similarity searching- FASTA and BLAST.

UNIT IV

Sequence analysis and Phylogeny – Multiple sequence alignment: methods, tools and applications. Phylogenetic analysis. Distance and Character based methods for phylogenetic tree construction: UPGMA, Neighbour joining, Ultrametric and Min ultrametric trees

UNIT V

Informatics in Genomics and Proteomics, Algorithms and applications of proteomics: proteome mining, DNA computing., Human Genome Project: genomes, Need of Human Genome Project, goals of HGP, uses and application.

TEXT BOOKS

1. Pevsner J. Bioinformatics and Functional Genomics, 3rd Edition.Wiley-Blackwell. 2015. ISBN: 978-1-118-58178-0

2. Baxevanis AD, Ouellettee BFF. Bioinformatics. A practical guide to the analysis of genes and Proteins. Third edition. John Wiley & Sons. 2006. ISBN: 978-0-471-47878-2.
3. Xinog J, Essentials of Bioinfomatics, Texas A & M University, Cambridge University press. 2006. ISBN: 9780521600828
4. Cohen NC. Guidebook on Molecular Modeling in Drug Design. Academic Press, Elseiver. 1996. ISBN: 9780121782450

REFERENCE BOOKS

1. Arabnia HR, Tran QN. Emerging Trends in Applications and Infrastructures for Computational Biology, Bioinformatics, and Systems Biology.Elsevier Science & Technology. 2016. ISBN: 9780128042038.
2. Ghosh Z, Mallick B. Bioinformatics: Principles and Applications. Oxford University Press, 2008. ISBN: 978019569230.
3. Campbell AM. Discovering Genomics, Proteomics, and Bioinformatics.CSHL Press, 2007. ISBN-13: 978-0805382198.

Marks including choice:

Unit	Marks
I	10
II	10
III	15
IV	13
V	12

About the Pattern of Questions:

Part A - Short answer (6 questions x Mark 1each = 6)
Answer all questions (6 questions x Mark 1each = 6)
Part B - Short Essay (8 questions x Marks 2 each = 16)
Answer any 6 questions (6 questions x Marks 2 each = 12)
Part C - Essay (6 questions x Marks 3 each = 18)
Answer any 4 questions (4 questions x Marks 3 each = 12)
Part D - Long Essay (4 questions x Marks 5 each = 20)
Answer any 2 questions (2 questions x Marks 5 each = 10)

Total marks including choice - 60
Maximum marks of the course – 40

Core Course III

MOLECULAR BIOLOGY

SEMESTER	COURSE CODE	HOURS PER WEEK	CREDIT	EXAM HRS
III	3B03 ZCB	3	3	3

Course outcomes

CO1. Understand the importance of bio molecules

CO2: Inspect the genome organization and protein synthesis

CO3: Understand the relevance of regulation of gene expression in prokaryotes and eukaryotes

CO4: To study various techniques and their scope in molecular biology.

UNIT I

Introduction

DNA as the genetic material. Central dogma of molecular biology and central dogma. Classical concepts of genes. One gene – one enzyme hypothesis, one gene – one polypeptide hypothesis; Modern concept of genes – cistron, muton, recon, complicon, transcripton, split genes, overlapping genes, pseudogenes, jumping genes, cryptic genes, Housekeeping genes. [brief accounts only].

UNIT II

Organization of genome

Nucleosome structure and packaging of DNA into higher order structures, Brief idea about condensins and cohesins. Mitochondrial genome. Role of mitochondrial genes in phylogeny

UNIT III

Nucleic Acids

Watson and Crick model of DNA structure. Different forms of DNA (A, B, Z) RNA Structure, types& Functions. Semiconservative method of DNA replication. DNA Repair mechanisms (Brief account - Photo reactivation, nucleotide and base excision repair, SOS repair, Rec BCD model in prokaryotes, Concepts of Eukaryotic Repair mechanisms)

UNIT IV

Protein synthesis

Genetic code, Transcription and Translation

UNIT V

Gene Regulation

Gene regulation in prokaryotes and eukaryotes, Operon concepts, types of operon, Regulation of transcription in prokaryotes, regulation of transcription in eukaryotes, siRNA and RNAi, miRNA mediated gene silencing. Epigenetic Regulation: DNA Methylation, Histone Methylation & Acetylation.

UNIT VI

Molecular Techniques (Principle and Applications-Brief account)

PCR, Western and Southern blot, Northern Blot. Model organisms for studying Molecular Biology (Neurospora, Caenorhabditis and Drosophila), CRISPR/CAS9gene editing. Genetic engineering-rDNA technology, Gene cloning, cloning vectors (plasmids, phages, cosmids, BAC, YAC), Enzymes of rDNA technology (Exonuclease, Endonuclease, Restriction enzyme, DNA ligase, DNA polymerase, Reverse transcriptase)

REFERENCES

1. De Roberties, E. D. P. et al.: Cell and Molecular Biology 7th/8th edition TMH
2. Freifelders Essentials of Molecular Biology, 4thEd (2015)
3. Gerlad Karp: Cell and Molecular Biology 6th/7th edition
4. Concepts and Experiments. Gupta, P. K.: Cell and Molecular Biology 5th edition, Rastogi Pubs., Meerut.

Marks including choice:

Unit	Marks
1	5
2	10
3	15
4	15
5	8
6	7

About the Pattern of Questions:

Part A -Short answer (6 questions x Mark 1each = 6)
Answer all questions (6 questions x Mark 1each = 6)
Part B Short Essay (8 questions x Marks 2 each = 16)
Answer any 6 questions (6 questions x Marks 2 each = 12)
Part C -Essay (6 questions x Marks 3 each = 18)
Answer any 4 questions (4 questions x Marks 3 each = 12)
Part D -Long Essay (4 questions x Marks 5 each = 20)
Answer any 2 questions (2 questions x Marks 5 each = 10)

Total marks including choice - 60
Maximum marks of the course - 40

Core Course IV
ZOOLOGY PRACTICAL-I

SEMESTER	COURSE CODE	HOURS PER WEEK	CREDIT	EXAM HRS
III	3B04 ZCB	4	-	

COI. To give training different cytological and biochemical techniques

Experiments

1. Study of mitotic stages – Onion root tip squash preparation
2. Staining of buccal epithelial cells
3. Staining of blood film to study blood cells
4. Determination of blood groups.
5. Qualitative Analysis for carbohydrates, lipids and proteins
6. Colorimetry-Estimation of protein /glucose
7. Chromatography – Determination of Rf value and identification of amino acid

TEXT/ REFERENCE BOOKS

1. Wood E. J. (1989) Practical Biochemistry for Colleges.
2. Jayaraman J.(2011) Laboratory Manual in Biochemistry

Core Course V
BIOMOLECULAR MODELLING AND SIMULATION

SEMESTER	COURSE CODE	HOURS PER WEEK	CREDIT	EXAM HRS
IV	4B05 ZCB	3	3	3

Course Outcomes

CO1: Able to understand various structural organisation and conformations of proteins for biomolecular modelling studies
CO2: Able to understand the scope of computational biology in predicting primary, secondary and tertiary structures of proteins
CO3: Able to apply different force fields for evaluation of protein structures by relevant bioinformatics approaches.
CO4: Able to implement simulation studies for various proteins and analyse their structural aspects for functional studies.
CO5: Able to design and develop models for unknown protein structures using various computational biology tools.

UNIT-01
Biomolecular Structure and modeling: Historical perspective, Introduction to Molecular Modeling, Roots of Molecular modeling in Molecular mechanics. Introduction to X-Ray crystallography and NMR spectroscopy. Introduction to PDB and 3D Structure data, PDB format and other 3D structural formats, Protein Structure Hierarchy: Helices – Classic α-Helix and π Helices, Left-Handed α-Helix and Collagen Helix. β-Sheets -β-sheets -parallel and Anti-parallel, Turns and Loops. Super secondary and Tertiary structure and Quaternary StructureQuaternary Structure Complex 3D Networks.

UNIT-02
Classes in Protein Architecture – Folds, α-Class, Bundles, Folded leaves, Hairpin arrays. β-Class folds, Anti-parallel β domains, parallel and Anti-parallel Combinations. α/β and α+β-Class, α/β Barrels, Open twisted α/β folds, Leucine-rich α/β folds. α+β folds. Quaternary structure. Overview of the prediction of primary, secondary and tertiary structure of proteins with suitable computational biology tools

UNIT-03
Molecular modeling: -Homology Modelling and ab initio /threading prediction methods. Generation of 3D Coordinates Crystal data, Fragment libraries, and conversion of 2D Structural data into 3D form. Force fields, and Geometry optimization. Energy minimizing procedures - Use of Charges, Solvent effects and Quantum Mechanical methods. Computational biology tools for force filed analysis.

UNIT-04
Computational tools for Molecular modeling. Methods of Conformational analysis - Systematic search procedures, Monte Carlo and molecular dynamics methods. Determining

features of proteins - Interaction potential, Molecular electrostatic potential, molecular interaction fields.

UNIT-05

Introduction to molecular dynamics (MD), Basic MD algorithm, its limitations, treatment of long-range forces. Statistical mechanics for MD, Newtonian and Mote Carlo approach, Energy minimization, Constant temperature, MD simulations, Brownian dynamics MD simulations, Molecular dynamics packages- AMBER, CHARMM, GROMOS, GROMACS, Energy calculations for complex interaction potentials, Molecular dynamics simulation of small molecule and macromolecules and their complexes, Free energy calculations.

UNIT-06

Membrane protein simulations: Membrane proteins and their importance, Membrane protein environments *in vivo* and *in vitro*. Modeling a complex environment - Simulation methods for membranes, Membrane protein systems, Complex solvents, Detergent micelles, Lipid bilayers, Self-Assembly and Complex systems

TEXT BOOKS

1. Hans-Dieter Höltje, Wolfgang Sippl, Didier Rognan. Molecular Modeling, Gerd Folkers, 2008.
2. Alberte Pullman. Modeling of Bimolecular Structures and Mechanisms, Joshua Jortner, 1995.
3. Jill P. Mesirov, Klaus Schulten, De Witt L. Sumners. Mathematical Approaches to Biomolecular Structure and Dynamics by, 1996.
4. Peter T. Cummings, Phillip R, Westmorland, Brice Carnahan Foundations of Molecular Modeling and Simulation by, Published by American Institute of Chemical Engineers, 2001.

