ALAGAPPA UNIVERSITY

(A State University Established in 1985)

Karaikudi - 630003. Tamil Nadu, India

2017 Accredited with A+ Grade by NAAC (CGPA : 3.64)

2018 MHRD Govt. of India & UGC Graded as Category - 1 & Granted Autonomy

2018 MHRD Swachh Campus Rank : 4

2021 nirf NATIONAL INSTITUTIONAL RANKING FRAMEWORK Rank : 33

2021 QS UNIVERSITY RANKINGS Asia Rank : 199

FACULTY OF SCIENCE

DEPARTMENT OF BIOINFORMATICS

M.Sc. BIOINFORMATICS

SYLLABUS

(For the candidates admitted from the Academic Year 2022 - 2023)

ALAGAPPA UNIVERSITY
DEPARTMENT OF BIOINFORMATICS
Science Campus, Karaikudi -630003, Tamil Nadu.

SYLLABUS - (CBCS-University Department)
[For the candidates admitted from the Academic Year 2022 – 2023 onwards]

Name of the Department : Bioinformatics

Name of the Programme : M.Sc., Bioinformatics

Duration of the Programme : Full Time (Two Years)

1. Programme Educational Objectives (PEOs)

PEO-1	To train the students in various Molecular Biology experimental methods that aids the students to perform related Structural Biology techniques (Cloning, Expression, Purification & Crystallization) to isolate the protein of interest skillfully through laboratory practical.
PEO-2	To emphasize on the flexibility of the state of the art technologies available especially in the area of Computer Aided Drug Design (CADD) and proived hands-on training in both computer and experimental lab.
PEO-3	To offer summer internship lab training, providing in-depth knowledge in interdisciplinary areas and how to use computational tools and techniques to analyze and interpret biological data, including DNA sequences and protein structures.
PEO-4	To address the challenges arising from the huge amount of genomic data and to overcome by analyzing and individualizing the corresponding drug responses towards appropriate drug specified dosages.
PEO-5	To provide a sound introduction to the discipline of database management as a subject in its own right, rather than as a compendium of techniques and product specific tools.
PEO-6	To build in candidates a strong foundation in interdisciplinary sciences for productive careers in bioinformatics, computer science, chemistry, and biophysics, integrating biology, mathematics, and data analysis to solve complex problems in life science solutions.
PEO-7	To offer a sustainable, skill-based value added course that fosters scientific thinking and enhances professional capabilities to equip students with the skills necessary for a competitive advantage in their careers, promoting a spirit of innovation and critical analysis.
PEO-8	To create user-friendly tools and databases with the help of programming languages and algorithms.
PEO-9	To establish an advanced research facility focused on bioinformatics, biotechnology, and molecular modeling to foster interdisciplinary collaboration, attract top talent, and leverage cutting-edge technologies to address complex scientific challenges.
PEO-10	To conduct journal clubs in a month/ annual national conference/ weekly career guidance(s) that would help them knowabout the recent advances in the subject and also develop their knowledge accordingly.

2. Programme Specific Objectives-(PSO)

PSO-1	To find out the methods for analyzing the expression, structure and function of DNA, RNA and proteins, and an understanding of the relationships between species.
PSO-2	To identify and define different types of biomolecules and the important structural features of biomolecules.
PSO-3	To provide basic genetic terminology at a general level and describe the organization and development of the genetic makeup on cellular, chromosomal and gene level and be able to explain the basic molecular genetics mechanisms in relation to the structure and function of the cells.
PSO-4	To introduce basic techniques and programming skills in bio statistical approach, thereby presents a suitable opportunity for the students to represent their data in various interpretations.
PSO-5	To provide advanced computational skills to analyze biological data, fostering an understanding of the intersection between biology and informatics using various computational tools and software.

3. Programme Outcome-(PO)

Knowledge:	
PO1	Comprehending the principles of Bioinformatics disciplines, along with the significance of Biological database, theories, technologies and scientific discoveries.
PO2	Working with confidence and conscience on the fundamentals of Biological problem and to study how biological data is retrieved from databases.
PO3	Enriching student's knowledge in various fields of Bioinformatics such as Molecular Cell Biology, Mathematics and Statistics for Biologists, Molecular Modeling and Drug Design, Computational Biology, Computer Science, Genetic Engineering, Structural Biology and Chemistry etc.
PO4	Understanding and appreciating the significance of Chemical informatics and Pharmacoinformatics applications in drug discovery, as well as how to deal with future difficulties and national interests.
Skills:	
PO5	Exhibiting diverse Bioinformatics talents, such as sequence alignment, structure database, and drug development, for recent health sciences challenges using new computational tools/software/database.
PO6	Acquiring the skills required for effective communication in academic and research settings.
PO7	Identifying the suitable leads against disease-causing targets gives a regimen for drug research and development.
PO8	Developing the skills in writing research articles, scientific proposal writing, giving a scientific presentation, reviewing a scientific paper, research ethics, and applying learned skills in the techniques within the chosen area of study.
Attitude:	
PO9	Identifying significant problems in society and the environment, as well as stimulating future work, by doing socially responsible research in the field ofmedicinal discovery.
PO10	Developing relationships between the community and industry in order toenhance services to the society.

4. Program Specific Outcomes (PSOs)

Knowledge:	
PSO1	The students can acquire knowledge in both theoretical and experimentaldomains for drug discovery through computational biological sciences.
Skills:	
PSO2	The student can develop various computational methods and related software to solve existing and emerging challenges, and provide lab training on how to manage acquired biological data.
PSO3	Providing skill-based projects to the student in multidisciplinary area to solve the current problem in drug discovery process.
Attitude:	
PSO4	Provide global research possibilities for advanced studies and scientific career.
PSO5	Demonstrate subject matter through technical writing and oral presentation.

M.Sc BIOINFORMATICS-PROGRAMME STRUCTURE

S.No.	Paper Code	Title of the Paper		T/P	Credit	Hrs/ Week	Marks		
							I	E	Total
SEMESTER-I									
1	502101	**Core I**	Introduction to Bioinformatics	T	5	5	25	75	100
2	502102	**Core II**	Molecular Cell Biology and Biochemistry	T	5	5	25	75	100
3	502103	**Core III**	Mathematics and Statistics for Biologists	T	5	5	25	75	100
4	502104	**Core IV**	Lab-I: DBMS and MYSQL	P	4	8	25	75	100
5	502501	**Elective I**	DSC-1 Major Elective-I	T	5	5	25	75	100
	Library					1			
	Yoga/ Journal Club/Career Guidance					1			
Total					**24**	**30**	**125**	**375**	**500**
SEMESTER-II									
6	502201	**Core V**	Phylogeny and Phylogenomics	T	4	4	25	75	100
7	502202	**Core VI**	Molecular Modeling and Drug Design	T	5	5	25	75	100
8	502203	**Core VII**	Computational Biology	T	5	5	25	75	100
9	502204	**Core VIII**	Programming in Scripting Languages (PYTHON, PERL &R)	T	5	5	25	75	100
	502205	**Core IX**	Lab-II: Molecular Biology and Biochemical Techniques	P	3	6	25	75	100
11	Non Major Elective (NME) - I			T	2	3	25	75	100
12	Self Learning Course (SLC) - I MOOC's				Extra Credit				
	Library					1			
	Yoga/ Journal Club/Career Guidance					1			
Total					**24**	**30**	**150**	**450**	**600**
SEMESTER-III									
13	502301	**Core X**	Genetics and Genetic Engineering	T	5	5	25	75	100
14	502302	**Core XI**	Structural Biology	T	5	5	25	75	100
15	502303	**Core XII**	Pharmacogenomics	T	4	5	25	75	100
16	502304	**Core XIII**	Lab-III: Computer Aided Drug Design (CADD)	P	4	5	25	75	100
17		**DSE-1**	Elective II	T	4	5	25	75	100
18	Non Major Elective (NME) - II			T	2	3	25	75	100
19	Self Learning Course (SLC) - II MOOC's				Extra Credit				
	Library					1			
	Yoga/ Journal Club/Career Guidance					1			
Total					**24**	**30**	**150**	**450**	**600**

SEMESTER-IV									
20	502401	**Core XIV**	Machine Learning and Artificial Intelligence	T	4	4	25	75	100
21	502402	**Core XV**	Systems Biology	T	4	4	25	75	100
22	502403	**Core XVI**	Lab-IV: Small and Macromolecula Crystallography	P	4	8	25	75	100
23	502999	**Core XVII**	Project Work & Viva-Voce		6	12	50	150	200
	Library					1			
	Yoga/ Journal Club/Career Guidance					1			
Total					**18**	**30**	**125**	**375**	**500**
Grand Total (Semester I + II + III + IV)					**90**	**120**	**500**	**1650**	**2200**

DSC- Department Students Choice, **EC**- Extra Credit; **I**-Internal Marks, **E**-External Marks, **Th**-Theory, **Tu**-Tutorial, **Pr**-Practical

Work Load

- **1 Credit** = 1 Theory period of one hour duration
- **1 Credit** = 1 Tutorial period of one hour duration
- **1 Credit** = 1 Practical period of two hour duration

Semester wise credit details:

I	Semester	24 Credits	Core Credits: 19; Major Elective Credits: 5
II	Semester	24 Credits + EC	Core Credits: 22; Non-Major Elective Credits: 2; Self Learning course credits – EC
III	Semester	24 credits+ EC	Core Credits: 18; Major Elective Credits: 4; Non-Major Elective: 2; Self Learning course credits – EC
IV	Semester	18 credits	Core Credits: 12; Project Work& Viva-Voce: 6
Total credits		**90+ EC**	**Core Credits: 71; Major Elective Credits: 9; Non-MajorElective Credits: 4; Project Work & Viva-Voce: 6 + Self Learning course credits - extra credits**

Major Electivefor the Department of Bioinformatics		
S. No	**Subject Code**	**Subject Name**
1.	502501	General Chemistry
2.	502502	Fundamentals of Computing
3.	502503	IPR, Bio-safety and Bioethics
4.	502504	Biosensor
5.	502505	Molecular Interactions
6.	502506	Introduction to Neural Networks
7.	502507	Data Warehousing and Data Mining
8.	502508	Programming in C and C++
9.	502509	Cell communication and Cell signaling
10.	502510	Big data analysis and Next Generation Sequencing
11.	502511	General Microbiology
12.	502512	Open Source in Bioinformatics
13.	502513	Biodiversity, Agriculture, Ecosystem, Environment and Medicine
14.	502514	Nanotechnology and Advanced Drug Delivery System
15.	502515	Immunology and Immunotechnology

Non Major Electives for the other Departments

S. No	Subject Code	Subject Name
1.	502101	Introduction to Bioinformatics
2.	502202	Molecular Modeling and Drug Design
3.	502203	Computational Biology
4.	502204	Programming in Scripting Languages (PYTHON, PERL& R)
5.	502302	Structural Biology
6.	502303	Pharmacogenomics

Required Facilities For The Programme

I. Wet Lab Facility:

Basic minor instruments

Thermocycler

-86°C Ultra Freezer

-20°C Deep Freezer

Walk-in cold room storage

Ultra Water Purification

Stackable Orbital Shaking Incubator

Ultra centrifuge

Ice flaks maker

Ultra sonicator

Refrigerated centrifuges

Next Generation Sequencer

FPLC - Protein Purification system

Multi Plate Reader

Nano Spectrophotometer

Kinetic Biospectrometer

Upright Polaroid Microscope

Small Angle X-ray Scattering

2-D Electrophoresis

Biacore

Isothermal Titration Calorimetry

Nano LC - MS/MS

Small and Macromolecule X-ray Diffractometer

II. Computational Lab:

IBM Super computer

High Performance Cluster Computers

High Performance Workstations -50

Desktop Computers – 50

UPS power backup

III. Softwares

Schrodinger Software commercial package

Gromacs

Amber

Gaussian

Cambridge Structural Database

SPSS Statistical Software

SEMESTER-I
Course Depiction
Introduction to Bioinformatics

Program: M.Sc.,	Semester : I (2022 Onwards)
Course Title**:** Introduction to Bioinformatics Subject Code: 502101	Class Time: As per the time table
Name of Course Teachers	Dr. Sanjeev Kumar Singh Dr. P. Boomi
Mobile: +91 - 9894429800 +91 - 9486031423	E-mail: sksingh@alagappauniversity.ac.in boomip@alagappauniversity.ac.in

Course Brief:

The course depicts the fundamental concepts and methods in Bioinformatics, a field at the junction of Biology and Computing. Data intensive, large-scale biological problems are addressed from a computational point of view. The most common problems are modeling biological processes at the molecular level and making inferences from collected data. The course covers the principles and methods used to search and compare DNA, RNA and proteins, cast as biological "sequences". The course explains why they can give us answers to fundamental biological questions important to fields such as Cell Biology, Biochemistry and Medical science. The important public data banks that provide details of biological systems and components will be discussed. It reviews a wide range of topics including open resources in bioinformatics, computational sequence analysis, sequence homology searching, gene finding and genome annotation, protein structure analysis and prediction, genomics, proteomics, phylogenetic analysis, biological databases, cheminformatics and medical informatics. Protein structures are three-dimensional data and the associated problems are structure prediction (secondary and tertiary), analysis of protein structures for clues regarding function, and structural alignment. It serves a gateway course for all science students.