REFERENCE BOOKS

1. Nicolas Claude Cohen, Guidbook on molecular modeling in drug design Academic Press. Elsevier, 1996.
2. Tamar Schlick. Molecular Modeling and Simulation: An Interdisciplinary Guide: An Interdisciplinary Guide. Second Edition, Springer. 2010.
3. Tamar Schlick, Innovations in Biomolecular Modeling and Simulations, Volume 2, RSC Publishing. 2012.
4. Timothy J. Barth, Michael Griebel, David E.Keyes, Risto M. Nieminen, Dirk Roose, Tamar Schlick. New Algorithms for Macromolecular Simulation by, Published by Springer, 2006.

Marks including choice

Unit	Marks
I	12
II	12
III	10
IV	10
V	10
VI	6

About the Pattern of Questions:

Part A - Short answer (6 questions x Mark 1each = 6)
Answer all questions (6 questions x Mark 1each = 6)
Part B - Short Essay (8 questions x Marks 2 each = 16)
Answer any 6 questions (6 questions x Marks 2 each = 12)
Part C - Essay (6 questions x Marks 3 each = 18)
Answer any 4 questions (4 questions x Marks 3 each = 12)
Part D - Long Essay (4 questions x Marks 5 each = 20)
Answer any 2 questions (2 questions x Marks 5 each = 10)

Total marks including choice - 60
Maximum marks of the course – 40

Core Course VI

COMPUTATIONAL BIOLOGY PRACTICAL-I

SEMESTER	COURSE CODE	HOURS PER WEEK	CREDIT	EXAM HRS
IV	4B06 ZCB	4	4	

Course outcome

CO1: Apply the concepts of bioinformatic tools and databases for solving various biological problems.

CO2: Apply the concepts of similarity searches and identification of best homologous sequences by various bioinformatics tools

CO3: Apply the concepts of sequence alignment and analyse the homologous relationship of various molecular sequences

CO4: Implement the concepts of computational biology and analyse the scope of structural bioinformatics and visualisation of macromolecular structures

Experiments

1. Bibliographic searches from various literature databases
2. Sequence retrieval from nucleic acid and protein sequence databases
3. Similarity searching by FASTA and BLAST
4. PDB structure retrieval and visualization by RASMOL, UCSF Chimera and PyMol
5. Pair wise alignment and comparison of molecular sequences
6. Multiple sequence analysis of molecular sequences using CLUSTALW

TEXT BOOKS

1. Baxevanis AD, Ouellettee BFF. Bioinformatics. A practical guide to the analysis of genes and Proteins. Third edition. John Wiley & Sons. 2006. ISBN: 978-1-118-58178-0.
2. Xinog J, Essentials of Bioinfomatics, Texas A & M University, Cambridge University press. 2006. ISBN: 9780521600828.
3. Mount DW. Bioinformatics: Sequence and genome analysis, Cold Spring Harbor.2004. ISBN-13: 978-0879697129.
4. Lesk A. Introduction to Bioinformatics, Fourth edition, Oxford Publications. 2013. ISBN: 9780199651566.

REFERENCE BOOKS

1. Campbell AM. Discovering Genomics, Proteomics, and Bioinformatics.CSHL Press, 2007. ISBN-13: 978-0805382198.
2. Cohen NC. Guidebook on Molecular Modeling in Drug Design. Academic Press, Elseiver. 1996. ISBN: 9780121782450.
3. Ghosh Z, Mallick B. Bioinformatics: Principles and Applications. Oxford University Press, 2008. ISBN: 978019569230.
4. Tramontano A. Introduction to Bioinformatics. Chapman and Hall/CRC Press, 2006. 9781584885696.

Core Course VII
ANIMAL PHYSIOLOGY

SEMESTER	COURSE CODE	HOURS PER WEEK	CREDIT	EXAM HRS
V	5B07 ZCB	3	3	3

Course Outcomes

CO1. Understand the function of various systems at cellular and system levels

CO2. Understand the mechanisms that work to keep the body alive and functioning

CO3. Apply the knowledge to lead a healthy life

UNIT I

Digestive System

Constituents of normal diet and their daily requirements, balanced diet: A human perspective; Malnutrition (PEM, Obesity), Digestion of carbohydrate, protein & lipids– role of salivary glands, liver, pancreas and intestinal glands in digestion. Absorption of carbohydrates, lipids, amino acids, water, electrolytes, vitamins and minerals in GIT, Movements in GI tract (Brief description of histology is expected). Bulk movement, GI hormones-functions

UNIT II

Body fluids and Circulation

Blood-composition & function. Structure of human heart, Conducting system of heart, Cardiac cycle, Blood clotting mechanism (Extrinsic and Intrinsic Pathway), Anticoagulants. Lymph & lymphatic system.

UNIT III

Respiration

Physiological anatomy of respiratory passage and lungs, Mechanism of respiration, Pulmonary

volumes and capacities, Exchange of gases, Transport of gases, Haldane Effect and Bohr Effect, Oxygen dissociation curve, Neural and chemical regulation of respiration. Respiratory problems at high altitude and deep sea.

UNIT IV

Excretion

Physiology of urine formation, Mechanism of concentration of urine -Counter current system,

Ornithine Cycle, Hormonal control of urine formation. Components (normal & abnormal) and characteristics of urine. Micturition.

UNIT V

Nerve Physiology

Propagation of action potential across the myelinated and non-myelinated nerve fibres,

Synaptic transmission. Neurotransmitters. (eg. Acetylcholine, Adrenaline, GABA, Dopamine, Serotonin, Glycine).

UNIT VI

Locomotion

Skeletal muscle- ultra structure, contractile proteins, Source of energy for muscle contraction – Cori Cycle, Mechanism of muscle contraction and relaxation-Sliding filament theory, Neuromuscular junction, All or none law, Fatigue.

UNIT VII

Endocrine and Reproductive System

Histology and function of thyroid, pancreas and adrenal. Function of pituitary- Classification of hormones. Placental hormones. Histology of mammalian testis and ovary; Hormonal control of menstrual cycle.

REFERENCES

1. Guyton, A.C. (2015). Text Book of Medical Physiology, W.B. Saundersco.
2. Hoar, W.S. (1983). General and Comparative Physiology, Prentice Hall.
3. Prosser, C.L. (1978). Comparative Animal Physiology. W.B. Saundersco.
4. Schmidt Nielsen, K. (1994). Animal Physiology: Adaptation and Environment. Cambridge University Press.
5. Jain, A.K. (2017) Text Book of Physiology. Avichal Publishing Company
6. Gerard J. Tortora / Bryan Derrickson (Principles of Anatomy & physiology. 14th Edition

Marks including choice

Unit	Marks
I	10
II	8
III	8
IV	8
V	8
VI	8
VII	10

About the Pattern of Questions:

Part A - Short answer (6 questions x Mark 1each = 6)
Answer all questions (6 questions x Mark 1each = 6)
Part B - Short Essay (8 questions x Marks 2 each = 16)
Answer any 6 questions (6 questions x Marks 2 each = 12)
Part C - Essay (6 questions x Marks 3 each = 18)
Answer any 4 questions (4 questions x Marks 3 each = 12)
Part D - Long Essay (4 questions x Marks 5 each = 20)
Answer any 2 questions (2 questions x Marks 5 each = 10)

Total marks including choice - 60
Maximum marks of the course – 40

Core Course VIII
DEVELOPMENTAL BIOLOGY

SEMESTER	COURSE CODE	HOURS PER WEEK	CREDIT	EXAM HRS
V	5B08 ZCB	3	3	3

Course Outcome

CO1: Understand the major steps in embryological development
CO2: Understand the intricate mechanisms involved in the development of animals.

UNIT I
Introduction
Theories of preformation, epigenesis, germplasm& recapitulation

UNIT II
Types of eggs
Structure of a typical egg (frog), Classification of egg, the development (determinate & indeterminate) with examples. (Diagrams expected). Egg membranes (primary, secondary and tertiary).

UNIT III
Cell Differentiation and Gene action during development, Cell differentiation, Controlled gene expression during development, Homeotic genes, Mention Hoxgenes, Stem cells-significance and applications

UNIT IV
Cleavage and cell lineage
Types of cleavage with examples. Different types of blastula, Cell lineage studies in planocera.

UNIT V
Morphogenetic movements &germ layers, Epiboly and Emboly. Germ layers and its fate

UNIT VI
Development of Man
Fertilization and development. Parturition & Lactation. Extra embryonic membranes & placenta in man. Reproductive technologies-Brief account of semen collection, preservation, storage, artificial insemination, infertility management. Cryopreservation and embryo transfer-Collection and care of eggs, *in vitro* fertilization and embryo transfer, test tube babies. Assisted Reproductive Techniques (ART) IUF, ET, AI, GIFT, ZIFT, ICSI embryo or oocyte donation, surrogate mother.

UNIT VII
Experimental Embryology
Fate map (example frog), Methods of fate map Construction — Vital staining, Marking With carbon particles &radioactive tracing. Spemann's constriction experiments on amphibian

embryos (Potency of nuclei and grey crescent), Gradient experiments in sea urchin. Organizers in amphibian development

UNIT VIII

Teratology

Environmental disruption of animal development (alcohol, drugs, Nicotine and chemicals

REFERENCES

Agarwal, P., Chordate Embryology and Histology, 1e, 2001,
Krishna Prakashan Balinsky, B.I. Embryology, Saunders &Topan
Gilbert, S.C., Developmental Biology, 5e, Sinauer Associations.
Jayaprakash, M. A Manual of Developmental Biology, 2e, Academia, Trivandrum.
Verma, P.S. & Agarwal V.K.: Chordate Embryology.
Vijayakumaran Nair, K. & George P.V. A Manual of Developmental Biology, 3e, 2002.
Muller, Developmental Biology, Springer Publishers.
Scott F. Gilbert, Developmental Biology

Marks including choice

Unit	Marks
I	5
II	5
III	5
IV	5
V	5
VI	15
VII	15
VIII	5

About the Pattern of Questions:

Part A - Short answer (6 questions x Mark 1each = 6)
Answer all questions (6 questions x Mark 1each = 6)
Part B - Short Essay (8 questions x Marks 2 each = 16)
Answer any 6 questions (6 questions x Marks 2 each = 12)
Part C - Essay (6 questions x Marks 3 each = 18)
Answer any 4 questions (4 questions x Marks 3 each = 12)
Part D - Long Essay (4 questions x Marks 5 each = 20)
Answer any 2 questions (2 questions x Marks 5 each = 10)

Total marks including choice - 60
Maximum marks of the course – 40

Core Course IX
CHEMOINFORMATICS AND COMPUTATIONAL MEDICINAL CHEMISTRY

SEMESTER	COURSE CODE	HOURS PER WEEK	CREDIT	EXAM HRS
V	5B09 ZCB	4	4	3

Course outcome

CO1: Able to understand the importance cheminformatics in drug discovery process
CO2: Able to understand the applications of databases and computational biology tools in various exercises in cheminformatics
CO3: Able to understand Pharmacokinetics and Pharmacodynamics aspects in Computational medicinal chemistry
CO4: Able to implement models for drug likeliness and ADMET predictions for various small molecules.
CO5: Equipped with knowledge of various kinds of small molecules and drugs used in computational medicinal chemistry.

UNIT-01

Introduction to Chemoinformatics: Fundamental concepts - molecular descriptors and chemical spaces, chemical spaces and molecular similarity, modification and simplification of chemical spaces. Compound classification and selection. Chemoinformatics Databases-Need and scope

UNIT-02

Types of small molecules databases, Small molecules structure creation, drawing programs, optimization, Database search methods: Chemical indexing, Proximity searching, 2D and 3D Structure and Substructure searching. Similarity searching: Structural queries and Graphs, Pharmacophores, Fingerprints.

UNIT-03

Basics concepts: Introduction to Medicinal Chemistry, History of Medicinal Chemistry, Classification of drugs, Important Terminology used in Medicinal Chemistry, Pharmacokinetics: Introduction to drug absorption, disposition, drug metabolism, elimination, toxicity, important pharmacokinetic parameters in defining drug disposition and in therapeutics, mention of uses of pharmacokinetics in drug development process, concept of pro drug and soft drug.

UNIT-04

Pharmacodynamics: Introduction, principles of drug action, mechanisms of drug action, introduction to the concept of receptors and drug receptor interactions, Dose-response relationships, drug potency and efficacy, combined effect of drugs. Drug Design & Development: History and development of SAR and QSAR, Physiochemical parameters, Lipophilicity, electronic parameters, steric parameters. Classical SAR/QSAR

UNIT-05

Classification and SAR of various drugs: Antibiotics: Introduction, classification, mode of action of various antibiotics, Antimalarial agents, Antifungal agents. Natural molecules from plants, microorganisms and marine sources (brief). Application of computational biology with case studies.

UNIT-06

Computational virtual screening: Introduction. "Drug-Likeness" and compound filters. Structure-based virtual screening and prediction of ADMET Properties. Various statistical models, Combinatorial Chemistry and Library Design: Introduction. Diverse and Focused libraries. Library enumeration. Combinatorial library design strategies.

TEXT BOOKS

1. Sehgal SA, Mirza AH, Tahir RA, Mir A. Quick Guideline for Computational Drug Design. Bentham Science Publishers, 2018.
2. Leach AR, Gillet VJ. An Introduction to Chemoinformatics, Springer, 2007.
3. Young D. C. Computational Drug Design: A Guide for Computational and Medicinal Chemists, Wiley-Interscience, 2009.
4. Povl Krogsgaard-Larsen, Tommy Liljefors, Ulf Madsen. Textbook of drug design and discovery, Published by Taylor & Francis, 2002.
5. Camille. G. Wermuth. The Practice of Medicinal Chemistry, 3rd Edition, Academic Press, 2008.
6. Graham & Patrick. Introduction to Medicinal Chemistry (3rd edn.) OUP (2005)

REFERENCE BOOKS

1. Alexandros Makriyannis, Diane Biegel, Marcel Dekker. Drug Discovery Strategies and Methods, 2004.
2. Charles Owens Wilson, John H. Block, Ole Gisvold, John Marlowe Beale Lippincott. Wilson and Gisvold's Textbook of Organic Medicinal and Pharmaceutical Chemistry, Williams & Wilkins, 2010.
3. Patrick. G.L. An introduction to medicinal chemistry, 5th edition, Oxford University Press, New York.
4. Varnek A, Tropsha A. Chemoinformatics Approaches to Virtual Screening, Royal Society of Chemistry, 2008.

Marks including choice

Unit	Marks
I	10
II	10
III	10
IV	10
V	10
VI	10

About the Pattern of Questions:

Part A - Short answer (6 questions x Mark 1each = 6)
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Part B - Short Essay (8 questions x Marks 2 each = 16)
Answer any 6 questions (6 questions x Marks 2 each = 12)
Part C - Essay (6 questions x Marks 3 each = 18)
Answer any 4 questions (4 questions x Marks 3 each = 12)
Part D - Long Essay (4 questions x Marks 5 each = 20)
Answer any 2 questions (2 questions x Marks 5 each = 10)

Total marks including choice - 60
Maximum marks of the course – 40

Core Course X
COMPUTER AIDED DRUG DISCOVERY

SEMESTER	COURSE CODE	HOURS PER WEEK	CREDIT	EXAM HRS
V	5B10 ZCB	3	3	3

Course outcome

CO1: Understand the concept of molecular modelling in computational drug discovery.
CO2: Understand the concept of chemo-informatics and computational medicinal chemistry in structure-based drug discovery.
CO3: Apply the theoretical aspects and relevance of computer assisted drug discovery in pharmaceutical industry.
CO4: Inspect the utility of computational virtual screening and molecular docking studies in the success of modern drug discovery approaches.
CO5: Evaluate the scope of molecular dynamic simulation and quantitative structure activity relationship towards molecular modelling and drug discovery pipelines.

UNIT-01

Introduction to Computational drug Discovery: Drug discovery and development process, Rational approaches in drug discovery, Second generation approaches, Molecular mimicry, Chemical intuition. Industrial perspectives: New lead discovery strategies. Composition of drug discovery teams, Current Practice of CADD in the pharmaceutical industry, Management structures of CADD groups, Contributions and achievements of CADD groups, Limitations of CADD support.

UNIT-02

Introduction to molecular modeling in drug discovery. Molecular superposition and structural alignment, Energy minimization approaches. Model visualization, Pharmacophore modeling, Receptor mapping. Computational biology tools for molecular modeling and model refinement. Case studies of small molecular modeling work- Nicotinic ligands, Sigma selective ligands, Antimalarial compounds.

UNIT-03

Computer aided Virtual screening in drug discovery: Computational virtual screening-Structure based virtual screening. Drug likeliness, ADMET Studies, Computational biology tools for prediction of ADMET-Various statistical models

UNIT-04

Molecular docking in Computational drug discovery: Molecular docking: Overview and principles, Types of docking, docking process-Preparation of ligand and receptor, Search algorithms, scoring functions, binding site analysis and setting the bounding box, Running the docking calculations. Docking with known and unknown three-dimensional structures of the receptors, Major docking programs and utilities.

UNIT-05

Molecular dynamic simulations: Force field and Overview of MD simulation, Computational requirements, Process of MD simulation, validation of force field and programs - MM,

AMBER, NAMD, CHARMM, GROMOS, GROMACS. Methods of molecular energy calculations - *ab* initio, semi-empirical, density functional analysis.

UNIT-06

QSAR Modelling in Computational drug discovery: QSAR-Overview, 2D/3D/4D/5D QSAR, Deriving a QSAR equation. Simple and multiple linear regressions. Designing a QSAR experiment. Principal components regression, Partial least squares. Molecular Field Analysis (CoMFA, CoMSIA). Application of QSAR modeling in drug discovery, Case studies.

TEXT BOOKS

1. Sehgal SA, Mirza AH, Tahir RA, Mir A. Quick Guideline for Computational Drug Design. Bentham Science Publishers, 2018.
2. Leach AR, Gillet VJ. An Introduction to Chemoinformatics, Springer, 2007.
3. Cohen NC, Guidebook on molecular modeling in drug design Academic Press. Elsevier, 1996.
4. Cummings PT, Phillip R, Westmorland, Carnahan B. Foundations of Molecular Modeling and Simulation by, Published by American Institute of Chemical Engineers, 2001.

REFERENCE BOOKS

1. Cavasotto CN. In Silico Drug Discovery and Design: Theory, Methods, Challenges, and Applications. CRC Press. 2015
2. Merz KM, Ringe D, Reynolds CH. Drug Design: Structure- and Ligand-Based Approaches. Cambridge University Press. 2010
3. Patrick. G.L. An introduction to medicinal chemistry, 5th edition, Oxford University Press, New York.
4. Varnek A, Tropsha A. Chemoinformatics Approaches to Virtual Screening, Royal Society of Chemistry, 2008.

Marks including choice

Unit	Marks
I	12
II	12
III	8
IV	10
V	8
VI	10

About the Pattern of Questions:

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Answer any 6 questions (6 questions x Marks 2 each = 12)
Part C - Essay (6 questions x Marks 3 each = 18)
Answer any 4 questions (4 questions x Marks 3 each = 12)
Part D - Long Essay (4 questions x Marks 5 each = 20)
Answer any 2 questions (2 questions x Marks 5 each = 10)

Total marks including choice - 60
Maximum marks of the course – 40

Core Course XI
ZOOLOGY PRACTICAL-II

SEMESTER	COURSE CODE	HOURS PER WEEK	CREDIT	EXAM HRS
V	5B11 ZCB	5	-	

CO1. To give training in different experimental procedures and techniques in physiology and developmental biology
CO2: To give training in different genetic methods and to solve simple problems in genetics.