Teaching Methods: The mode of teaching is based on the following learning activities:

- Lectures covering the theoretical part will be delivered using PowerPoint presentations.
- A set of laboratory exercises to analyze biological problems using softwares andtools to develop student's interests in scientific discovery.
- Case studies in informatics-based research.

Attendance: The students are expected to attend the classes regularly, since regular attendance is essential to gain academic achievement. As per the University norms, the students having a minimum scale of 70-75% attendance are only qualified to write their end-semester examinations.

Punctuality: Punctuality is the most important quality for the student to be followed and maintained to achieve success. Students who arrive late by 10 mins to the class without any vital reason will be marked absent in the attendance register. On the other hand, valid excuse including personal or medical emergency is acceptable, with prior consent by the Head of the Department.

Class Participation: A student's overall growth and personality development is based on his/her involvement in the class not just by mere presence but rather being interactive through questioning that will lead to propagation of ideas, initiation of thought-provoking practice and much more that will provide a wholesome enriched classroom experience. When students participate, they learn from one another and gain their knowledge better.

Submission of Assignment: Assignments are given to students in order to apply the concepts for deeper understanding of the subject. Therefore, each student will be allocated two assignments for the course, covering the entire topic. Students will be given deadline to submit the assignment by the course instructor and good preparation of assignment will help the students for their final exams.

Presentation of Seminar: Apart from the assignments, students are supposed to give an oral presentation during the class seminar hours in their assigned topic. The concerned instructor will encourage the participants to ask valid questions during seminar presentation in order to put up their confidence levels and communication skills. In addition, students will be able to gain information and can be updated in their course.

Preparedness: At the end of every class, the concerned instructor conveys the students about the details that will be handled in the next class to increase the student's awareness related to the topics.

Academic Dishonesty: Academic dishonesty is a completely unacceptable mode of conduct and every student should be aware of this important aspect. Thus, the respective faculty members educate the students of possible means of academic malpractices (plagiarism, violation of copyrights and stealing the patented knowledge) and the following consequences that will make them more vigilant in their academic career.

Subject to change clause: Depending upon the requirement of student's possibility, the course syllabus will be re-structured and updated accordingly at the discretion of the Professor(s) and Board of studies chairperson.

Important dates: Scheduled dates for the various activities related to the course

CIA Test I	CIA Test II	Assignment	Seminar
As per Academic Calendar		After CIA Test I	

Course Outline: Core: Introduction to Bioinformatics

- An overview of bioinformatics-concepts and basic terminology used in bioinformatics-scope of bioinformatics in biological system- basic introduction to bioinformatics computing and includes background information on computers in general, the fundamentals of the UNIX/Linux operating system-various open resources essential for bioinformatics.
- Bioinformatics Sequence analysis - biological basics needed in bioinformatics, Sequence alignment-Global and Local- Pairwise Alignment, Multiple Alignment-ClustalW.
- Phylogenetics-Phylip package-Various tools used for sequence analysis-BLAST-types-Algorithms used in sequence alignments-Hidden Markov Model for gene detection- Needleman–Wunsch algorithm- Smith–Waterman algorithm-Dynamic Programming-Dot matrix analysis-Parsimony.
- Databases-Concepts and introduction of different data types-Various protein databases-Protein Data Bank-MMDB-Swiss-Prot, Protein information resources-

primary and secondary nucleotide databases-importance of SCOP, PROSITE,CATH.

- Carbohydrate databases-Drug-drug interaction studies-synergism and antagonism-Entrez as information retrieval system.
- Cheminformatics-tools- chemical database-PUBCHEM, SMILES, ACD, Chembank; Structural visualization tool.
- Pharmacy informatics- medication-related data and knowledge within the continuum of healthcare systems - including its acquisition, storage, analysis, use and dissemination - in the delivery of optimal medication-related patient care

  and health outcomes-Medical coding-Application of pharmacoinformatics-ethicalissues in medical informatics.

More books for Reading and Referencing

Introduction To Bioinformatics- **Attwood** Publisher: Pearson Education Singapore Pte Ltd, 2007. (**ISBN: 978-81-775-8641-1**)
Bioinformatics Basics: Applications in Biological Science and Medicine- **Hooman Rashidi, Lukas K. Buehler** Publisher: CRC Press/Taylor & Francis Group, 2005. (**ISBN: 978-08-493-2375-1**)
Bioinformatics in the Post-Genomic Era: Genome, Transcriptome, Proteome, and Information-Based Medicine- **Jeffrey Augen** Publisher: Addison-Wesley, 2004. **(ISBN: 978-03-211-7386-7)**
Introduction to Bioinformatics: A Theoretical and Practical Approach- **Stephen A.Krawetz, David D. Womble** Publisher: Humana Press, 2003. **(ISBN: 978-15-882-9241-4)**
Fundamental Concepts of Bioinformatics- **Dan E. Krane, Michael L. Raymer** Publisher: Benjamin/Cummings, 2002. **(ISBN: 978-08-053-4633-6)**
Bioinformatics: Sequence, Structure and DatabanksA Practical Approach- **Des Higgins,Willie Taylor** Publisher: Oxford University Press, 2000. **(ISBN: 978-01-996-3790-4)**
Chemoinformatics: A Textbook- **Johann Gasteiger, Thomas Engel** Publisher: Wiley publication, 2004. **(ISBN: 978-35-273-0681-7)**
Pharmacy Informatics- **Philip O. Anderson, Susan M. McGuinness, Philip E. Bourne** Publisher: CRC press, Taylor and Francis group, 2010. **(ISBN: 978-14-200-7175-7)**

I – Semester					
Core-I	**Course Code: 502101**	**Introduction to Bioinformatics**	**T**	**Credits:5**	**Hours:5**

Unit-I		
Objective -1	To understand the essential features of the interdisciplinary area of science for better understanding of biological data.	
Basics of Bioinformatics: Introduction to Bioinformatics; Computers in Biology to understand Biological System; Basic commands of Windows, Unix and Linux operating systems; Concept of open resources in Bioinformatics.		
Outcome – 1	Understand the essential feature of Computer and Biological data	**K2**
Unit-II		
Objective – 2	To provide a strong foundation to students for performing further research in bioinformatics.	
Sequence Analysis: Biological background for sequence analysis; Sequence alignment: Global, Local, Pair wise and Multiple sequence analysis; Algorithm for alignments; Database Searching; Tools for Sequence alignment.		
Outcome – 2	Categorize the sequence alignment methods.	**K4**
Unit-III		
Objective – 3	To create opportunities for students to learn algorithm, tool, anddata in the current scenario.	
Biological Databases: Database concepts; Introduction to Data types and source; Protein Sequence and Structural Databases; Nucleic acid databases; Genome databases; Specialized Databases; Carbohydrate Databases; Clinically relevant drug-drug interactions databases; Information retrieval from Biological databases: Entrez system, TCGA data bases, Bioportal		
Outcome – 3	Summarize the details about biological tools anddatabase.	**K2**
Unit-IV		
Objective – 4	To look at a biological problem from the computational aspects.	
Cheminformatics: Introduction; Cheminformatics tools; Chemical structure representation (SMILES and SMARTS); Chemical Databases: CSD, ACD, WDI, Chembank, PUBCHEM, Chemical Structure file formats; Structural Isomers; Structure visualization.		
Outcome – 4	Discuss the need for chemi-informatics in drug discovery and explain the different structural database and their advantages	**K2**
Unit-V		
Objective – 5	To find out the methods for analyzing the expression, structureand function of DNA, RNA and proteins, and to understand the relationships between organisms.	
Medical and Pharmacy Informatics: Introduction to pharmacy informatics, Medical Transcription, Role of informatics to enhance the services provided by pharmaceutical care givers. Health Information Systems Architecture, Health Data Management, Medical Coding, Telemedicine and Telehealth, Ethics in medical informatics, Pharmacy systems and automation, Informatics applications in pharmacy, survey and evaluation of on-line resources.		
Outcome – 5	Understand the significance of medical informatics and Acquire knowledge about the development andapplication of Bioinformtics.	**K6**

Suggested Readings :

Lesk, A.M. (2014) "*Introduction to Bioinformatics*"; Oxford University Press, UK, Fourth edition.

Gretchen Kenney, (2016) "*Bioinformatics: Principles and Analysis*"; Syrawood Publishing House USA.

Higgins D. and Taylor W. (2000). *Bioinformatics.* Cary: Oxford University Press, 1st edition, ISBN 13: 9780199637904.

Scott Markel (2003). "*Sequence Analysis in a Nutshell* – A Guide to Common Tools & Databases"; O′Reilly; 1 edition, ISBN-13: 978-0596004941.

Bergeron B. (2003). *Bioinformatics Computing - The Complete Practical Guide to Bioinformatics for Life Scientists*, by Prentics- Hall, Inc., New Jersey 07458, USA, 1st edition, ISBN :81-203-2258-4.

Bourne P. E. Weissig H. (2003). *Structural Bioinformatics*, published by John Wiley &Sons, Inc., Hoboken, New Jersey, 1st edition, ISBN: 0-471-20200-2.

David Mount, (2004), "*Bioinformatics: Sequence and Genome Analysis*"; Cold Spring harbor laboratory Press, US Revised Edition.

Ole Lund, Nielsen, M., Lundegaard, C. Kesmir, C. and Brnak, S. (2005) "*Immunological Bioinformatics*"; The MIT press.

Xiong J. (2006). *Essential Bioinformatics. Cambridge*: Cambridge University Press, 1st edition, ISBN-13 978-0-511-16815-4.

Jean-Michel, Cand Notredame, C. (2006) "*Bioinformatics for Dummies*"; John Wiley&Sons, Second Edition.

Kindreas D Batevanis, (2006) "*Bioinformatics: A Practical Guide to the Analysis of Geneand Protein*"; Wiley Inter Science, Singapore, 3rd Edition.

Andrew R. Leach & Valerie J. Gillet, (2007) "*An Introduction to Chemoinformatics*"; Springer, Revised Edition.

David Edward, (2007) "*Plant Bioinformatics*": Methods and Protocol, Humana Press. Rastogi S. C. Mendiratta N. and Rastogi P. (2008). *Bioinformatics Methods and Applications - Genomics, Proteomics and Drug Discovery*, published by PHI LearningPrivate Limited, New Delhi, Third edition, ISBN: 978-81-203-3595-0.

Posada D. (2009). *Bioinformatics for DNA sequence analysis.* New York: Humana Press,1st edition, ISBN-13: 978-1588299109

Gopal S. Jones R. Tymann P. and Haake A. (2010). *Bioinformatics*. Tata McGraw-Hill,1st edition, ISBN-10: 0073133647

Yang, Z. (2010). *Machine learning approaches to bioinformatics*. Singapore: WorldScientific, 1st edition, ISBN-13: 978-9814287302

Baxevanis, A.D. and Francis Ouellellette, B.F. (2011) "*Bioinformatics* –a practical guideto the analysis of Genes and Proteins"; John Wiley & Sons, UK, Third Edition.

Hossein G. Gilani, Katia G. Samper, Reza Khodaparast Haghi, (2012) "*Chemoinformatics: Advanced Control and Computational Techniques*"; Apple Academic Press, First edition.

Peerez-Saanchez, H. (2012). *Bioinformatics*, Rijeka, Croatia: InTech, 1st edition, ISBN: 980-953-307-202-4

Caroline St Clair, Jonathan E. Visick, (2013) "*Exploring Bioinformatics*"; Jones and Bartlett Publishers, Inc; 2nd Edition, ISBN-13: 978-1284034240.

Arthur Lesk, (2013) "*Introduction to Bioinformatics*"; OUP Oxford; 4 Edition, ISBN-13: 978-0199651566.

Kayvan Najarian, Siamak Najarian, Shahriar Gharibzadeh, (2017) "*Systems Biology and Bioinformatics: A Computational Approach*"; CRC Press; 1 Edition, ISBN-13: 978-1138118034.

Keith J. (2017). *Bioinformatics*. Totowa, NJ: Humana Press, a part of Springer Science Business Media, LLC, 2nd edition, ISBN 978-1-60327-429-6.