Experiments

1. Measurement of blood pressure using sphygmomanometer (Demo)
2. WBC differential count
3. Urine analysis for abnormal constituents (glucose, albumin)
4. Measurement of human pulse rate
5. Total RBC count using Haemocytometer (Demo)
6. Study of permanent slide of transverse section of organs: Lung, Stomach, liver, kidney, intestine
7. Study of slides/models/specimens with neat labelled sketches and notes (a) Frog – blastula C S, gastrula V S, neurula V S. (any two) (b) Chick embryo – Primitive streak, 24 hrs, (c) Mammalian foetus with placenta.
8. Simple problems based on Monohybrid cross, Dihybrid cross, Test cross
9. Study of Polytene chromosomes and lamp brush chromosomes using photographs

TEXT/ REFERENCE BOOKS

1. Ghai C.L.(2013) A Textbook of Practical Physiology
2. Verma P S and Srivastava P C (2012) Advanced Practical Zoology

Core Course XII
COMPUTATIONAL BIOLOGY PRACTICAL II

SEMESTER	COURSE CODE	HOURS PER WEEK	CREDIT	EXAM HRS
V	5B12 ZCB	5	-	

Course outcome

CO1: Apply various computational biology tools and study phylogenetics and evolutionary relationship of molecular sequences

CO2: Study the prediction of the structural aspects of proteins by various computational biology tools

CO3: Understand the folding patterns of RNA and study the disordered regions of various proteins.

CO4: Determine the three-dimensional structures of proteins from the basic amino acids by computational modelling approaches.

Experiments

1. Phylogenetic and evolutionary analysis of molecular sequences- Phylogenetic tree building and evaluation
2. Identification of functional sites in genes
3. Prediction of secondary structures of proteins and disordered regions
4. Prediction of secondary structures and folding of RNA
5. Prediction of post transnational modifications of proteins
6. Prediction of three-dimensional structure of proteins-homology modelling.

TEXT BOOKS

1. Baxevanis AD, Ouellettee BFF. Bioinformatics. A practical guide to the analysis of genes and Proteins. Third edition. John Wiley & Sons. 2006. ISBN: 978-1-118-58178-0.
2. Xinog J, Essentials of Bioinfomatics, Texas A & M University, Cambridge University press. 2006. ISBN: 9780521600828.
3. Mount DW. Bioinformatics: Sequence and genome analysis, Cold Spring Harbor.2004. ISBN-13: 978-0879697129.
4. Lesk A. Introduction to Bioinformatics, Fourth edition, Oxford Publications. 2013. ISBN: 9780199651566.

REFERENCE BOOKS

1. Campbell AM. Discovering Genomics, Proteomics, and Bioinformatics.CSHL Press, 2007. ISBN-13: 978-0805382198.
2. Cohen NC. Guidebook on Molecular Modeling in Drug Design. Academic Press, Elseiver. 1996. ISBN: 9780121782450.
3. Ghosh Z, Mallick B. Bioinformatics: Principles and Applications. Oxford University Press, 2008. ISBN: 978019569230.
4. Tramontano A. Introduction to Bioinformatics. Chapman and Hall/CRC Press, 2006. 9781584885696.

Core Course XIII
ENVIRONMENTAL SCIENCE AND BIODIVERSITY

SEMESTER	COURSE CODE	HOURS PER WEEK	CREDIT	EXAM HRS
VI	6B13 ZCB	4	4	3

CO1. Students are able to describe the relation between abiotic and biotic factors.

CO2. Able to describe various biological interactions.

CO3. Students are able to understand how change in population affect the ecosystem

UNIT I

Environment and Ecosystem

Abiotic and biotic factors-interrelationship, Ecosystem interaction. Energy flow in the ecosystem. Laws of thermo dynamics. Energy based classification of ecosystem. Ecological pyramids. Concept of limiting factors-Leibig's law of minimum, Shelford's law of tolerance, combined concept of limiting factors.

UNIT II

Biogeochemical Cycles

Basic types – Gaseous cycle- Carbon & Nitrogen cycles. Sedimentary cycle – Phosphorous cycle. Recycling pathways and recycling index.

UNIT III

Population Ecology and Population Interactions (A General account)

Properties of Population. Population growth forms (J and S curves). Emigration, immigration, migration and population fluctuation. Interspecific association – positive and negative interactions- mutualism, commensalisms, parasitism, predation, competition, proto cooperation.

UNIT IV

Habitat ecology (Brief account)

Biosphere and its divisions. Physical features, fauna and their adaptations in aquatic and terrestrial ecosystem. Very brief account on laterite hills of Kerala.

UNIT V

Magnitude, Level and Gradient of biodiversity

Introduction, Definition of biodiversity, scope, hotspots of biodiversity, Levels of biodiversity: Species diversity – brief account on economic values, scientific and educational values; spiritual and ecological values. Ecosystem diversity – definition; values of ecosystems Genetic diversity - importance of genetic diversity, mention basic methods for

molecular analysis of genetic diversity - electrophoresis, RFLP, RAPD, hotspots of biodiversity. Brief account of the biogeography of India – Western Ghats and Himalayas.

UNIT VI

Conservation of Biodiversity- (Brief over view)

Value of biodiversity- Direct use Value, Indirect use value, Aesthetic value, Ethical Value, Optional Value. Threats to Biodiversity- causes leading to loss of biodiversity, Man- wild life conflict. Conservation of biodiversity. Threatened and endemic species. Species Extinction, Characters of species susceptible to extinction, IUCN Red list Categories. In-situ Conservation- Protected Areas, National Parks, Wildlife Sanctuaries, Biosphere Reserves, Preservation Plots, Project Tiger, Project Elephant, Sacred Forests and Sacred Lakes. Ex-situ Conservation-Botanical Gardens, Zoos, Aquaria. Mention role of NBPGR, NBAGR inBiodiversity Conservation.

UNIT VII

Governance in Conserving Biodiversity (Brief account)

Introduction- International efforts for biodiversity Conservation, Biodiversity Treaty, Role of Environmental Institution in Biodiversity Conservation-NBA, SBB. Brief account on PBR, BMC and ABS, Legal Regulations-Biological Diversity Act, 2002. Environment (Protection) Act – 1986.Wildlife Protection Act (1972), The Forest (Conservation) Act–1980.

UNIT VIII

Global Environmental Issues and Disaster and Environmental Management (A General account)

Causes, effects and remedial measures of Air, water, Noise, Radioactive, solid waste and pesticide pollution. Ozone depletion, Greenhouse effect, Global warming, Acid rain, oil spills, Impact of sand mining, wetland reclamation, rain water harvesting. Brief Account on National green tribunal Act 2010.Disaster prone regions in India. Flood, Earth quakes, Cyclones and their mitigation Measures. Government efforts towards Disaster Management. EIA, EIS, Role of Remote Sensing in Environmental Monitoring

REFERENCES

1. Aravind Kumar: Text Book of Environmental Science; APH Pub Corporation (NewDelhi).
2. Chapman & Reiss: Ecology- Principles and Applications; Cambridge.
3. Chatterjee B: Environmental Laws- Implementation and Problems.
4. Misra and Pandey- Essential Environmental Studies-Ane Books India
5. Sharma PD : Environmental Biology; Rastogi Pub.
6. Varma PS & Agarwal VK: Environmental Biology; S. Chand.
7. Odum E P and Barret: Fundamentals of Ecology; Thomson.
8. Darlington PJ Jr.: Zoogeography- The Geographical Distribution of Animals

Marks including choice

Unit	Marks
I	5
II	5
III	10
IV	10
V	10
VI	5
VII	5
VIII	10

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Answer any 6 questions (6 questions x Marks 2 each = 12)
Part C - Essay (6 questions x Marks 3 each = 18)
Answer any 4 questions (4 questions x Marks 3 each = 12)
Part D - Long Essay (4 questions x Marks 5 each = 20)
Answer any 2 questions (2 questions x Marks 5 each = 10)

Total marks including choice - 60
Maximum marks of the course – 40

Core Course XIV
HEALTH AND IMMUNO-INFORMATICS

SEMESTER	COURSE CODE	HOURS PER WEEK	CREDIT	EXAM HRS
VI	6B14 ZCB	4	4	3

Course outcome

CO1: Understand the fundamental concepts of health informatics and its scope and application

CO2: Implement the modelling framework of health informatics with the aids of computational tools and databases

CO3: Analyse the scope and applications of computational biology tools and databases in health care information systems

CO4: Understand the fundamental concepts of computational immunology and its utility.

CO5: Inspect the applications of computational biology tools and techniques in studying various aspects of immunology.

CO6: Implement the computational biology tools and techniques in epitope mapping and prediction.

UNIT-1

An introduction to Health care informatics: An interaction between health care and information systems. Acquisition, storage, retrieval, and use of information in health and biomedicine. Tools and techniques. Information systems in Medicine

UNIT-2

Building blocks of Health care informatics: Standards, types of standards. Modeling – principles of modeling for healthcare. Architecture of Health care system – models, sub systems, packages and components. Modeling framework for health care. generic health care information model. Unified modeling language. Modeling methodologies in healthcare systems. Databases, types, and applications.

UNIT-3

Tools and techniques in Health Informatics: Introduction, conditions for telemedicine development, applications, access techniques in telecare and Internet technologies in medical systems: Requirement of Medical systems in the internet environment, internet medical architectures, and internet based telemedical services, next generation point of care information systems, internet access technologies in Telecare. Electronic Health records (EHR): characteristics of good EHR, HER Standards and Scope

UNIT-4

Basics of the Immune System: Innate & Adaptive Immunity, Cells of the Immune System, Antigens, epitope of antigen, hapten, Antibodies-Immunoglobulin Classes & Subclasses, Major Histocompatibility Complex- MHC Polymorphism, Antigen Processing & Presentation: The Cytosolic & Endocytic Pathway

UNIT-5

Basics of Immunoinformatics, Principles and its Uses; Databases, Tools and Web Resources for Immunoinformatics: The International ImMunoGeneTics information system (IMGT), AntigenDB, The Immune Epitope Database (IEDB), The Immuno Polymorphism Database (IPD).

UNIT- 6

Epitope Mapping & Prediction: B-cell epitope prediction methods, T-cell epitope prediction methods; Role of Immunogenomics & Immunoproteomics in Vaccine Development, Peptide Modelling

TEXT BOOKS

1. Naakesh A. Dewan, John Luo, Nancy M. Lorenz. Information Technology Essentials for Behavioral Health Clinicians, 2010.
2. Krzysztof Zielinski, Mariusz Duplaga. Technology Solutions for Healthcare (Hardcover), 2006.
3. Moya Conrick, Health Informatics, 2006.
4. Flower Darren R. Immunoinformatics: Predicting Immunogenicity In Silico publisher: New Jersey, Humana Press.
5. Lund Ole, Nielsen Morten, Lundegaard Claus, Kashmir Can, Brunak SÃ¸ren. Immunological Bioinformatics. Publishers: London, MIT Press

REFERENCE BOOKS

1. Foundation Novartis. Immuno-informatics: Bioinformatic Strategies for Better Understanding of Immune Function. Publisher: Chichester, John Wiley & Sons Inc
2. Ellis Ronald W. Vaccines: New Approaches to Immunological Problems. Publisher: Stoneham, Butterworth-Heinemann
3. Frank Sullivan, Jeremy Wyatt. ABC of Health Informatics, 2009
4. Moya Conrick. Health Informatics, 2006.

Marks including choice

Unit	Marks
I	8
II	12
III	10
IV	10
V	10
VI	10

About the Pattern of Questions:

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Answer any 6 questions (6 questions x Marks 2 each = 12)
Part C - Essay (6 questions x Marks 3 each = 18)
Answer any 4 questions (4 questions x Marks 3 each = 12)
Part D - Long Essay (4 questions x Marks 5 each = 20)
Answer any 2 questions (2 questions x Marks 5 each = 10)

Total marks including choice - 60
Maximum marks of the course – 40

Core Course XV
RESEARCH METHODOLOGY AND BIOETHICS

SEMESTER	COURSE CODE	HOURS PER WEEK	CREDIT	EXAM HRS
VI	6B15 ZCB	5	5	3

CO1. Apply scientific methods in day to day life

CO2. Able to design a research work on a topic

CO3. To give a basic understanding in bioethics in research

UNIT I

Definition of science as a type of knowledge and process – ancient science and origin of modern science. Principles and criteria of science – natural causality, universality, objectivity, falsifiability. Scientific attitude and scientific temper, pseudoscience, science vs. technology, Inductive and deductive approach.

UNIT II

Basic concepts of research

Meaning, Objectives, Approaches, Types of research. Research Process (different steps of deductive research – identifying problem, review of literature, hypothesis, experiment, analysis of data, discussion, publication - with examples like Karl von Frisch's work on honey bee communication.

UNIT III

Experimentation and Publication

Principles of experimentation – replication, randomization and local control. Dependent and independent variables. Pilot study. Research report writing (Structure of a scientific paper). Presentation techniques: Oral presentation, Assignment, Seminar, Debate, Workshop, Colloquium, Conference. Peer review, plagiarism.

UNIT IV

Analysis of data (biostatistics)

Biostatistics – definition, role of statistics in life sciences; Population and Sample; sampling - sample size, sampling errors and brief account of sampling methods; Presentation of data: a) Graphic representation- histogram, frequency polygon, and frequency curve; b) Diagrammatic representation - line diagram, bar diagram and pie diagram. Analysis of data (for grouped and ungrouped data): a) Measures of central tendency – mean, median and mode. b) Measures of dispersion – range, mean deviation and standard deviation. Testing of Hypothesis – Simple, composite, null and alternative hypothesis; Types of errors - critical region, significance levels, power of test; Tests of significance – ANOVA, chi-square test and

goodness of fit. Correlation and regression (brief account). Data analysis packages – SPSS, R etc (brief mentioning only). Measurement of biodiversity-diversity indices (species richness, evenness and dominance)

UNIT V

Principles of bioethics: Legality, morality and ethics, autonomy, human rights, beneficence, privacy, justice, equity etc. The expanding scope of ethics from biomedical practice to biotechnology, bioethics vs. business ethics, ethical dimensions of IPR, technology transfer and other global biotech issues.

UNIT VI

Laboratory associated infections and other hazards, assessment of biological hazards and levels of biosafety, prudent biosafety practices in the laboratory/ institution

REFERENCES

1. Bailey, N. T.J. (1994/'95). Statistical Methods in Biology,3e,CUP/LPE.
2. Gupta, S. P. (2002). Statistical Methods.31e,SultanChand&Co.
3. Holmes, D., Moody, P. and Dine, D. (2006). Research Methods for the Biosciences ,Oxford University Press.
4. Little Brown. Prasad, S. (2004/'05). Elements of Biostatistics, Rastogi Publs., Meerut.
5. Ruxton, G.D. and Colegrave, N. (2006). Experimental Design for Life Sciences, 2e, Oxford University Press.
6. Bioethics by Ben Mepham, Oxford University Press.
7. Bioethics & Biosafety by R Rallapalli & Geetha Bali, APH Publication.
8. Rastogi, V. FundamentalsofBiostatistics2ndedition–Ane's student edition. 7. Steel, R. G.D. and Torrie, J.H. Principles and Practice of Statistics with special reference to Biological Science.

Marks including choice

Unit	Marks
I	5
II	10-
III	10
IV	15
V	10
VI	10

About the Pattern of Questions:

Part A - Short answer (6 questions x Mark 1each = 6)
Answer all questions (6 questions x Mark 1each = 6)
Part B - Short Essay (8 questions x Marks 2 each = 16)
Answer any 6 questions (6 questions x Marks 2 each = 12)
Part C - Essay (6 questions x Marks 3 each = 18)
Answer any 4 questions (4 questions x Marks 3 each = 12)
Part D - Long Essay (4 questions x Marks 5 each = 20)
Answer any 2 questions (2 questions x Marks 5 each = 10)

Total marks including choice - 60
Maximum marks of the course – 40

Core Course XVI
ZOOLOGY PRACTICAL III

SEMESTER	COURSE CODE	HOURS PER WEEK	CREDIT	EXAM HRS
VI	6B16 ZCB	5	-	

CO1. To give training different experimental procedures in environmental science and basic methods in biostatistics

Experiments

1. Estimation of dissolved oxygen using Winkler's method.
2. Estimation of dissolved carbon dioxide in water
3. Measurement of salinity
4. Measurement of water pH using pH paper.
5. Turbidity using Secchi disc
6. Estimation of hardness of three different water samples.
7. Construction of food web
8. Study of ecological adaptations – any three
9. Simple problems in statistics – mean, median, mode,
10. Construction of simple and percentage Bar diagram, Pie diagram &Histogram.
11. Use of computers for diagrammatic and graphic representation of data- bar diagram (3 types), pie diagram and frequency curve.

TEXT/ REFERENCE BOOKS

1. Vikas Pali (2016) Practical Handbook of Genetics
2. Rao K.S. (2013) Practical Ecology
3. Gupta, S. P. (2002). Statistical Methods.31e, Sultan Chand & Co.

Core Course XVII
COMPUTATIONAL BIOLOGY PRACTICAL III

SEMESTER	COURSE CODE	HOURS PER WEEK	CREDIT	EXAM HRS
VI	6B17 ZCB	5	-	

Course outcome

CO1: Apply the concepts of bioinformatic tools and predict the three-dimensional structure of protein by *ab initio* and fold recognition methods.
CO2: Analyse the stereochemical quality and structural validation of hypothetical models of proteins.
CO3: Predict the drug likeliness and pharmacokinetics properties of ligand molecules for computer aided virtual screening.
CO4: Implement various computational biology tools and study the interaction of protein-protein and protein -ligand interactions by molecular docking studies.

Experiments

1. Prediction of the three-dimensional structure of the protein by *ab initio* prediction and fold recognition methods
2. Model refinement, validation and energy minimization of the hypothetical model
3. Creation of the structure of lead molecules and optimization and analysis of 3D structures of the lead molecules
4. Prediction of drug likeliness features and ADMET properties of lead molecules.
5. Prediction of the binding sites of the protein target
6. Study of protein-protein docking-rigid body docking
7. Study of receptor ligand interaction-Flexible body docking

TEXT BOOKS

1. Baxevanis AD, Ouellettee BFF. Bioinformatics. A practical guide to the analysis of genes and Proteins. Third edition. John Wiley & Sons. 2006. ISBN: 978-1-118-58178-0.
2. Xinog J, Essentials of Bioinfomatics, Texas A & M University, Cambridge University press. 2006. ISBN: 9780521600828.
3. Mount DW. Bioinformatics: Sequence and genome analysis, Cold Spring Harbor.2004. ISBN-13: 978-0879697129.
4. Lesk A. Introduction to Bioinformatics, Fourth edition, Oxford Publications. 2013. ISBN: 9780199651566.

REFERENCE BOOKS

1. Campbell AM. Discovering Genomics, Proteomics, and Bioinformatics. CSHL Press, 2007. ISBN-13: 978-0805382198.
2. Cohen NC. Guidebook on Molecular Modeling in Drug Design. Academic Press, Elseiver. 1996. ISBN: 9780121782450.
3. Ghosh Z, Mallick B. Bioinformatics: Principles and Applications. Oxford University Press, 2008. ISBN: 978019569230.
4. Tramontano A. Introduction to Bioinformatics. Chapman and Hall/CRC Press, 2006. 9781584885696.