Online Resourse :-

1. https://www.google.co.in/books/edition/Introduction_to_Bioinformatics
2. https://www.google.co.in/books/edition/Chemoinformatics

K1-Remember	*K2-Understand*	*K3-Apply*	*K4-Analyze*	*K5-Evaluate*	*K6-Create*

Course desighned by : Dr. Sanjeev Kumar Singh & Dr.P. Boomi

Course Outcome VS Programme Outcomes

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S(3)	S(3)	S(3)	L(1)	M (2)	L(1)	-	L(1)	L(1)	L(1)
CO2	S(3)	S(3)	S(3)	M (2)	S(3)	M (2)	-	L(1)	L(1)	L(1)
CO3	S(3)	S(3)	S(3)	S(3)	S(3)	M (2)	M (2)	L(1)	L(1)	L(1)
CO4	S(3)	S(3)	S(3)	S(3)	S(3)	M (2)	S(3)	L(1)	L(1)	L(1)
CO5	S(3)	S(3)	S(3)	S(3)	S(3)	M (2)	S(3)	L(1)	M (2)	M (2)
W.AV	3	3	3	2.4	2.8	1.8	1.6		1.2	1.2

S –Strong (3), M-Medium (2), L- Low (1)

Course Outcome VS Programme Specific Outcomes

CO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	S(3)	S(3)	-	S(3)	S(3)
CO2	S(3)	S(3)	-	S(3)	S(3)
CO3	S(3)	S(3)	L(1)	S(3)	S(3)
CO4	S(3)	S(3)	M(2)	S(3)	S(3)
CO5	S(3)	S(3)	M(2)	S(3)	S(3)
W.AV	3	3	1	3	3

S –Strong (3), M-Medium (2), L- Low (1)

Assignment & Seminar - Introduction to Bioinformatics

1. Basic commands of Windows, Unix and Linux operating systems
2. To learn Sequence Analysis using a known gene/protein
3. Database analysis using publicly available datasets.
4. To analyze the structure using Cheminformatics tools.
5. To practice an example of Pharmacy Informatics.
6. Explain the concept of open resources in bioinformatics.
7. Write a short note on global and local alignment.
8. Describe the salient features and importance of NCBI.
9. Give a detailed note on nucleotide sequence databases.
10. Explain the applications of Markov chains and Hidden Markov Model to gene analysis.

Molecular Cell Biology and Biochemistry

Program: M.Sc.,	Semester : I (2022 Onwards)
Course Title: Molecular Cell Biology and Biochemistry Subject Code: 502102	Class Time: As per time table
Name of Course Teacher	Dr. J. Joseph Sahayarayan
Mobile: +91 - 9884495511	Email : josephj@alagappauniversity.ac.in

Course Brief:

Biochemistry and Molecular Cell Biology have unique properties that determine how they contribute to the structure and function of cells and participate in the processes necessary to maintain life. Students will come to an understanding of the central dogma of molecular biology: DNA makes RNA, and RNA makes protein. They will learn about how we classify the different amino acids and their bonding form the building blocks of complex proteins. The study of structures and functions of biomolecules that include carbohydrates, lipids, proteins and nucleic acids, which controls and processes the metabolism at cellular levels promoted by specific catalysts, flow of genetic information and gene regulation, DNA technology, role of biomolecules in normal physiological systems with some medical applications. The course includes the molecular and cellular basic functions of life with specific foci on mechanisms that facilitate development of multicellular organisms (growth and heredity, interactions between cells, cell motility and transport and cell specialization). The part is built around human development from germ cells to an embryo and gives an introduction to the most important functions of the cell and its structures, embryology and the molecular mechanism of the developmental biology. The part includes elementary gene regulation with an emphasis on eukaryotes and molecular biological methods to study gene regulation. Usage of bioinformatics tools to study complex regulatory relationships and clinical genetics with an emphasis on human hereditary diseases. The part gives an overview of the latest methods that are used in medical research. The course is completed with an integrating project where the contents from the parts Biochemistry, Cell biology and Molecular biology and genetics are examined summationally.

Teaching Methods: The mode of teaching of delivering the courses are as follows through these below mentioned methodologies:

- Delivering the lectures in the form of presentation using advanced technologies devices such as smart board.
- Video-conferencing for lectures that will be sought from experts belonging to overseas reputed institutions
- Case-studies and Review questions

Attendance: Having good attendance record marks the student's sincerity and has an overall positive impact on his/her personality trait development. The students are asked to attend the classes on a regular note and those having a minimum scale of 70-75% attendance are eligible to take up the end-semester examinations as per the University norms.

Punctuality: It is the most important attribute to be followed and maintained by the student throughout his/her life which for sure will lead to the path of success. Students who arrive late

by 10mins after the attendance will be marked absent unless there is a valid reason (medical/ personal emergency) at the discretion of the Head of the Department.

Class Participation: A student's overall growth and personality development is based on his/her involvement in the class not just by mere presence but rather being interactive through questioning that will lead to propagation of ideas, initiation of thought-provoking process and much more that will provide a wholesome enriched classroom experience. Therefore, students are advised to be more attentive so that they learn from one another and develop quality-based knowledge.

Submission of Assignment: Assignments are given to students with just one motive to get more quantitative and qualitative knowledge insights into the assigned topic/chapter that will lead to preparation and completion of the assignment in a constructive manner here just the knowledge provided is not merely counted but also completion prior to proposed deadline will also have a check on the student's serious consideration of the assignments.

Presentation of Seminar: Apart from the assignments the concerned instructors also allocate the students with a topic or based on their interests to present seminar that will aid them built their confidence levels, command over English language to communicate with precision and fluently. In addition, the fellow students are encouraged to pose questions that will instigate interest and provide update in that particular topic besides the information presented helping them to prepare for their examinations that can be taken as added advantage for the students.

Preparedness: At the end of every class, the concerned instructor tells the students what will be taken in the next class using these details the students should be aware of the topics that will be covered in the upcoming lectures which actually enhance the student's capability to grasp the knowledge and concepts provided much efficiently.

Academic Dishonesty: This is an important aspect that every student should be aware of. Thus, the respective faculty members educate the students of possible means of academic malpractices (plagiarism, violation of copyrights and stealing the patented knowledge) and the following consequences that will make them more vigilant in their academic career.

Subject to change clause: Based on the requirement of student's feasibility and meeting the competitive demands of the discipline the syllabus courses will be re-structured and updated accordingly at the discretion of the Professor(s) and Board of studies chairman.

Important dates: Please note down the important dates and stick to the schedule:

CIA Test I	**CIA Test II**	**Assignment**	**Seminar**
As per Academic Calendar		After CIA Test-I	

Course Outline: Molecular Cell Biology and Biochemistry

The physiological activities in all the living organisms' viz. movement, growth, respiration, digestion, excretion, respiration and response to stimuli are performed by the cells. The Cell is basic unit of structure and function in living system. The structural organization and functions of the cells are uniquely maintained by four major biomolecules namely carbohydrates, lipids, proteins and nucleic acids. The course encompasses the study of cell, cell organelles and deals with detail study of definition, classification, structure and cellular functions of its biomolecules carbohydrates, lipids, proteins and nucleic acids. The overall perspective will be the biomolecules their characteristic properties and organization in carrying out all the living functions which constitute the life.

Carbohydrates:

1. Identify their chemical elements and the difference between simple sugars and complex carbohydrates.
2. On the food labels, what do sugar or sugar alcohol and fiber refer to?
3. Compare and contrast the structure and function of the following carbohydrates and where they are found: glucose, glycogen, starch, cellulose and chitin.

Proteins:

1. Identify their chemical elements and functional groups.
2. Recognize the structure of an amino acid and the peptide bond that connects di-, triand polypeptides.
3. Recognize the presence of 20 amino acids and that not all are essential amino acids.
4. Summarize the function of proteins and recognize the importance of the three dimensional shape of a protein on its function and the role of non-covalent bonds in maintaining the shape of a protein.
5. Explain protein denaturation and the effect of heat on protein structure and function.

Lipids:

1. Identify their chemical elements and learn their property of insolubility in water.
2. Identify the three groups of lipids.
3. Compare and contrast saturated, mono-unsaturated and poly-unsaturated fatty acids.
4. Explain the importance of poly-unsaturated fatty acids and why omega-3 and omega-6 fatty acids are considered essential.
5. List the sources of polyunsaturated fatty acids.

Nucleic Acids:

1. Identify their chemical elements and components of a nucleotide.
2. Describe the function of DNA.
3. Compare and contrast the 2 types of nucleic acids: DNA and RNA.

Enzymes:

1. Interpret steady-state and pre-steady state kinetic parameters of enzymatic reactions.
2. Bring together structural and kinetic information relevant to a specific reaction to propose a mechanistic model of enzyme catalysis.
3. Describe the characteristics of biological membranes and outline broad themes surrounding membrane channels and pumps.

More books for Reading and Referencing:

Biomolecules: (Introduction, Structure & Function) Carbohydrates by Suman Khowala, Deepak Verma, Samudra P. Banik (2008)
Biomedical Chemistry: Current Trends and Developments by Nuno Vale - De Gruyter Open Ltd , 2016 (ISBN: 13: 9783110468748)
RNA Interference by Ibrokhim Y. Abdurakhmonov (ed.) – InTech, 2016 (ISBN: 978-953-51-2272-2)

Semester-I					
Core-II	**Course Code 502102**	**Molecular Cell Biology and Biochemistry**	**T**	**Credits:5**	**Hours:5**

Unit – I		
Objective - 1	To describe the basic structure and function of prokaryotic andeukaryotic cells.	
Cellular Components and their functions: Basic aspects of Prokaryotic and eukaryotic cells (plant and animal cells). Dynamics of the eukaryotic cell- Molecules of life- Cellular evolution assembly of macromolecules and Origin of life- integrated structural organization of prokaryotic and eukaryotic cells- Concept of a composite cell and Molecular composition of cells. Biomembranes- Structural organization- Models of a plasma membrane, Membrane permeability- Transport across cell membranes- Transmembrane signals- Artificial membranes- liposome. Prokaryotic and Eukaryotic genome organization and structure, mechanisms of gene expression in Prokaryotes and Eukaryotes, factors involved in gene regulation.		
Outcome - 1	Understand the structure, function, and dynamics of cellular components in prokaryotic and eukaryotic cells.	**K2**

Unit – II		
Objective - 2	To discuss the cell cycle and the processes of mitosis and meiosis.	
Cell cycle and cell division: Cell cycle - Different stages of mitosis – significance of meiosis- Cohesins and condensins in chromosome segregation, Microtubules in spindle assembly, Structure of kinetoshore, centrosomes and its functions, Components in cell cycle control - Cyclin, CDKs, Check points in cell cycle, phase dependent cyclic CDK complexes Cell cycle and its regulation, events during mitosis and meiosis.		
Outcome - 2	Know the aspects of the cell cycle, cell division, and themolecular mechanisms involved in these processes.	**K2**

Unit – III		
Objective -3	To classify and describe the structure and function of biomoleculesincluding proteins, carbohydrates, lipids, nucleic acids and vitamins.	
Structure, Functions and Classifications of Biomolecules: Classification, properties, structural organization of proteins - Primary, secondary, tertiary and quaternary structures, forces stabilizing the structure. Carbohydrates: Introduction and general classification of carbohydrates. Structures, properties and biological functions of monosaccharides. Classification, structure and properties of lipids. Introduction, structure of nitrogenous bases - purines and pyrimidines, nucleosides, nucleotides, formation of phosphodiester bonds. Structure, types, properties, functions of DNA and RNA. Introduction, structures, sources, RDA, functions, deficiency diseases of fat soluble and water soluble vitamins.		
Outcome - 3	Gain knowledge of the structure, function, and classification of biomolecules, including proteins, carbohydrates, lipids, and nucleic acids.	**K4**

Unit – IV		
Objective - 4	To explain the basic concepts of genes, mutations and recombinant DNA technology.	

Concepts of Gene and Mutations: Basic concepts of replication, Regulation of translation, Post transcriptional modifications, processing of DNA, RNA and proteins methods for studying gene expression and regulatory sequences, Recombinant DNA technology, overexpression. Mechanisms of genome alterations: Recombination, mutation, inversion, duplication, transposition. Extra chromosomal inheritance: Inheritance of mitochondrial and chloroplast genes, maternal inheritance. Concepts of gene: Allele, multiple alleles, pseudo allele, complementation tests. Mendelian principles: Inheritance, sex linked inheritance, Dominance, segregation, independent assortment. Extensions of Mendelian principles: Codominance, incomplete dominance, gene interactions. Gene mapping methods: Linkage maps, tetrad analysis, mapping with molecular markers, mapping byusing somatic cell hybrids, development of mapping population in plants.

Outcome - 4	Understand the concepts of gene expression, regulation, and mutation, as well as the principles of Mendelian inheritance and gene mapping methods.	**K3**

Unit-V

Objective - 5	To describe the properties of cancer cells and the roles of oncogenes andtumor suppressor genes in carcinogenesis.

Oncogenetics: Properties of malignant cells, Types of genes - Proto oncogenes, Oncogenes, Cellular oncogenes, Tumor Suppressor genes, Chromosomal abnormalities associated with the specific malignancies- APL, CML & Retinoblastoma.