GENERAL AWARENESS COURSES

General Awareness Course I
CELL BIOLOGY AND GENETICS

SEMESTER	COURSE CODE	HOURS PER WEEK	CREDIT	EXAM HRS
III	3A11ZCB	4	4	3

Course outcomes

CO1. Structural and functional aspects of basic unit of life i.e. cell concepts

CO2. Gather basic concepts of Cell Biology along with various cellular functions

CO3. Comprehensive and detailed understanding of the chemical basis of heredity.

UNIT I

Introduction

History and scope of cell biology, cell theory and its modern concept, Prokaryotes and eukaryotes. Protoplasm – Physical properties and functions. Plasma membrane- Structure (Fluid Mosaic model), Functions - passive transport, active transport, bulk transport-endocytosis and exocytosis. Coated vesicles-COPI, COPII and Clathrin coated vesicles Differentiation of cell surface -invaginations, microvilli, tight junctions (zonula occludens), gap junctions (nexus); cell coat.

UNIT II

Cell organelles (Structure and Functions)

Endoplasmic reticulum, Golgi bodies, Lysosomes, GERL concept, Mitochondria, Ribosomes, Peroxisomes

Nucleus and Chromosomes

Interphase nucleus: nuclear envelope, pore complex, Nucleus, Nucleoplasm, chromatin– structure and functions. Chromosomes: Physical and chemical structure, chromatin – heterochromatin and euchromatin. Barr Body, Lyon Hypothesis. Giant Chromosomes – Polytene and Lamp brush chromosomes, Endomitosis. Cytoskeleton – brief account of microtubules, microfilaments and intermediate filaments.

UNIT III

Cell Division, Cell cycle, mitosis and meiosis

UNIT IV

Genetics-Introduction

Brief account of Mendelian principles of inheritance. Short account of alleles (wild and mutant), homozygous and heterozygous condition of alleles. Mono, di and trihybrid crosses,

back cross and testcross. Interaction of genes- Epistasis, Polygenic inheritance – Human skin colour

UNIT V

Multiple allelism, Linkage and Crossing Over

Genetics of A B O blood groups and Rh factor in man. Mention other groups such as M, N, MN and Bombay group. Chromosomal theory of inheritance. Linkage groups. Complete and incomplete linkage. Disruption of linkage through crossing over and recombination. Factors affecting crossing over. Significance of crossing over. Construction of linkage maps.

UNIT VI

Mutation

Mutation theory of De Vries; types of mutations; molecular basis of gene mutations. Mutagens, natural and induced mutations. Significance of mutations. Chromosomal aberrations – structural and numerical.

Unit VII

Human genetics and Genetic Services (Brief over view)

Eugenics, euphenics and euthenics. Pharmacogenetics. Identification of Human Chromosomes: - Characterisation of Chromosomes using various banding techniques, Pedigree Construction – symbols used in pedigree construction. Genetic Counselling.

REFERENCES

1. Karp, G. (2010). Cell and Molecular Biology: Concepts and Experiments VI edition. John Wiley and Sons.Inc.
2. Koshy Thomas& Joe Prasad Mathew (Editors)(2011)Cell Biology and Molecular Biology.
3. Rastogi S. C. (1998) Cell Biology. Tata Mc. Graw Hill Publishing Co., New Delhi.
4. Ali, S (2014) The Cell: Organization Function and Regulatory Mechanisms, Pearson
5. De Robertis, E.D.P. and De Robertis, E.M.F. (2006). Cell and Molecular Biology. VIII Edition. Lippincott Williams and Wilkins, Philadelphia
6. Lewin, B. Genes IX edition. OUP.
7. Primrose, S. B. et al.: Principles of Gene Manipulation, 6e, 2000, Black well Science.
8. Strickberger: Genetics, 4e, W.C. Brown Pub., Maxwell Macmillan.

Marks including choice:

Unit	Marks
I	13
II	15
III	5
IV	8
V	7
VI	7
VII	5

About the Pattern of Questions:

Part A - Short answer (6 questions x Mark 1each = 6)
Answer all questions (6 questions x Mark 1each = 6)
Part B - Short Essay (8 questions x Marks 2 each = 16)
Answer any 6 questions (6 questions x Marks 2 each = 12)
Part C - Essay (6 questions x Marks 3 each = 18)
Answer any 4 questions (4 questions x Marks 3 each = 12)
Part D - Long Essay (4 questions x Marks 5 each = 20)
Answer any 2 questions (2 questions x Marks 5 each = 10)

Total marks including choice - 60
Maximum marks of the course – 40

General Awareness Course II

ALGORITHMS AND STATISTICAL METHODS IN BIOINFORMATICS

SEMESTER	COURSE CODE	HOURS PER WEEK	CREDIT	EXAM HRS
III	3A12ZCB	4	4	3

Course Outcome

CO1: Able to gain fundamental knowledge about the major algorithms used in computational biology

CO2: Able to implement scripts of BioPerl and Biopython in analysis of sequence information of macromolecules

CO3: Able to implement MATLAB programming for bio-statistical applications

CO4: Able to apply R- programming concepts to extrapolating functional information of macromolecules

CO5: Able to understand the applications of biostatics in computational biology exercise

CO6: Able to understand with the bivariate distributions and analyse the statistical significance of various exercises in computational biology

UNIT-01

Major Algorithms in Computational biology: PERL Basics of Perl. Introduction to BioPerl and BioPerl Objects - Brief descriptions. (Seq, PrimarySeq, LocatableSeq, RelSegment, LiveSeq, LargeSeq, RichSeq, SeqWithQuality, SeqI), Location objects, Interface objects and Implementation objects.

UNIT-02

Major Algorithms in Computational Biology-Python: Introduction to python. Python basics – Variables, Operators, Data types and Assignments. Statements – Input/output statements, flow control. Introduction to object-oriented programming in python. BioPython in Computational biology (Brief description)

UNIT-03

Major Algorithms in Computational Biology- NCBI tool Kits Introduction to the NCBI C++ Toolkit: Introduction to C++ modules - CORELIB, ALGORITHM, CGI, CONNECT, CTOOL, DBAPI, GUI, HTML, OBJECT MANAGER, SERIAL and UTIL module.

UNIT-04

Major Algorithms in Computational Biology-Matlab: Introduction to MatLab and molecular forces; Bioinformatics ToolBox, Statistics ToolBox, Distributed computing server, Signal Processing ToolBox. The Matlab working environment. Variables, constants and reserved words. Arrays and matrices.

UNIT-05

Overview of the R language: Defining the R project, Obtaining R, Generating R codes, Scripts, Text editors for R, Graphical User Interfaces (GUIs) for R, Packages. R Objects and data structures: Variable classes, Vectors and matrices, Data frames and lists, Data sets included in R packages

UNIT-6

Scope of biostatistics: definition, data collection, presentation of data, graphs, charts (scale diagram, histogram, frequency polygon, frequency curve, logarithmic curves). Sampling & selection bias, probability sampling, random sampling, sampling designs. Descriptive statistics: Measure of central tendency (arithmetic mean, geometric mean, harmonic mean, median, quartiles, mode); Measure of dispersion (range, quartile deviation, mean deviation and standard deviation, coefficient of variation).

UNIT 7

Bi-Variate Distribution: Correlation and regression analysis (simple and linear) curve fitting (linear, non-linear and exponential). Comparison of means: Test statistics; t-test, F distribution, one way and two ay ANOVA

TEXT BOOKS

1. John Lewis, Peter Joseph DePasquale, Joseph Chase, Joe Chase. Java Foundations by Addison- Wesley, 2010.
2. D. Curtis Jamison. Perl Programming for Biologists by, Wiley-IEEE, 2003.
3. Mitchell L Model. Bioinformatics Programming Using Python by, O'Reilly Media, Inc., 2009.
4. Alain F. Zuur, Elena N. Ieno, and Erik Meesters. A Beginner's Guide to R. Use R. Springer,2009.
5. Marcello Pagano & Kimberlee Gauvreu. Principles of Biostatistics. Thompson Learning.

REFERENCE BOOKS

1. Kaladhar D S V G K. BioJava: A Programming Guide by, 2012.
2. Jason M. Kinser. Python for bioinformatics, Jones & Bartlett Learning, 2009.
3. Curtis Jamison D. Perl Programming for Biologists, John Wiley & Sons,2003
4. James Tisdall. Mastering Perl for Bioinformatics, O'Reilly Media, Inc,2003.
5. Ronadd N Forthofer and Eun Sul Lee. Introduction to Biostatistics, Academic Press.

Marks including choice:

Unit	Marks
I	8
II	8
III	8
IV	8
V	8
VI	10
VII	10

About the Pattern of Questions:

Part A - Short answer (6 questions x Mark 1each = 6)
Answer all questions (6 questions x Mark 1each = 6)
Part B - Short Essay (8 questions x Marks 2 each = 16)
Answer any 6 questions (6 questions x Marks 2 each = 12)
Part C - Essay (6 questions x Marks 3 each = 18)
Answer any 4 questions (4 questions x Marks 3 each = 12)
Part D - Long Essay (4 questions x Marks 5 each = 20)
Answer any 2 questions (2 questions x Marks 5 each = 10)

Total marks including choice - 60
Maximum marks of the course – 40

General Awareness Course III
EVOLUTION

SEMESTER	COURSE CODE	HOURS PER WEEK	CREDIT	EXAM HRS
IV	4A13ZCB	4	4	3

Course outcomes

CO1. Realise that the whole living system has a common ancestry and so all are related

CO2. Realise the fundamental characteristics of science as a human enterprise

UNIT I

Origin of life

Theories - Panspermia theory or Cosmozoic theory, Theory of spontaneous generation (Abiogenesis or Autogenesis), Special creation, Biogenesis, Endosymbiosis. Chemical evolution - Haldane and Oparin theory, Miller-Urey experiment

UNIT II

Evidences of Organic Evolution

Morphological, anatomical, physiological, biochemical, Biogeographical, embryological and palaeontological evidences. Geological time scale, Fossils, Fossilization, fossil dating, significance of fossils

UNIT III

Theories of organic evolution

Lamarck's theory and its criticism, Weisman's germplasm theory, Neolamarckism, Darwin's theory and its criticism, Contribution of Alfred Russel Wallace. Neo Darwinism, Hugo De Vries' mutation theory

UNIT IV

Nature of evolution

Adaptive radiation and Divergent evolution (Darwin's finches), Convergent evolution, Preadaptation, species concept and intraspecific categories. Isolation and isolating mechanisms. Speciation. Co evolution. kin selection. Mimicry and evolution - Batesian mimicry, Mullerian mimicry. Micro and macro evolution

UNIT V

Modern concepts of evolutionary forces

Genetic basis of evolution, genetic drift, Hardy-Weinberg equilibrium, Punctuated Equilibrium. Modern ideas on origin of life - Naked gene hypothesis RNA world theory.