Outcome - 5	Describe about oncogenetics, the properties of malignant cells,and the genetic basis of specific malignancies.	**K4**

Suggested Readings :-

Nelson, DL., Cox, MM. (2004). Lehninger's Principle of Biochemistry. Freeman, 4th ed.

Murray, RK., Granner, DK., Mayes, PA., Rodwell, VW., (2006). Harper's Biochemistry. McGraw Hill,27th ed.

De Robertis EDD., De Robertis EMF., Cell & Molecular Biology. waverly publication.

Alberts, B., Bray, D., Lews, J., Raff, M., Roberts, K., Watson, JD. (1991). Molecular Biology of the cell.Garland publishers, Oxford 3rd edn.

Voet, D., Voet, J., (2010). Biochemistry Part III, "Biomolecules - Mechanisms of Enzyme Action andMetabolism" John Wiley & Sons, INC, 4th Edition.

Berg Jermy, M., Tymoczko John, L., Gatto Gregory, J., Stryer Lubert, JR. (2015). "Biochemisty" Macmillan Learning, Bedford Freeman & Worth Publishing Group, 8th Edition.

A.L. Lehninger. (2017). "Principles of Biochemistry"; W.H. Freeman and Company, 7th edition. Russel, PJ. (2010) "iGenetics – A Molecular Approach"; Pearson Educational Limited, 3rd Edition. Alberts, B. (2014) "The Molecular Biology of The Cell"; Garland Science Publisher, 6th Edition. Lewin, B. (2017) "Genes XII"; Jones and Bartlett Learning.

Alberts, B. Bray, D, lewis, J, Raff, M. Roberts, K, Hopkin, K, Johnson, A. (2014). "Essential CellBiology"; Garland Science Publisher, 4th Edition.

Berg Jermy, M, Tymoczko John, L, Gatto Gregory, J , Stryer Lubert, JR. (2015) "Biochemisty"; Macmillan Learning, Bedford Freeman & Worth Publishing Group, 8th Edition.

Watson, J.D, Levine, M. Losick, R. Gann, A, Bell, S P. (2013). "Molecular Biology of the Gene;Pearson Educational Limited,m", 7th Edition.

Lodish, H. (2016) "Molecular Cell Biology"; W.H Freeman Publisher, 8th Edition.

Cooper, G.M. Hausman, R.E. (2015)"The Cell: A Molecular Approach; Oxford University Press", 7th Edition.

Karp, G, Marshell ,W, Twasa, J. (2015) " Cell and Molecular Biology –Concepts and Experiments";John Wiley & Sons, New York, 8th Edition.

De Roberties, E.D.P. De Roberties, E.M.F. (2010) "Cell and Molecular Biology", Lippincott Williams& Wilkins, 8th Edition.

Online Resources:

1. https://www.google.co.in/books/edition/Biological_Macromolecules
2. https://www.sciencedirect.com/topics/neuroscience/cell-cycle

K1-Remember	*K2-Understand*	*K3-Apply*	*K4-Analyze*	*K5-Evaluate*	*K6-Create*

Course designed by:Dr. J. Joseph Sahayarayan

Course Outcome VS Programme Outcomes

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S(3)	S(3)	S(3)	M(2)	L(1)	S(3)	-	S(3)	M(2)	M(2)
CO2	S(3)	S(3)	S(3)	L(1)	L(1)	S(3)	-	S(3)	M(2)	M(2)
CO3	S(3)	S(3)	S(3)	S(3)	S(3)	S(3)	M(2)	S(3)	M(2)	S(3)
CO4	S(3)	S(3)	S(3)	M(2)	S(3)	S(3)	M(2)	S(3)	S(3)	S(3)
CO5	S(3)	S(3)	S(3)	S(3)	S(3)	S(3)	M(2)	S(3)	S(3)	S(3)
W.AV	3	3	3	2.2	2.2	3	1.2	3	2.4	2.6

S –Strong (3), M-Medium (2), L- Low (1)

Course Outcome VS Programme Specific Outcomes

CO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	M(2)	M(2)	-	M(2)	S(3)
CO2	L(1)	L(1)	L(1)	M(2)	S(3)
CO3	M(2)	L(1)	L(1)	L(1)	S(3)
CO4	M(2)	L(1)	L(1)	L(1)	S(3)
CO5	S(3)	S(3)	M(2)	M(2)	S(3)
W.AV	2	1.6	1	1.6	3

S –Strong (3), M-Medium (2), L- Low (1)

Assignment & Seminar – Biochemistry and Molecular Cell Biology

1. Composition of living matter.
2. Biomembrane organization and function.
3. Structure, diversity and function of nucleic acids.
4. Lipoprotein structure, properties and function.
5. Structure and properties of storage and membrane lipids.
6. General principles of enzyme catalysis
7. Regulatory steps in metabolic regulation.
8. Glycolytic pathway.
9. Kreb’s cycle.
10. Basic principles of Bioenergetics

Program: M.Sc.,	Semester: I (2022 Onwards)
Course Title and Code: Mathematics and Statistics for Biologists Subject Code: 502103	Class Time: As per Time Table
Name of the Course Teacher	Prof. J. Jeyakanthan Dr. M. Karthikeyan
Mobile: +91 - 97898 09245 +91 - 9486981874	Email: jjeyakanthan@alagappauniversity.ac.in karthikeyanm@alagappauniversity.ac.in

Course Brief:

Advances in mathematical methods and techniques in Bioinformatics have been growing rapidly. Mathematics has a vital role in describing the complexities of biological processes and structures. Mathematical analyses in the depiction of molecular structures of Biological systems have essential meaning for Bioinformatics, Biomathematics and Biotechnology. Mathematics is used to elucidate trends, patterns,
connections and relationships in a quantitative manner that can lead to important discoveries in biology. This syllabus is committed to bring a closer connection and better integration between mathematical methods and biological codes, sequences, structures, networks and systems biology. It is intended for graduate students andresearchers who want an overview of the field and information about the possibilities and challenges presented at the interface between mathematics and bioinformatics. At the end of the course, the student will gain valuable knowledge about mathematical methods and tools, phenomenological results and interdisciplinary connections in the fields of Molecular Genetics, Bioinformatics, and Informatics. Biostatistics represents an introduction and provides a series of methodologies to analyze and handle different data and types. Specific topics include tools for describing central tendency and variability in data; methods for performing inference on population means and proportions via sampling the data; statistical hypothesis testing and its application to group comparisons; issues of power and sample size in study designs; and random sample and other study types. While there are some formulae and computational elements to the course, the emphasis is on interpretation and concepts. R programming represents as a promising tool for the statistic application in biology. It helps to analyze the basic statistics such as correlation, probability distributions, co-variance, T-test and ANOVA using R-programming.

Teaching Methods: The mode of teaching of delivering the courses are as follows through these below mentioned methodologies:

- Delivering the lectures in the form of presentation using advanced technologies devices such as smart board.
- Solving complex equations using real time solving approaches that areassociated with biological problems such as probability and statistics.
- Video-conferencing for lectures that will be sought from experts belonging to overseas reputed institutions
- Case-studies and Review questions

Attendance: Having good attendance record marks the student's sincerity and has an overall positive impact on his/her personality trait development. The students are asked to attend the

classes on a regular note and those having a minimum scale of 70-75% attendance are eligible to take up the end-semester examinations as per the University norms.

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Important dates: Please note down the important dates and stick to the schedule

CIA Test I	CIA Test II	Assignment	Seminar
As per Academic Calendar		After CIA Test I	

Course Outline: Core: Mathematics and Statistics for Biologists (5 Credits)

- On completion of this course students will be able to follow the mathematical demonstrations and proofs used in Mathematics and Biostatistics, and to understand the mathematics behind statistical methods introduced at PG level.
- The intention is to allow students to concentrate on statistical concepts in subsequent courses, with an understanding of the mathematics employed.
- Content includes: exponential functions; vector algebra; calculus; integrals and differentiation; series, limits, approximations and expansions; matrices and determinants

and numerical methods.

- Set theory and Probability: Addition law of probability, Conditional probability, Central limit theorem and Bayes theorem.
- R-Programming for Biostatistics: Basic statistics in R, probability distribution, correlation, ANOVA and student's t-test.

More books for Reading and Referencing

Matrix Methods and Differential Equations - A Practical Introduction **Wynand S. Verwoerd**; 2012 **(ISBN: 978-87-403-0251-6)**
Essentials of Statistics: Exercises **David Brink**; 2010 **(ISBN: 978-87-7681-409-0)**
A First Course in Ordinary Differential Equations **Norbert Euler**; 2015 **(ISBN: 978-87-403-1045-0)**
An introduction to partial differential equations **R.S. Johnson**; 2012 **(ISBN: 978-87-7681-969-9)**
Statistical methods in the Biological and Health Sciences"; Third Edition, McGraw Hill Publishers. **Milton, J.S.** ; 1998 **(ISBN:978-00-7290-148-1)**

Semester- I					
Core-III	**Course Code: 502103**	**Mathematics and Statistics for Biologists**	**T**	**Credits: 5**	**Hours: 5**

Unit – I

Objective -1	**Formulate as well as analyze mathematical and statistical problems, precisely define the key terms, and draw clear and reasonable conclusions**

Trigonometry, Vector Analysis, Calculus and Matrices: Trigonometric Functions, Series Expansion, Inverse, General Values, Graphs, Calculus: Limits, Analysis, Definite Integrals, Vector Algebra, Vector Calculus, Basic Computations, Matrices. Measure Theory: Introductory Concepts, Borel Sets, Lebesgue Integration, Complex Variable: Complex Functions, DeMoivre's Theorem, Conformal Map, Complex Integration, Numerical Techniques: Basic Formalism, Methods for Solving Equations, Finding Eigen values & Eigenvectors, Solving ODE & PDE, Differentiation and Integration.

Outcome-1	**Remember the basics of trigonometry, vector calculus and matrices**	**K1**

Unit – II

Objective-2	**Use mathematical and statistical techniques to solve well-defined problems and present their mathematical work.**

Data Representation: Types of numerical data, Tables and Graphs. Measures of central tendency: Arithmetic Mean, Weighted arithmetic mean, Median and Mode - Geometric mean and Harmonic mean. Measures of dispersion**:** Range, Inter-quartile range, Average deviation, Standard deviation and Coefficient of variation, Lorenz curve. **Theory of Sampling:** The purpose of sampling, Principles of sampling, Methods of samplings, Techniques of non-probability sampling, Size of Sample, Sampling and Non-Sampling errors.

Outcome-2	**Understand the principles of data representation and sampling techniques**.	**K2**

Unit – III

Objective-3	**Explain the importance of mathematics and its techniques to solve real life problems and provide an alternative paradigm for the limitations of such techniques and validate the results accordingly.**

Distributions: Expected value and Variance Normal Binomial distribution, Poisson distribution, Normal distribution, Chi square test, Students't' test. Testing of hypothesis: Type I and Type II errors, power of a test, p value. **Set theory and Probability:** Roaster and Set builder form; Demorgans' Law, Limits: Constants, Types of constants, variables, function, right and left hand limits. Concept of probability, Samples pace, Independent events, mutually exclusive events, Addition law of probability, Conditional probability, Central limit theorem, Bayes theorem, Markov chains, their transition probability and stationary distributions.

Outcome-3	**Acquire the knowledge of Probability and types of distribution**	**K3**

Unit – IV

Objective-4	**Assessing the impact of chance and variability on the interpretation of research findings and subsequent recommendations for public health practice and policy.**

Correlation and Regression: Types of Correlation, Methods of studying Correlation: Scatter diagram, Karl Pearson's Coefficient of Correlation, Spearman's Rank Correlation.

Outcome-4	**Analyze the significance of correlation and regression in statistics**	**K4**

Unit – V

Objective-5	Biostatistics can be applied in major areas of drug design and discovery for example to evaluate the different hypotheses using ANOVA, t-test, correlation, and regression using R-programming for the data generated during the exercise of computational technique.

Biostatistics: Application of statistics to biology, sample size and power analysis, hypothesis testing, confidence intervals, regression, ANOVA, Computers of software package for statistical analysis including R, SAS, and PRISM packages.