Molecular evolution -Neutral theory of kimura, concept of molecular clock, mitochondrial eve hypothesis, molecular phylogeny, phylogeography, selfish genes, C value paradox.

UNIT VI

Evolution of Man and vertebrates

Organic evolution of human: different species of Primitive ape, apeman, primitive man, modern man. Socio cultural evolution, future evolution. Evolution of vertebrate groups - Fishes, amphibians, reptiles, birds and mammals (brief account)

REFEENCES

1. Andrews. M.I and Joy, K.P. 2003. Environmental biology, evolution, Ethology and Zoogegraphy. St. Mary's press and book dept. Changanassery.
2. Darwin, C.: The Origin of Species,6e.OUP.
3. Dobzhansky Th.(1964):Genetics and the Origin of Species. Columbia University Press

Marks including choice:

Unit	Marks
1	10
2	10
3	15
4	15
5	5
6	5

About the Pattern of Questions:

Part A -Short answer (6 questions x Mark 1each = 6)
Answer all questions (6 questions x Mark 1each = 6)
Part B Short Essay (8 questions x Marks 2 each = 16)
Answer any 6 questions (6 questions x Marks 2 each = 12)
Part C -Essay (6 questions x Marks 3 each = 18)
Answer any 4 questions (4 questions x Marks 3 each = 12)
Part D -Long Essay (4 questions x Marks 5 each = 20)
Answer any 2 questions (2 questions x Marks 5 each = 10)

Total marks including choice - 60
Maximum marks of the course - 40

General Awareness Course IV
GENOMICS AND PROTEOMICS

SEMESTER	COURSE CODE	HOURS PER WEEK	CREDIT	EXAM HRS
IV	4A14ZCB	4	4	3

Course Outcome

CO1.Understand the basic concepts of genomics and proteomics.

CO2.Understand the concepts of genetic mapping

CO3.Understand the methods of DNA sequencing

UNIT I

Introduction to Genomics, Proteomics and Metabolomics, - genetic mapping, linkage mapping, types of genetic mapping, application of gene mapping, genetic markers, application of genetic markers, DNA polymorphism-SNP, DNA typing.

UNIT II

Protein digestion techniques, SDS-PAGE, 2D-Electrophoresis, Isoelectric focusing (IEF), Chromatography, basic principles, normal phase and reverse phase chromatography, High Performance Liquid Chromatography- Mass Spectroscopy (HPLC-MS). MALDI TOF MS. Tools for the analysis- use and application of these techniques

UNIT III

Overview of genome, genome sequence acquisition and analysis, comparative homologies, evolutionary changes, Microarrays; sequence specific tags, sequence tagged sites, ISH, FISH. Application.

UNIT IV

DNA sequencing: Maxam and Gilbert method, Sanger method, Ladder, Fluorescent, Shotgun, Automation DNA sequencing. Implications of DNA sequencing. Basics about Next Generation Sequencing. Southern blotting, Northern blotting

UNIT V

Construction of cDNA and genomic DNA libraries; Polymerase Chain Reaction (PCR), Yeast two-hybrid system, SAGE Adaptation for Downsized Extract (SADE), ESTs.

TEXT BOOKS

1. Leibler DC. 2002. Introduction to proteomics, tools for the new biology. Humana press.
2. Hunt SP, Livesey FJ, 2000. Functional genomics, Oxford University press.
3. Cantor CR, 1999. Genomics. John Wiley, NY.

4. Westermier R, Naven T, 2002. Proteomics in practice: A laboratory manual of proteome analysis. John Wiley- VCH.

REFERENCE BOOKS

1. Introduction to Bioinformatics – Attwood & Parry-Smith, Pearson Education
2. Bioinformatics- A beginner's guide by Jean-Michel Claverie, John Wiley & Sons.
3. Structural Bioinformatics by Philip E. Bourne and Helge Weissing, Wiley
4. Bioinformatics-Methods and applications, Rastogi,S.C. Mendiratta, N. and Rastogi P, Prentice-Hall of IndiaPvt. Ltd, New Delhi
5. Essential Bioinformatics-Jin Xiong, Cambridge University Press

Marks including choice:

Unit	Marks
1	10
2	12
3	10
4	15
5	13

About the Pattern of Questions:

Part A -Short answer (6 questions x Mark 1each = 6)
Answer all questions (6 questions x Mark 1each = 6)
Part B Short Essay (8 questions x Marks 2 each = 16)
Answer any 6 questions (6 questions x Marks 2 each = 12)
Part C -Essay (6 questions x Marks 3 each = 18)
Answer any 4 questions (4 questions x Marks 3 each = 12)
Part D -Long Essay (4 questions x Marks 5 each = 20)
Answer any 2 questions (2 questions x Marks 5 each = 10)

Total marks including choice - 60
Maximum marks of the course - 40

GENERIC ELECTIVE COURSES

Generic Elective Course

FIRST AID

SEMESTER	COURSE CODE	HOURS PER WEEK	CREDIT	EXAM HRS
V	5D01ZCB	2	2	2

Course outcomes

CO 1: Acquire basic knowledge in first aid

CO 2: Develop service mentality

UNIT-1

Introduction

First aid- definition, importance, First aid kit- constituents and uses, responsibilities of a first aider.

UNIT-2

Wounds and bleeding

External bleeding-How to stop bleeding, Head injuries, eye injuries, dressings and bandages, Internal bleeding, personal hygeine while dealing with wounds, care of amputated digits.

UNIT 3

Shocks

Asphyxia and causes, Fainting, unconsciousness, low BP, diabetic coma, seizures, heart attack, drowning, treating foreign bodies, CPR.

UNIT 4

Burns & Fractures

Burns and scalds, fire burns, electric shock, sunstroke, Fractures and sprains

dislocations strains, tourniquets, splints.

UNIT 5

Animal bites and allergies Insect bites, stings, snake bites, dog bites, allergic reactions

UNIT 6

Poisoning Swallowing, inhaling, touching, injecting gases, medicines, cosmetics, detergents, pesticides, petrochemicals, heavy metals, radioactive metals.

UNIT 7

Transportation of the victim.

One -person carry, two-persons carry, three – persons carry, Drag method, stretcher.

REFERENCES

1. Varghese S and Joseph V. Nursing foundations and first aid. 2nd Ed. Frontline publ. Hyderabad.
2. Gupta LC and Gupta A. Reference manual of first aid. Jaypee brothers (P)Ltd.
3. First aid manual. St.John ambulance. 9th Ed. Publ-British red cross.

Marks including choice:

Unit	Marks
I	3
II	4
III	4
IV	5
V	5
VI	5
VII	4

About the Pattern of Questions:

Part A - Short answer (6 questions x Mark 1each = 6)
Answer all questions (6 questions x Mark 1each = 6)

Part B - Short Essay (6 questions x Mark 2 each = 12) Answer any 4 questions (4 questions x Marks 2 each = 8)

Part C - Essay (2 questions x Marks 6 each = 12)
Answer any 1 question (1 questions x Marks 6 each = 6)

Total marks including choice - 30
Maximum marks of the course – 20

Generic Elective Course
WILDLIFE CONSERVATION AND MANAGEMENT

SEMESTER	COURSE CODE	HOURS PER WEEK	CREDIT	EXAM HRS
V	5D02ZCB	2	2	2

Course outcomes

CO 1: Develop interest in conservation of nature

CO 2: Acquire knowledge in in wildlife conservation strategies

UNIT I

Introduction

Definition of wildlife. Importance of conservation

UNIT 2

Threats to Wildlife and Conservation Methods

Factors leading to endangered status. Exotic and Extinct species.

In – situ and Ex-situ conservation – Zoos – captive breeding; Modern zoo concept – safari, nocturnal zoo. Gene banks

UNIT 3

Techniques for Wildlife Study and Tribals And Wildlife

Study of animal evidence in the field (Animal signs), Marking and tagging of animals. Radio telemetry, Remote sensing, Wildlife photography

Tribal groups in Kerala. Role of tribals in Wildlife conservation - Joint Forest Management

UNIT 4

Wildlife policy and legislation

Indian Board of Wildlife; Wildlife Protection Act1972; CITES, IUCN; Red Data Book (Criteria for treating a species as endangered); Convention on Biodiversity.

UNIT 5

Conservation projects

Project Tiger, Project elephant, Gir Lion sanctuary project, Crocodile breeding project

UNIT 6

Conservation organizations and Wildlife Management

UNEP, UNDP, FAO, WWF, BNHS. Mention Chipko movement and Silent Valley movement

Conventions related to Wetland management. Ramsar sites in India, Zoo management. Safari parks. Healthcare and disease management. Zoonosis

UNIT 7

Ecotourism

Tourism and Wildlife - Importance of Tourism in Wildlife conservation

REFERENCES

1. Aron N H :Wlidlife Ecology; Freeman & Co.
2. Negi, S.S. (1993): Biodiversity and its conservation in India. Indus Publishing Co., New Delhi. Negi, S.S. Manual for Wildlife Management in India.
3. Rajesh Gopal: Fundamentals of Wildlife Management; Justice Home.

Marks including choice:

Unit	Marks
I	3
II	3
III	7
IV	4
V	4
VI	5
VII	4

About the Pattern of Questions:

Part A - Short answer (6 questions x Mark 1each = 6)
Answer all questions (6 questions x Mark 1each = 6)

Part B - Short Essay (6 questions x Mark 2 each = 12) Answer any 4 questions (4 questions x Marks 2 each = 8)

Part C - Essay (2 questions x Marks 6 each = 12)
Answer any 1 question (1 questions x Marks 6 each = 6)

Total marks including choice - 30
Maximum marks of the course – 20

Generic Elective Course
APICULTURE

SEMESTER	COURSE CODE	HOURS PER WEEK	CREDIT	EXAM HRS
V	5D03ZCB	2	2	2

CO 1: Develop self-employment capabilities.

CO 2: Acquires scientific knowledge of profitable farming.

UNIT I

Definition, Scope, Classification of bees, choice of species in Apiculture. Bee colony-Distinctive features (social organization), Development of Honey bee-egg, larva and pupa. Food of the bee- honey and pollen-royal jelly. Artificial feeding. Behaviour of bees-dances.

UNIT II

Principles of apiculture, arranging an apiary, position-space-direction, acquiring bees-care of newly captured colonies-handling the bees. Different types of Modern hives (Newton, Langstroth) – Architecture. Appliances used in Apiaries.

UNIT III

Swarming-Prevention and control. Uniting stocks. Feeding methods. Apiary management. Inter-relationships of plants and bees.

UNIT IV

Honey bee products. Honey- Collection and Extraction, Preservation and storage –nutritive and medicinal values-honey as daliy food. Bee wax- Production, method of extraction-characteristics and uses. Bee venom-method of collection and its uses.

UNIT V

Enemies of bees- and their management. Diseases of bees-Prevention and Control measures.

REFERENCES

1. Bee Keeping in India – Sardar Singh-KAR,Delhi.
2. Bee keeping in South India – Cherian M.C. & Ramachandran, Govt. Press, Chennai.
3. Handbook of bee keeping – Sharma P.L. & SinghS.,Chandigarh.
4. Apiculture – J. Johnson and Jeyachandra, Marthandam, Tamil Nadu.

Marks including choice:

Unit	Marks
I	6
II	6
III	6
IV	8
V	4

About the Pattern of Questions:

Part A - Short answer (6 questions x Mark 1each = 6)
Answer all questions (6 questions x Mark 1each = 6)

Part B - Short Essay (6 questions x Mark 2 each = 12) Answer any 4 questions (4 questions x Marks 2 each = 8)

Part C - Essay (2 questions x Marks 6 each = 12)
Answer any 1 question (1 questions x Marks 6 each = 6)

Total marks including choice - 30
Maximum marks of the course – 20

Generic Elective Course
INTRODUCTION TO ARTIFICIAL INTELLIGENCE

SEMESTER	COURSE CODE	HOURS PER WEEK	CREDIT	EXAM HRS
V	5D04ZCB	2	2	

Corse outcome

CO1: The understand the fundamental of artificial intelligence
CO2: Analyse the current techniques and algorithms used in artificial intelligence
CO3: Understand the concepts of probability in artificial intelligence
CO4: Implement the applications of Artificial intelligence in computational biology

UNIT 01
Introduction to Artificial Intelligence: Introduction to Artificial Intelligence, Problems, Approaches and tools for Artificial Intelligence.

UNIT 02
Introduction to search, Search algorithms, Heuristic search methods, Optimal search strategies.

UNIT03
Current Techniques of Artificial Intelligence: Probabilistic approaches

UNIT 04
Introduction to probability, Bayes' theorem, Bayesian networks and Markov networks.

UNIT 05
Applications of Artificial intelligence, Examples and case studies (brief description)

TEXT/REFERENCE BOOKS

1. Artificial Intelligence Methods and Tools for Systems Biology by Werner Dubitzky, Francisco Azuaje, Published by Springer, 2005.
2. Intelligent Bioinformatics: The Application of Artificial Intelligence Techniques to
3. Bioinformatics Problems by Edward Keedwell, Ajit Narayanan, published by John Wiley and Sons, 2005.
4. Computational Intelligence in Bioinformatics by Arpad Kelemen, Ajith Abraham, Yuehui Chen, SpringerLink (Online service) Published by Springer, 2008.
5. Computational Intelligence in Biomedicine and Bioinformatics: Current Trends and
6. Applications by Tomasz G. Smolinski, Mariofanna G. Milanova, Aboul Ella Hassanien Published by Springer, 2008.

Marks including choice:

Unit	Marks
I	7
II	6
III	7
IV	6
V	4

About the Pattern of Questions:

Part A - Short answer (6 questions x Mark 1each = 6)
Answer all questions (6 questions x Mark 1each = 6)

Part B - Short Essay (6 questions x Mark 2 each = 12) Answer any 4 questions (4 questions x Marks 2 each = 8)

Part C - Essay (2 questions x Marks 6 each = 12)
Answer any 1 question (1 questions x Marks 6 each = 6)

Total marks including choice - 30
Maximum marks of the course – 20

Generic Elective Course
INTRODUCTION TO BIG DATA ANALYSIS

SEMESTER	COURSE CODE	HOURS PER WEEK	CREDIT	EXAM HRS
V	5D05ZCB	2	2	

Corse outcome

CO1: The understand the fundamentals of Big data analysis
CO2: Analyse the current technologies used in Big data analysis
CO3: Understand the concepts of Cloud computing
CO4: Understand the Hadoop ecosystems in big data analysis

UNIT 01
Overview of Big Data: history of big data, its elements, career related knowledge, advantages, disadvantages

UNIT02
Technologies for Handling Big Data: Introduction to Hadoop, functioning of Hadoop

UNIT03
Cloud computing-features, advantages, applications

UNIT04
Hadoop Ecosystem: HDFS, MapReduce, YARN, HBase, Hive, Pig, Sqoop, Zookeeper, Flume, Oozie

TEXT BOOKS

1. Thomas Erl, Wajid Khattak, Paul Buhler. Big Data Fundamentals-Concepts, Drivers & Techniques. Prentice Hall. 2016
2. Rupam Kumar Sharma, Gypsy Nandi ·Data Science Fundamentals and Practical Approaches Understand Why Data Science Is the Next. BPB PUBN

Marks including choice:

Unit	Marks
I	10
II	5
III	5
IV	10

About the Pattern of Questions:

Part A - Short answer (6 questions x Mark 1each = 6)

	Answer all questions (6 questions x Mark 1each = 6)
Part B -	Short Essay (6 questions x Mark 2 each = 12) Answer any 4 questions (4 questions x Marks 2 each = 8)
Part C -	Essay (2 questions x Marks 6 each = 12) Answer any 1 question (1 questions x Marks 6 each = 6)

Total marks including choice - 30
Maximum marks of the course – 20

MODEL QUESTION PAPER

I Semester B.Sc. Degree CBCSS (OBE)

CORE COURSE IN B.Sc. LIFE SCIENCES (ZOOLOGY) & COMPUTATIONAL BIOLOGY

1B01 ZCB: BIOCHEMISTRY AND BIOPHYSICS

Time: 3Hours **Max. Marks: 40**

PART- A

Write about each of the following in **2 or 3** sentences. Each question carries **1** mark**. (6x1=6)**

1. Buffer
2. Colorimeter
3. Lecithin
4. TLC
5. Zwitter ion
6. BMR

PART- B

Explain about any **six** of the following. Each question carries **2** marks. **(6x2=12)**

7. Isozymes
8. Homopolysaccharides
9. Induced fit hypothesis
10. Essential and nonessential amino acids
11. Glycogenolysis
12. Prostaglandins
13. Gluconeogenesis
14. Autoradiography

PART- C

Write short essay on any **four** of the following. Each question carries **3** marks. **(4x3=12)**

15. Primary, secondary and tertiary structure of proteins.

16. Principle and applications of PAGE

17. Explain glycolysis.

18. Describe the IUB classification of enzymes.

19. Give an account of factors influencing the velocity of enzyme action.

20. Explain oxidation of glycerol.

PART- D

Write essay on any **two** of the following. Each question carries **5** marks. **(2x5=10)**

21. Explain Krebs cycle.

22. Write down the principle and applications of different types of microscopy.

23. Explain the different mechanism of enzyme inhibition.

24. Give an account of biological functions of carbohydrates.

MODEL QUESTION PAPER

I Semester B.Sc. Degree CBCSS (OBE)

CORE COURSE IN B.Sc. LIFE SCIENCES (ZOOLOGY) & COMPUTATIONAL BIOLOGY

2B02 ZCB: FUNDAMENTALS OF COMPUTATIONAL BIOLOGY & BIOINFORMATICS

Time: 3Hours **Max. Marks: 40**

PART- A

Write about each of the following in **2 or 3** sentences. Each question carries **1** mark**. (6 × 1=6)**

1. Two emerging areas of Bioinformatics
2. KEGG
3. BLOSUM
4. UPGMA
5. HGP
6. Proteomics

PART- B

Explain about any **six** of the following. Each question carries **2** marks. **(6× 2=12)**

7. Scope of Computational biology
8. Structural databases
9. Smith Watermann algorithm
10. Dotplot
11. Molecular phylogenetics
12. Ultrametric trees
13. Algorithms in proteomics
14. Proteome mining

PART- C

Write short essay on any **four** of the following. Each question carries **3** marks. **(4 × 3=12)**

15. Highlight the applications and opportunities in Computational biology

16. Describe the file format of PDB

17. Analyse the applications of Entrez and SRS in computational biology

18. What do you mean dynamic programming? Discuss.

19. Discuss the practical applications of multiple sequence alignment.

20. What are the major steps involved in phylogenetic analysis? Outline briefly

PART- D

Write essay on any **two** of the following. Each question carries **5** marks. **(2 × 5=10)**

21. Elaborate in details various primary nucleotide sequence data bases along with their file formats.

22. Prioritize the utilities and applications of various similarity searching programs in computational biology.

23. Investigate the distance and character-based methods for phylogenetic data analysis.

24. What do you mean by DNA computing. Discuss the scope and applications of computing with DNA with relevant examples.