Outcome- 5	**Apply and Evaluate the Biological data using techniques of biostatistics**	**K5**

Suggested Readings:

Segal,L.(1980) "Mathematical Models in Molecular and Cellular Biology";Cambridge:

Cambridge University Press.
Isaev, Berlin, A. (2004) "Introduction to mathematical methods in bioinformatics"; Springer.
Zar,J.H.(1984) "Bio Statistical Methods"; Prentice Hall International Edition,USA
Gurumani,N.,(2015)."An Introduction to Biostatistics", MJP Publisher, 2nd Edition.
NormanM.(2001) "The Art of R Programming – A Tour of Statistical Software Design", Cengage Learning.
Lander,P.(2017)"R for Everyone: Advanced Analytics and Graphics",2nd Edition, Pearson.
Raman, K.V. and PalSourav, P. (2005)" Mathematics in chemistry";Vikas publishing house Pvt.ltd., NewDelhi.
Stephenson,
F.H.(2003)"Calculationsinmolecularbiologyandbiotechnology:aguidetomathematicsinthelaboratory";Amsterdam,AcademicPress.
Stephenson,G. and Radmore, P.M. (1990)" Advanced mathematical methods for engineering & science students"
Viergever, M.A. and Todd-Pokropek, Andrew (1988) "Mathematics and computer science in medical imaging".
Arfken, G.(1970)"Mathematical Methods for Physicists";Academic Press,NY.
Roman P., Pergamon.(1975)"Some Modern Mathematics for Physicists and Other Outsiders";NewYork,Vol.2,p.660.
Balaguruswamy."NumericalMethods";Tata MegraHill.
Warren, J., Gregory, E. and Grant, R. (2004) "Statistical methods in Bioinformatics"; First edition, Springer-Verlag, Berlin.
Milton, J.S.(1992)"Statistical methods in the Biological and Health Sciences";Second Edition,McGraw Hill Publishers.
Rosner, B. (2005) "Fundamentals of Biostatistics"; Duxbury Press.

Online Resources:

1. https://link.springer.com/book/10.1007/978-981-10-8627-4
2. https://onlinelibrary.wiley.com/doi/book/10.1002/0471602396

K1-Remember	*K2-Understand*	*K3-Apply*	*K4-Analyze*	*K5-Evaluate*	*K6-Create*

Course designed by: Prof. J. Jeyakanthan & Dr. M. Karthikeyan

Course Outcome Vs Program Outcomes

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S(3)	S(3)	S(3)	S(3)	S(3)	S(3)	S(3)	S(3)	M(2)	M(2)
CO2	S(3)	S(3)	M(2)	S(3)	S(3)	M(2)	S(3)	S(3)	M(2)	S(3)
CO3	S(3)	M(2)	S(3)	S(3)	M(2)	S(3)	L(1)	L(1)	L(1)	M(2)
CO4	S(3)	M(2)	S(3)	M(2)	M(2)	S(3)	S(3)	S(3)	M(2)	S(3)
CO5	S(3)	S(3)	M(2)	L(1)	M(2)	S(3)	S(3)	S(3)	L(1)	M(2)
W. AV	3	2.6	2.6	2.4	2.4	2.8	2.6	2.6	1.6	2.4

S-Strong (3), M-Medium (2), L-Low (1)

Course Outcome Vs Program Specific outcomes

CO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	M(2)	S(3)	S(3)	M(2)	M(2)
CO2	M(2)	S(3)	M(2)	M(2)	L(1)
CO3	S(3)	M(2)	M(2)	M(2)	L(1)
CO4	M(2)	L(1)	S(3)	S(3)	L(1)
CO5	L(1)	M(2)	M(2)	S(3)	L(1)
W. AV	2	2.2	2.4	2.4	1.4

S-Strong (3), M-Medium (2), L-Low (1)

Assignment & Seminar - Mathematics and Statistics for Biologists

1. Solving Problems based on the exercises in Vector Algebra, Matrices and Determinants, Integral calculus Differential Calculus and Trigonometry.
2. Computational exercises using SAS packages and R programming.
3. To find the angle between vectors using scalar and vector products.
4. Describe the equations using vector expressions.
5. Students‘t’ test and De Morgan’s’ Law.
6. Measures of central tendency.
7. Explain the principle, purpose and method of sampling?
8. Write short note on analysis of variance (ANOVA).
9. Differentiate between Regression and Correlation with suitable examples.
10. Power analyzes for sample size determination

Lab-I Database Management System and MYSQL

Program: M.Sc., Bioinformatics	Semester : I (2022 Onwards)
Course Title: Lab-I Database Management System and MYSQL Subject Code: 502104	Class Time: As per time
Name of Course Teacher	Dr. RM. Vidhyavathi
Mobile: +91 - 9444835869	Email : vidhyamiss@gmail.com

Course Brief

The primary goal of this course is to learn principles and practices of database management and database design. Applications development using database programming techniques emphasizing database structures, modeling, and database access. It includes representing information with the relational database model, manipulating data with an interactive query language (SQL) and database programming, database development including internet applications, and database security, integrity and privacy issues.

MySQL is one of the most popular RDBMS used today and a solid understanding of SQL is critical if the students want to have a successful career in web development. In this class is intended for analysts, developers, designers, administrators, and managers new to the SQL programming language. Upon completion, students will understand SQL functions, join techniques, database objects and be able to write queries and stored procedures.

Teaching methods

The teaching includes lectures, discussions, demonstrations, concept maps and models, self-study and question times and an integrating project work. The project work is in-depth studies in groups with an emphasis on own work and literature studies. The course is completed with a written final examination.

Attendance: Having good attendance record marks the student's sincerity and has an overall positive impact on his/her personality trait development. The students are asked to attend the classes on a regular note and those having a minimum scale of 70-75% attendance are eligible to take up the end-semester examinations as per the University norms.

Punctuality: It is the most important attribute to be followed and maintained by the student throughout his/her life which for sure will lead to the path of success. Students who arrive late by 10mins after the attendance has been taken will be marked absent unless there is a valid reason (medical/ personal emergency) at the discretion of the Head of the Department.

Class Participation: A student's overall growth and personality development is based on his/her involvement in the class not just by mere presence but rather being interactive through questioning that will lead to propagation of ideas, initiation of thought-provoking process and much more that will provide a wholesome enriched classroom experience. Therefore, students are advised to be more attentive so that they learn from one another and develop quality-based knowledge.

Submission of Assignment: Assignments are given to students with just one motive to get more quantitative and qualitative knowledge insights into the assigned topic/chapter that will lead to preparation and completion of the assignment in a constructive manner here just the knowledge provided is not merely counted but also completion prior to proposed deadline will also have a check on the student's serious consideration of the assignments.

Presentation of Seminar: Apart from the assignments the concerned instructors also allocate

the students with a topic or based on their interests to present seminar that will aid them built their confidence levels, command over English language to communicate with precision and fluently. In addition, the fellow students are encouraged to pose questions that will instigate interest and provide update in that particular topic besides the information presented helping them to prepare for their examinations that can be taken as added advantage for the students.

Preparedness: At the end of every class, the concerned instructor tells the students what will be taken in the next class using these details the students should be aware of the topics that will be covered in the upcoming lectures which actually enhance the student's capability to grasp the knowledge and concepts provided much efficiently.

Academic Dishonesty: This is an important aspect that every student should be aware of. Thus, the respective faculty members educate the students of possible means of academic malpractices (plagiarism, violation of copyrights and stealing the patented knowledge) and the following consequences that will make them more vigilant in their academic career.

Subject to change clause: Based on the requirement of student's feasibility and meeting the competitive demands of the discipline the syllabus courses will be re-structured and updated accordingly at the discretion of the Professor(s) and Board of studies chairman. **Important dates:** Please note down the important dates and stick to the schedule

CIA Test I	CIA Test II	Assignment	Seminar
As per Academic Calendar		After CIA Test-I	

Course Outline: Database Management System and MYSQL

On completion of this course students will be able to acquire knowledge about

- Database Fundamentals and three levels of Database architectures.
- Install, configure, and interact with a relational database management system and MySQL.
- Utilize a database modeling technique for a single entity class.
- Implement the principles and concepts of information integrity, security and confidentiality.
- Normalization Theory: Functional dependencies, 2NF, 3NF, BCNF, 4NF, 5NF.
- Transactions, Concurrency, And Recovery: Transaction basics; Concurrency basics; Recovery basics; Shading in Mongo.
- Apply ethical computing concepts and practices to database design and implementation.
- Demonstrate the functions of MySQL. Use SQL to update an existing and create a table in the database.
- Database maintenance: Backing Up and Restoring MySQL Databases.
- Crash Recovery, MySQL Options File and Configuring and Tuning the MySQL Server.
- DBMS Data Security, Recovery, and Support and Database Administration.

More books for Reading and Referencing

Fundamentals of Database Systems: Ramez Elmasri & Shamkant B. Navathen, Pearson Education, 2016 .ISBN: 013-3970779.
High Performance MySQL: Optimization, Backups, and Replication, Baron Schwartz, Peter Zaitsev, Vadim Tkachenko, O'Reilly Media, Inc,2012. ISBN: 1449332498, 9781449332495
Concepts of Database Management System: Naik , Pearson Education India, 2013. ISBN - **10:** 9332526281, ISBN **-13:** 978-9332526280
Database Driven Web Development with Perl & MySQL, By Thomas Valentine, 2016 ISBN: 1484205154, 9781484205150.

Semester-I					
Core-IV	**Course Code: 502104**	**Lab-I –Database Management System and MYSQL**	**P**	**Credits:4**	**Hours:8**

UNIT-I		
Objective -1	To provide a sound introduction to the discipline of database management as a subject in its own right, rather than as a compendium of techniques and product-specific tools.	
Introduction to DBMS: Introduction to Databases, DBMS Definition, Characteristics of DBMS, Application and advantages of DBMS, Instances, Schemas and Database States, Three Levels of Architecture, Data Independence, DBMS languages, Data Dictionary, Database Users, Data Administrators.		
Outcome - 1	Understand the services provided by a Database Management System. Database Administrators, Database Application Developers, Database Specialists, and DBMS developers.	**K2**

UNIT-II		
Objective -2	To give a good formal foundation on the relational model of data.	
Data Models in DBMS: Entity Relationship Model, Entity Types, Entity Sets, Attributes and its types, Keys, E-R Diagram, Data Integrity RDBMS –Concept, Components and Codd's rules. **Relational Database Model:** Logical view of data, keys, integrity rules, Relational Database Design: features of good relational database design, atomic domain and Normalization (1NF, 2NF, 3NF, BCNF).		
Outcome - 2	Identify the methodology of conceptual modeling throughEntity Relationship model.	**K4**

UNIT-III		
Objective -3	To present SQL and procedural interfaces to SQL comprehensively.	
Open Source Database Software: Features of MySQL data types: Numeric, date & time, string, Table creation in MySQL: insert, delete, update, select, where clause, ordering the result, like operator Selecting Multiple tables: using join, using queries Modifying records:		
update command, replace command, delete command date & time functions in MySQL. Advanced Concepts in Database Management System- Object-based Database Systems: Object Oriented DBMS (OODBMS)-Object Relational DBMS (ORDBMS)		
Outcome - 3	Develop an understanding of the differences between OODBMS, ORDBMS and RDBMS and the practical implications of each approach	**K5**

UNIT-IV		
Objective -4	To present the concepts and techniques relating to query processing bySQL engines.	
Introduction to MySQL: Basic Linux commands, About Linux, Linux Command, Command Types, Installing MySQL: MySQL Installation, Windows Installation, Linux RPM Installation, Linux Binary Installation, Source Installation, Starting and stopping MySQL: Four different methods to start MySQL in Linux, MySQL Stopping, Basic MySQL Queries: DML Queries, DDL Queries, TCL Queries, Types of Joins, Unions, Various logs in MySQL and its uses: MySQL Logs, Error Log, Query Log, Slow Query Log, Binlog and its format, Relay Log.		
Outcome - 4	Examine the use of indexing and hashing technique used inDatabase design.	**K4**

UNIT-V		
Objective -5	Create applications using MYSQL Admin Commands	
Mysql Admin Commands: MySQL Admin Commands, Workbench MySQL, Locking in MySQL: Locking in MySQL, Internal Locking, Table level Locking, Row level Locking, External Locking, Dead Lock, MySQL client Programs, MySQL Table maintenance: Table Maintenance, Analyze Table, Backup Table, Check Table, Checksum Table, Optimize Table, Repair Table, Restore Table, Moving Tablespace, Information Schema and Performance Schema: MySQL Information schema, Tables in Information schema, MySQL Performance schema.		
Outcome - 5	Examine the use of indexing and hashing technique used in Database design	**K6**

Suggested Readings;-

Silberschatz, A., Korth, H.F. and Sudarshan, S. (2010) "Database system Concepts", McGraw Hill Publishers, Fourth Edition.

VaswaniVikram, (2017) "MySQL(TM): The Complete Reference", Tata McGraw HillPublications, First Edition

Rob, Coronel, (2014) "Database Systems", Cengage Learning, Seventh Edition. RamezElmasri, Shamkant B. Navathe, (2010), "Fundamentals of Database Systems", Pearson / Addisionwesley, Sixth Edition.

Paul DuBois, (2003)"MySQL Cookbook ", Sams Publishing, Second Edition.

Raghu Ramakrishnan & Johannes Gehrke, (2003)," Database Management System", McGraw-Hill Education, Third edition.

Date, C.J. (2000) "An introduction to Database systems", Addison Wesley Publishers, Seventh Edition.

Luke Welling, Laura Thomson, (2003)," MySql Tutorial",Sams Publishing.

Online Resources:

1.https://mrcet.com/downloads/digital_notes/ECE/III%20Year/DATABASE%20MANAGEMENT%20SYSTEMS.pdf

2. https://books.goalkicker.com/MySQLBook/

K1-Remember	*K2-Understand*	*K3-Apply*	*K4-Analyze*	*K5-Evaluate*	*K6-Create*

Course designed by: Dr.RM.Vidhyavathi

Course Outcome VS Programme Outcomes

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S(3)	-	M(2)	S(3)	-	-	L(1)	L(1)	M(2)	M(2)
CO2	S(3)	S(3)	S(3)	S(3)	S(3)	M(2)	L(1)	M(2)	M(2)	M(2)
CO3	S(3)	M(2)	M(2)	M(2)	S(3)	S(3)	M(2)	M(2)	M(2)	M(2)
CO4	S(3)	M(2)	M(2)	M(2)	S(3)	M(2)	S(3)	M(2)	M(2)	M(2)
CO5	S(3)	S(3)	S(3)	S(3)	S(3)	S(3)	S(3)	M(2)	M(2)	S(3)
W.AV	3	2	2.4	2.6	2.4	2	2	1.8	2	2.2

S –Strong (3), M-Medium (2), L- Low (1)

Course Outcome VS Programme Specific Outcomes

CO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	S(3)	-	L(1)	S(3)	S(3)
CO2	S(3)	S(3)	L(1)	-	S(3)
CO3	S(3)	S(3)	M(2)	S(3)	S(3)
CO4	S(3)	S(3)	M(2)	S(3)	S(3)
CO5	S(3)	S(3)	S(3)	S(3)	S(3)
W.Avg	3	2.4	1.8	2.4	3

S –Strong (3), M-Medium (2), L- Low (1)

Assignment & Seminar - Database Management System and MYSQL

Overview and types of DBMS, Features of DBMS, E-R Model.

1. Logical view of data, keys, 1NF, 2NF, 3NF, BCNF.
2. MySQL data types with suitable example.
3. Write the basic commands in Linux and basic MySQL Queries.
4. MySQL Four different methods to start MySQL in Linux, MySQL Stopping, MySQL and its uses.
5. Write the Procedure of Installing MySQL in Various Operating Systems.
6. Explain MySQL Logs, Error Log, Query Log, Slow Query Log, Binlog and its format, Relay Log.
7. Describe MySQL Admin Commands and Explain Deadlock.
8. MySQL Table maintenance, Information Schema and Performance Schema in MySQL.

SEMESTER-II

Phylogeny and Phylogenomics

Program: M.Sc.,	Semester: II (2022 Onwards)
Course Title: Phylogeny and Phylogenomics Subject Code: 502201	Class Time: As per Time Table
Name of the Course Teacher	Dr. M. Karthikeyan
Mobile:+91 - 9486981874	E-mail:karthikeyanm@alagappauniversity.ac.in

Course Brief:

This course is for students/researchers dealing with the analysis of multiple molecular sequences at several levels: Populations, species, clades, communities. These biologists address questions relative to the evolutionary relationships among these sequences, as well as the evolutionary forces structuring biodiversity at different scales. The course provides exceptional knowledge in Phylogenetics through computational algorithms and software skills.

Teaching Methods: The mode of teaching of delivering the courses are as follows through these below mentioned methodologies:

- Delivering the lectures in the form of presentation using advanced technologies devices such as smart board.
- Video-conferencing for lectures that will be sought from experts belonging to overseas reputed institutions
- Case-studies and Review questions

Attendance: Having good attendance record marks the student's sincerity and has an overall positive impact on his/her personality trait development. The students are asked to attend the classes on a regular note and those having a minimum scale of 70-75% attendance are eligible to take up the end-semester examinations as per the University norms.

Punctuality: It is the most important attribute to be followed and maintained by the student throughout his/her life which for sure will lead to the path of success. Students who arrive late by 10mins after the attendance has been taken will be marked absent unless there is a valid reason (medical/ personal emergency) at the discretion of the Head of the Department.

Class Participation: A student's overall growth and personality development is based on his/her involvement in the class not just by mere presence but rather being interactive through questioning that will lead to propagation of ideas, initiation of thought-provoking process and much more that will provide a wholesome enriched classroom experience. Therefore, students are advised to be more attentive so that they learn from one another and develop quality-based knowledge.

Submission of Assignment: Assignments are given to students with just one motive to get more quantitative and qualitative knowledge insights into the assigned topic/chapter that will lead to preparation and completion of the assignment in a constructive manner here just the knowledge provided is not merely counted but also completion prior to proposed deadline will also have a check on the student's serious consideration of the assignments.

Presentation of Seminar: Apart from the assignments the concerned instructors also allocate the students with a topic or based on their interests to present seminar that will aid them built

their confidence levels, command over English language to communicate with precision and fluently. In addition, the fellow students are encouraged to pose questions that will instigate interest and provide update in that particular topic besides the information presented helping them to prepare for their examinations that can be taken as added advantage for the students.

Preparedness: At the end of every class, the concerned instructor tells the students what will be taken in the next class using these details the students should be aware of the topics that will be covered in the upcoming lectures which actually enhance the student's capability to grasp the knowledge and concepts provided much efficiently.

Academic Dishonesty: This is an important aspect that every student should be aware of. Thus, the respective faculty members educate the students of possible means of academic malpractices (plagiarism, violation of copyrights and stealing the patented knowledge) and the following consequences that will make them more vigilant in their academic career.

Subject to change clause: Based on the requirement of student's feasibility and meeting the competitive demands of the discipline the syllabus courses will be re-structured and updated accordingly at the discretion of the Professor(s) and Board of studies chairman.

Important dates: Please note down the important dates and stick to the schedule

CIA Test I	II CIA Test	Assignment	Seminar
As per Academic Calendar		After CIA Test-I	

Course Outline: Core: Phylogeny and Phylogenomics

- Basic concepts in systematics, taxonomy and phylogeny.
- Species concept, kingdom to species, the five kingdoms, classical, phenetic and cladistic approaches.
- Definition and description of phylogenetic trees and various types of trees.
- Fundamental concepts of neutral evolution, molecular divergence and molecular clocks.
- Protein and nucleotide sequence analysis.
- Gene duplication and divergence. concepts and rate of change in gene frequency through natural selection, migration and random genetic drift;
- Phylogenetic analysis algorithms: Maximum Parsimony, UPGMA, maximum likelihood algorithm and Bootstrapping methods.
- Transformed Distance - Neighbors-Relation, Neighbor-Joining, jackknife method.
- Gene discovery using Fourier analysis
- Survey of software programs available for phylogenetic analysis.

More books for Reading and Referencing

Phylogenetic Analysis Of DNA Sequences, Oxford Press, New York by Michael M. Miyamoto, 1992 (**ISBN:0-19-506698**)
Practical taxonomic computing by Pankhurst, R.J, 1991 (**ISBN: 0521417600, 9780521417600**)

Semester – II					
Core-V	**Course Code 502201**	**Phylogeny and Phylogenomics**	**T**	**Credits: 4**	**Hours: 4**

Unit – I

Objective - 1	To understand concepts of molecular evolution and the nature of data forderiving molecular phylogeny

Molecular Evolution: Concepts of neutral evolution, molecular divergence and molecular clocks; Molecular tools in phylogeny, classification and identification; Protein and nucleotide sequence analysis; Origin of new genes and proteins; Gene duplication and divergence. Concepts and rate of change in gene frequency through natural selection, migration and random genetic drift; Adaptive radiation; Isolating mechanisms; Speciation; Allopatricity and Sympatricity; Convergent evolution; Sexual selection; Co-evolution.

Outcome - 1	Understand molecular evolution principles and the properties ofdata for generating molecular phylogeny	**K2**

Unit – II

Objective - 2	To gain knowledge about the algorithms used for the sequence alignment and its applications

Algorithm in Sequence Alignment: Why align sequences - similarity v/s homology - heterologs, orthologs, paralogs, xenologs - details of Needleman - Wunsch, Smith- Waterman algorithms with worked out examples - hashing methods with worked out examples – BLAST and FASTA. Basic concepts of various approaches for MSA (e.g. progressive, hierarchical etc.). Representing and scoring a multiple sequences alignment - dynamic programming for multiple sequence alignment pitfalls progressive or hierarchical alignment with worked out examples substitution matrices - evolutionary models - PAM substitution matrices - BLOSUMsubstitution matrices - gap penalties.

Outcome - 2	Expound the algorithms in sequence alignment methods	**K4**

Unit – III

Objective - 3	To understand the pattern discovery and classification methods of proteins

Pattern Discovery and Characterization in Protein and DNA Sequences: Sequence pattern representations – deterministic patterns – regular expressions – probabilistic patterns – sequence logos – general methods of pattern classification – methods for proteins – hidden Markov models and application to analyses of protein sequences – general methods of gene discovery – using HMM, Genemark – artificial neural networks – introduction and their use in gene discovery, GRAIL – Gene discovery using Fourier analysis, GeneScan

Outcome - 3	Describe the concept of pattern discovery and discuss about the protein and DNA sequence characterization	**K1**

Unit – IV

Objective - 4	To learn and apply the statistical approaches and models for phylogenetic analysis and tree reconstruction

Phylogenetic trees: Phylogenetic representations, Definition and description, various types of trees; Steps in constructing a tree, Consensus (strict, semi-strict, Adams, majority rule, Nelson). Data partitioning and combination. Tree to tree distances, similarity. **Phylogenetic analysis algorithms:** Maximum Parsimony, UPGMA, Transformed Distance, Neighbors- Relation, Neighbor-Joining, jackknife, Probabilistic models and associated algorithms such as Probabilistic models of evolution and maximum likelihood algorithm, Bootstrapping methods.Use of HMM-based Algorithm for MSA (e.g. SAM method).

Outcome - 4	Discuss the phylogenetic trees and phylogenetic analysis algorithms	**K2**

Unit – V		
Objective - 5	The main objectives of the course are to teach the theoretical bases of phylogenetic analysis, and to give the ability to initiate a phylogenetic analysis starting from the files of molecular sequences until the interpretation of the results and the graphics.	

Softwares for phylogenetic analysis: Survey of software programs available forphylogenetic analysis. Algorithm of CLUSTALW and PHYLIP, MUSCLE, MAFFT and PileUp and their application for sequence analysis (including interpretation of results), concept of dendrogram and its interpretation. Plotting, visualizing & printing phylogenetic trees: TreeView and other tools. Applications of phylogeny analyses, Comparison of Phylogenetic Trees obtained using DNA seq. vs. protein seq. vs. Full genomes. Phylogenetic analysis of ancient DNA.

Outcome - 5	Summarize the details about phylogenetic analysis software.	**K4**

Suggested Readings :

Page, R. D. M. and Holmes, E.C. (1998) "Molecular Evolution A Phylogenetic Approach"; BlackwellScientific.

Mount, D. (2004) "Bioinformatics: Sequence and Genome Analysis"; Cold SpringHarbor Laboratory Press,New York.

Baxevanis, A.D. and Francis Ouellellette, B.F., (2009). "Bioinformatics- a PracticalGuide to theAnalysis of Genes and Proteins" 3rd Edition, Wiley India.

Graur, D. and W-H Li. (2000) Fundamentals of Molecular Evolution" 2nd Edition, Sinauer Associates.

Patthy, L. (1999) "Protein Evolution"; Blackwell Scientific. Pankhurst, R.J.(1991) "Practical taxonomic computing";

Michael M. Miyamoto, (2001) Phylogenetic Analysis Of DNA Sequences, OxfordPress, New York

Philippe Lemey, Marco Salemi and Anne-Mieke Vandamme (2009) "ThePhylogenetic Handbook: A

Practical Approach to Phylogenetic Analysis and Hypothesis Testing"; 2nd Edition, Cambridge University Press.

Online Resources:

1. https://www.britannica.com/science/phylogeny
2. https://www.nature.com/scitable/topicpage/reading-a-phylogenetic-tree-the-meaning-of-41956/
3. https://evolution.berkeley.edu/evolution-101/the-history-of-life-looking-at-the-patterns/understanding-phylogenies/

K1-Remember	*K2-Understand*	*K3-Apply*	*K4-Analyze*	*K5-Evaluate*	*K6-Create*

Course designed by: Dr. M. Karthikeyan

Course Outcome VS Programme Outcomes

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S(3)	S(3)	S(3)	-	L(1)	-	-	S(3)	L(1)	L(1)
CO2	S(3)	S(3)	M(2)	S(3)	S(3)	S(3)	S(3)	S(3)	L(1)	S(3)
CO3	S(3)	S(3)	S(3)	M(2)	S(3)	S(3)	1	-	L(1)	M(2)
CO4	S(3)	S(3)	S(3)	S(3)	M(2)	S(3)	M(2)	S(3)	L(1)	S(3)
CO5	S(3)	S(3)	S(3)	S(3)	M(2)	S(3)	3	S(3)	L(1)	S(3)
W.AV	3	3	2.8	2.2	2.2	2.4	1.8	2.4	1	2.4

S-Strong (3), M-Medium (2), L-Low (1)

Course Outcome Vs Program Specificoutcomes

CO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	S(3)	M(2)	S(3)	S(3)	S(3)
CO2	M(2)	S(3)	S(3)	S(3)	S(3)
CO3	L(1)	L(1)	M(2)	S(3)	S(3)
CO4	M(2)	S(3)	S(3)	S(3)	S(3)
CO5	M(2)	S(3)	S(3)	S(3)	S(3)
W. AV	2	2.4	2.8	3	3

S-Strong (3), M-Medium (2), L-Low (1)

Assignment & Seminar: Phylogeny and Phylogenomics

Write the difference between rooted and un-rooted trees.

1. Describe the character and distance based approaches.
2. Explain the role of Clustal W for phylogenetic analysis.
3. Define PHYLIP and its application.
4. Expand (a) UPGMA (b) NJ (c) Clustal W and (d) MEGA.
5. Give short note on evolutionary trace analysis.
6. How do you generate multiple datasets from the original input using bootstrapping?
7. Explain the importance of multiple sequence alignment for tree construction.
8. Discuss on Jackknife test.
9. Softwares for phylogenetic analysis

Molecular Modeling and Drug Design

Program: M.Sc., Bioinformatics	Semester : II (2022 Onwards)
Course Title: Molecular Modeling and Drug Design Subject Code: 502202	Class Time: As per Time Table
Name of Course Teacher	Dr. Sanjeev Kumar Singh
Mobile: +91 - 9894429800	E-mail: sksingh@alagappauniversity.ac.i

Course Brief:

The course depicts the basic theory of molecular modeling and drug design. It reviews a vast range of topics including the concept of molecular modeling; Quantum and Molecular Mechanics, *Ab initio* structure modeling and active site prediction, theories and to recognize drug like properties, computer molecular dynamics simulation and changes in conformations, pharmacophore, lead identification and *de novo* ligand design methods, molecular docking, QSAR, HTVS, Lipinski's rule, ADME properties, energy concepts, Bond structure and bending angles, finding new drug targets to treat diseases; drug discovery and development. It also discusses the recent advances and limitations of molecular modelling methods. This course serves as a basic introduction of molecular modeling to the students. As it covers a vast range of topics in molecular modeling, it could provide sound basic knowledge as well.

Teaching Methods: The mode of teaching is based on the following learning activities:

- Lectures covering the theoretical part will be delivered using PowerPoint presentations.
- A set of laboratory exercises to analyze biological problems using softwares and tools to develop student's interests in scientific discovery.
- Case studies in informatics-based research.

Attendance: The students are expected to attend the classes regularly, since regular attendance is essential to gain academic achievement. As per the University norms, the students having a minimum scale of 70-75% attendance are only qualified to write their end-semester examinations.

Punctuality: Punctuality is the most important quality for the student to be followed and maintained to achieve success. Students who arrive late by 10 mins to the class without any vital reason will be marked absent in the attendance register. On the other hand, valid excuse including personal or medical emergency is acceptable, with prior consent by the Head of the Department.

Class Participation: A student's overall growth and personality development is based on his/her involvement in the class not just by mere presence but rather being interactive through questioning that will lead to propagation of ideas, initiation of thought-provoking practice and much more that will provide a wholesome enriched classroom experience. When students participate, they learn from one another and gain their knowledge better.

Submission of Assignment: Assignments are given to students in order to apply the concepts for deeper understanding of the subject. Therefore, each student will be allocated two assignments for the course, covering the entire topic. Students will be given deadline to submit the assignment by the course instructor and good preparation of assignment will help the students for their final exams.

Presentation of Seminar: Apart from the assignments, students are supposed to give an oral presentation during the class seminar hours in their assigned topic. The concerned instructor will encourage the participants to ask valid questions during seminar presentation in order to

put up their confidence levels and communication skills. In addition, students will be able to gain information and can be updated in their course.

Preparedness: At the end of every class, the concerned instructor conveys the students about the details that will be handled in the next class to increase the student's awareness related to the topics.

Academic Dishonesty: Academic dishonesty is a completely unacceptable mode of conduct and every student should be aware of this important aspect. Thus, the respective faculty members educate the students of possible means of academic malpractices (plagiarism, violation of copyrights and stealing the patented knowledge) and the following consequences that will make them more vigilant in their academic career.

Subject to change clause: Depending upon the requirement of student's possibility, the course syllabus will be re-structured and updated accordingly at the discretion of the Professor(s) and Board of studies chairperson.

Important dates: Scheduled dates for the various activities related to the course

CIA Test I	**CIA Test II**	**Assignment**	**Seminar**
As per Academic Calendar		After CIA Test I	

Course Outline: Molecular Modeling and Drug Design

- Role of Bioinformatics in drug design, Target identification and validation, lead optimization and validation, Structure-based drug design and ligand based drug design.
- Concepts in Molecular Modeling: Introduction; Coordinate System; potential energy surfaces molecular graphics; Quantum mechanics; Molecular Mechanics: Features of molecular mechanics, force fields
- Bond structure and bending angles – electrostatic, van der Waals and non-bonded interactions, hydrogen bonding, Inter and intramolecular interactions: Weak interactions in drug molecules; hydrogen bonding in molecular mechanics
- Homology modeling, concepts of homology modeling, secondary structure prediction methods: Threading, *ab initio* structure prediction Protein folding and model generation; analyzing secondary structures; Protein loop searching, loop generating methods, loop analysis.
- Molecular Dynamics using simple models; Molecular Dynamics with continuous potentials and at constant temperature and pressure; Time dependent properties; Solvent effects in Molecular Dynamics; Conformational changes in Molecular Dynamics.
- Structure and Ligand based Drug Design: Pharmacophore identification, methods to identify lead compounds, Molecular Docking, *De-novo* ligand design methods, Applications of 3D Database Searching in Molecular docking. Random Screening, Virtual Screening, HTVS, QSAR, Target identification and Validation.
- Receptorology: Drug-receptor interactions, receptor theories and drug action. Theories of enzyme inhibition and inactivation; Enzyme activation of drugs and prodrugs. Drug like molecules and theories associated with the recognition of drug like properties. Physical organic chemistry of drug- metabolism, drug deactivation and elimination; Phase-I and phase-II transformations; Concept of hard and soft drugs; Chemistry of ADME and toxicity properties of drugs. Lipinski rule.

More books for Reading and Referencing

Pharmacoinformatics and Drug Discovery Technologies: Theories and Applications **Tagelsir Mohamed Gasmelseid** Publisher: Idea Group, 2012. **ISBN: 978-1466603097**
Molecular Modelling for Beginners - **Alan Hinchliffe** Publisher: John Wiley & Sons Inc, 2008. **ISBN: 978-0470513149**
Molecular Modeling. Basic Principles and Applications - **Hans-Dieter Höltje, Wolfgang Sippl, Didier Rognan, Gerd Folkers** Publisher: Wiley-VCH, 2008. **ISBN: 978-3527315680**
Molecular Modeling Basics - **Jan H. Jensen** Publisher: CRC Press, 2010. **ISBN 978-1420075267**
Molecular Modeling and Simulation: An Interdisciplinary Guide - **Tamar Schlick** Publisher: Springer-Verlag New York, 2002. **ISBN: 978-1441963505**
Computational Chemistry and Molecular Modeling - **K. I. Ramachandran, Gopakumar Deepa, Krishnan Namboori** Publisher: Springer – Verlag Berlin Heidelberg. 2008. **ISBN: 978-3540773023**

Semester-II					
Core-VI	**Course Code: 502202**	**Molecular Modeling and DrugDesign**	**T**	**Credits: 5**	**Hours: 5**

Unit – I

Objective - 1	To let students to understand the use of informatics in drug design and development, finding new targets to treat disease; mechanism of drug designing

Introduction to Molecular Modeling: Molecular Modeling and Pharmacoinformatics in Drug Design, Phases of Drug Discovery, Target identification and validation, lead identification and optimization, finding of new drug targets.

Outcome - 1	The students would understand the process and steps for designing new drugs along with identifying new target and its validation	**K2**

Unit – II

Objective - 2	To understand the concept of molecular modeling, mechanics and interactions

Concepts in Molecular Modeling: Coordinate System; potential energy surfaces; molecular graphics; Quantum mechanics; Molecular Mechanics**:** Features of molecular mechanics, force fields; Bond structure and bending angles – electrostatic, van der Waals and non-bonded interactions, hydrogen bonding, Inter and intramolecular interactions: Weak interactions in drug molecules; hydrogen bonding in molecular mechanics; Energy concept and its importance in drug action, application of energy minimization.

Outcome - 2	The students would be able to understand the concepts of Molecular Modelling and molecular dynamics simulation	**K2**

Unit –III

Objective - 3	To provide clear concepts on bond angle, bond stretching, bond distance and roleon different types of bonds in interactions

Protein Structure Prediction and Analysis: Protein Structure prediction methods: Secondary Structure Prediction, Homology modeling, Threading and *abinitio* method, Tools for Structure prediction; Protein structural visualization; Geometry optimization and Loop refinement; Structure validation tools; Ramachandran Plot.

Outcome - 3	The students would be able to understand the theory of inhibition and inactivation of enzymes, drug deactivation.	**K2&K3**

Unit –IV

Objective - 4	To study about protein structure prediction and conformational changes throughout the simulation

Structure and Ligand Based Drug Design: Pharmacophore identification and Mapping; methods to identify lead compounds, Molecular Docking, *De-novo* ligand design, 3D Database Searching in Molecular docking., Virtual Screening, HTVS, , QSAR and Molecular Descriptors and its applications.

Outcome - 4	Understand the relationship between the structure and activity of ligands	**K5**

Unit-V

Objective - 5	To provide brief idea of receptor and receptor-ligand complex, inhibition andinactivation of enzyme, receptor theories

Receptorology: Drug-receptor interactions, receptor theories and drug action; Theories of enzyme inhibition and inactivation; Enzyme activation of drugs and prodrugs. Concept of Drug like molecules; Chemistry of drug- metabolism, Pharmacodynamics and pharmacokinetics; Phase-I and phase-II transformations; Concept of hard
and soft drugs; Chemistry of ADME and toxicity properties of drugs. Lipinski rule, agonist and antagonist.

Outcome - 5	Describe the Drug action mechanism	**K2**

Suggested Readings :

Leach, AR (2001) "Molecular Modeling – Principles and Applications"; 2nd Edition, Prentice Hall, USA Schlick T, "Molecular Modeling and Simulation An Interdisciplinary Guide", Springer, Acc. No. 73052

Doucet J. and Weber J. (1996). Computer-aided molecular design. London: Academic Press, 1st edition, ISBN0-12-221285-1

Gundertofte K, (2000) "Molecular Modeling and Prediction of Bioactivity", Springer, ISBN-978-1-4613-6857-1.

Jiang T. Xu Y. Zhang M. (2002). Current topics in computational molecular biology. Cambridge, Mass.: MITPress, 2nd edition, *ISBN*-10: 0262100924

Schneider G. and So S. (2003). Adaptive systems in drug design. CRC press, 1st edition, *ISBN* 9781587060595

Cramer CJ (2004) "Essentials of Computational Chemistry: Theories and Models", Wiley-Blackwell, ISBN-978-0470091821.

Pirrung MC (2004) "Molecular Diversity and Combinatorial Chemistry: Principles and Applications",Elsevier, ISBN-0-08-044493-8.

Bajorath JB (2004) "Chemoinformatics-Concepts, Methods, and Tools for Drug Discovery", Springer, ISBN978-1-59259-802-1.

Kukol A. (2008). Molecular modeling of proteins. Totowa, N.J.: Humana Press, 1st edition, ISBN 978-1-59745-177-2

Ramachandran KI (2008) "Computational Chemistry and Molecular Modeling: Principles and Applications", Springer, ISBN- 978-3-540-77304-7.

Hinchliffe (2008) "Molecular Modelling for Beginners"; Second Edition, Wiley-Blackwell, ISBN- 978-0470513149.

Gilani HG, Samper KG and Haghi RK (2012) "Chemoinformatics: Advanced Control and ComputationalTechniques", CRC Press, ISBN-9781466559332.

Bladon P and Hammond RB (2012), "Molecular Modelling: Computational Chemistry Demystified" RSCpublishing, ISBN: 978-1-84973-352-6.

Silverman RB and Holladay MW (2014) "The Organic Chemistry of Drug Design and Drug Action", thirdedition, Elsevier, ISBN-978-0-12-38-2030-3.

Czechtizky W and Hamley P (2016) "Small Molecule Medicinal Chemistry: Strategies and Technologies", John Wiley & Sons, ISBN-978-1-118-77160-0.

Dastmalchi S. Hamzeh-Mivehroud M. and Babak Sokouti (2018). Quantitative Structure - ActivityRelationship: A Practical Approach. CRC Press. ISBN: 9780815362098

Sehgal, A. Mirza H. Tahir R. A. Mir A. (2018). Quick Guideline for Computational Drug Design. BenthamScience. ISBN: 978-1-68108-603-3

Hey-Hawkins E. Teixidor C. V. (2018). Boron-Based Compounds: Potential and Emerging Applications inMedicine. John Wiley & Sons. ISBN: 978-1-119-27558-9

Gervasio F. L. Spiwok V. Mannhold R. (2019). Biomolecular Simulations in Structure-Based Drug Discovery. John Wiley & Sons. ISBN: 978-3-527-342655

Andricopulo A. D. and Ferreira L. L. G. (2019). Chemoinformatics Approaches to Structure- and Ligand-Based Drug Design. Frontiers Media SA. ISBN: 978-2-88945-744-1

Online Resources:

1. https://www.sciencedirect.com/book/9780444626479/elementary-molecular-quantum-mechanics
2. https://link.springer.com/book/9780792347927

K1-Remember	*K2-Understand*	*K3-Apply*	*K4-Analyze*	*K5-Evaluate*	*K6-Create*

Course designed by: **Dr. Sanjeev Kumar Singh**

Course Outcome VS Programme Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S(3)	L(1)	S(3)	S(3)	S(3)	M(2)	S(3)	M(2)	S(3)	L(1)
CO2	M(2)	-	L(1)	S(3)	S(3)	L(1)	M(2)	-	L(1)	L(1)
CO3	S(3)	S(3)	S(3)	L(1)	L(1)	M(2)	M(2)	L(1)	S(3)	M(2)
CO4	M(2)	S(3)	S(3)	S(3)	M(2)	S(3)	S(3)	M(2)	S(3)	M(2)
CO5	S(3)	M(2)	S(3)	S(3)	S(3)	S(3)	S(3)	M(2)	S(3)	M(2)
W.AV	2.6	1.6	2.6	2.6	2.4	2.2	2.6	1.4	2.6	1.4

S –Strong (3), M-Medium (2), L- Low (1)

Course Outcome VS Programme Specific Outcomes

	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	S(3)	S(3)	M(2)	S(3)	S(3)
CO2	S(3)	S(3)	S(3)	S(3)	S(3)
CO3	S(3)	S(3)	S(3)	S(3)	S(3)
CO4	S(3)	S(3)	S(3)	S(3)	M(2)
CO5	S(3)	M(2)	S(3)	S(3)	S(3)
W.AV	3	2.8	3	3	2.8

S –Strong (3), M-Medium (2), L- Low (1)

Assignment & Seminar – Molecular Modeling and Drug Design

1. Role of Bioinformatics in drug design
2. Structure Based Drug Design
3. Coordinate System
4. Quantum Mechanics
5. Energy concept and its importance in drug action
6. *Ab initio* method of structure prediction
7. Solvent effects in Molecular Dynamics
8. Application of 3D Database searching in Molecular Docking
9. Receptor theories and drug action
10. Concept of Hard and Soft drugs

Program: M.Sc., Bioinformatics	Semester : II (2022 Onwards)
Course Title: Computational Biology Subject Code: 502203	Class Time: As per Time Table
Name of Course Teacher	Dr. P. Boomi
Moble:+91 9486031423	E-mail:boomip@alagappauniversity.ac.in

Course Brief:

The course will cover topics of Computational Biology and Bioinformatics. Students will be introduced to computational modelling of cellular processes and some techniques for analysing these models to develop student research skills in the area of computational biology. It helps to develop working knowledge of computational techniques and their applications to biomedical research. Students will be empowered with fundamental new understandings of biological mechanisms related to the field of biological and medical sciences. Computational techniques are needed to analyze genome sequences, protein structures, metabolic and regulatory pathways, evolutionary patterns and the genetic basis of diseases. Students will also be introduced to some key problems in bioinformatics, the models used to formally describe these problems, and algorithmic approaches used to solve them. This course is designed to benefit students to understand the principles of analyzing biological data, building models and testing hypotheses related to computational and experimental works.

Teaching Methods: The mode of teaching is based on the following learning activities:

- Lectures covering the theoretical part will be delivered using PowerPoint presentations.
- A set of laboratory exercises to analyze biological problems using softwares andtools to develop student's interests in scientific discovery.
- Case studies in informatics-based research.

Attendance: The students are expected to attend the classes regularly, since regular attendance is essential to gain academic achievement. As per the University norms, the students having a minimum scale of 70-75% attendance are only qualified to write their end-semester examinations.

Punctuality: Punctuality is the most important quality for the student to be followed and maintained to achieve success. Students who arrive late by 10 mins to the class without any vital reason will be marked absent in the attendance register. On the other hand, valid excuse including personal or medical emergency is acceptable, with prior consent by the Head of the Department.

Class Participation: A student's overall growth and personality development is based on his/her involvement in the class not just by mere presence but rather being interactive through questioning that will lead to propagation of ideas, initiation of thought-provoking practice and much more that will provide a wholesome enriched classroom experience. When students participate, they learn from one another and gain their knowledge better.

Submission of Assignment: Assignments are given to students in order to apply the concepts for deeper understanding of the subject. Therefore, each student will be allocated two assignments for the course, covering the entire topic. Students will be given deadline to submit the assignment by the course instructor and good preparationof assignment will help

the students for their final exams.

Presentation of Seminar: Apart from the assignments, students are supposed to give an oral presentation during the class seminar hours in their assigned topic. The concerned instructor will encourage the participants to ask valid questions during seminar presentation in order to put up their confidence levels and communication skills. In addition, students will be able to gain information and can be updated in their course.

Preparedness: At the end of every class, the concerned instructor conveys the students about the details that will be handled in the next class to increase the student's awareness related to the topics.

Academic Dishonesty: Academic dishonesty is a completely unacceptable mode of conduct and every student should be aware of this important aspect. Thus, the respective faculty members educate the students of possible means of academic malpractices (plagiarism, violation of copyrights and stealing the patented knowledge) and the following consequences that will make them more vigilant in their academic career.

Subject to change clause: Depending upon the requirement of student's possibility, the course syllabus will be re-structured and updated accordingly at the discretion of the Professor(s) and Board of studies chairperson.

Important dates: Scheduled dates for the various activities related to the course

CIA Test I	CIA Test II	Assignment	Seminar
As per Academic Calendar		After CIA Test I	

Course Outline: Core: Computational Biology

- String algorithms are a traditional area of study in computer science in recent years-algorithms in bioinformatics – sequences algorithms on strings, trees and protein sequences can be represented as strings over finite.
- Shortest path algorithm-Hamiltonian Path for graph representation-Maximum flow.
- Comparative genomics: Orthologues and paralogues, xenologues (horizontal gene transfer); Non-orthologous gene displacement; Analogues; Orthologue identification by BLAST and reciprocal best hit.
- Use of comparative genomics in gene annotation, and function prediction; Phylogenetic foot printing; Gene order.
- Details of Needleman - Wunsch and Smith- Waterman algorithms-BLAST and FASTA applications.
- Web based servers and softwares for genome analysis: Ensembl, NCSC genome browser, NCBI genome.
- Hierarchical alignment with worked out examples of substitution matrices- PAM substitution matrices - BLOSUM substitution matrices.
- Hidden Markov models and application to analyze of protein and genome sequences.
- Methods of representing biological molecules – geometrical analyses – Protein Structure Comparison and Classification- different classes of Protein interactions.

More books for Reading and Referencing

Understanding Bioinformatics - **Marketa Zvelebil, Jeremy Baum** Publisher: Garland Science, First edition, 2007. (**ISBN: 978-08-153-4024-9**)
Bioinformatics and Functional Genomics - **Jonathan Pevsner** Publisher: Wiley-Blackwell, Third edition, 2015. **(ISBN: 978-11-185-8178-0)**

Practical Computing for Biologists - **Steven Haddock, Casey Dunn** Publisher: Sinauer Associates, Inc.; First edition, 2010. **(ISBN: 978-08-789-3391-4)**
Introduction to Computational Biology: An Evolutional Approach - **Bernhard Haubold, Thomas Wiehe** Publisher: Springer (sie) (2008). **(ISBN: 978-37-643-7387-0)**
Algorithms on strings, trees, and sequences: computer science and computational biology- **Dan Gusfield** Publisher: Cambridge University Press, 1997. **(ISBN: 978-05-215-8519-4)**
Bioinformatics: A biologist's guide to biocomputing and the internet -**Stuart M. Brown** Publisher: Eaton Publishing, 2000. **(ISBN: 188129918X, 9781881299189)**

Semester-II					
Core-VII	**CourseCode 502203**	**Computational Biology**	**T**	**Credits:5**	**Hours:5**

Unit-I		
Objective - 1	To provide students with the basic knowledge of biosimilar, computational biology and their advances of synthetic biology	
Biosimilars: Introduction to biosimilars, Definition, Examples of Biosimilars- Genetically engineered products of biosimilars, Molecular Complexity of biosimilars. Critical manufacturing parameters of biosimilars and Challenges-Modifications linked to the process, conversion and formulation. Concept of expression cassette and vector, Host cell and expression system. Non Clinical and Clinical Aspects of Biosimilars.		
Preclinical approach and Clinical approach.		
Outcome - 1	Students will obtain basic knowledge about the biosimilar and can learn about clinical approach of biosimilar	**K2**

Unit-II		
Objective - 2	To facilitate the students to attain skills in basic computational biology that is essential for various biomedical applications.	
Introduction to Computational Biology: Introduction to Computational Biology: Nature and scope of Computational Biology, Alignment definition, Pairwise sequence alignment, biological interpretation of the alignment problem, scoring alignment, Global alignment, local alignment, overlap alignment, banded alignment, normalized local alignment, maximizing Vs minimizing score, similarity and distance measures, PAM matrices, BLOSUM matrices, comparison between PAM and BLOSUM matrices, Application of substitution matrices		
Outcome - 2	Students will gain the how to alignment the sequence, analysis and apply score matrix using computational approach.	**K2 &K3**

Unit-III		
Objective - 3	This course will give the various methods of Sequence matching	
Pairwise sequence matching analysis: Sequence matching method-Dot plot visualization method, Dynamic programming method, Word method, Bayesian method, progressive method, Markov chain model, Hidden Markov Models and Kernal methods.		
Outcome - 3	Student will obtain basic knowledge about the biosimilar, sequence matching analysis and dynamic programming methods.	**K3**

Unit-IV		
Objective - 4	To give the various methods of Sequence matching and Multiple sequence alignment.	
Computational Sequences and Maps: General ideas of sequence alignment, multiple sequence alignment, Restriction map-Graph, Interval graphs and Measuring fragment sizes. Multiple maps-double design problems, reflection, overlap equivalence, overlap size equivalence, restriction map and border block graph, Cassettle transformation of restriction map. Vector and plasmid design.		
Outcome - 4	Discusse and calsify the sequence alignment	**K4**

Unit-V		
Objective -5	To learn about advanced computational biology using synthetic biology and quantum mechanics.	
Advances of Computational Biology: Synthetic biology- Ethical issues of Synthetic Biology, Computational Synthetic biology, Codon optimization, AND gate and OR gate in biology, Operons, Switches and clocks, Re-pressilator. **Computational Quantum Mechanics**- One electron atoms, Polyelectron atoms and molecules, Molecular orbitals, Hartree-Fock Equations, Molecular Properties using ab initio methods, Semi-empirical methods, Huckel Theory.		
Outcome -5	Develop the knowledge in advanced computational biology using synthetic biology and quantum mechanics	**K5**

Suggested Readings:

S. Aluru, (2005) "Handbook of Computational Molecular Biology"; Publisher CRCPress.

C. Voigt, (2011) "Synthetic Biology: Methods for part/device characterization and chassis engineering" Academic Press.

J L. Prugnaud, J H.Trouvin, (2012) "Biosimilars: A New Generation of Biologics";Publisher Springer Science & Business Media.

M.S. Waterman, (1995) "Introduction to Computational Biology: Maps, Sequences and Genomes"; Publisher CRC Press.

K.I. Ramachandran, G. Deepa, K. Namboori, (2005) "Computational Chemistry andMolecular Modeling: Principles and Applications"; Springer.

B. Haubold, T. Wiehe, (2006) "Introduction to Computational Biology: An Evolutionary Approach"; Publisher Springer Science & Business Media.

K. Najarian, S. Najarian, S. Gharibzadeh, C.N. Eichelberger, (2009) "Systems Biologyand B ioinformatics: A Computational Approach"; Publisher CRC Press.

C. Voigt, (2011). "Synthetic Biology, Part B: Computer Aided Design and DNA Assembly. Meth ods in enzymology"; Elsevier Science.

H. J. Gutka, H.Yang, S. Kakar, (2018) "Biosimilars: Regulatory, Clinical, and Biopharmaceutical Development"; Publisher Springer.

Online Resources:

1. https://ocw.mit.edu/courses/7-91j-foundations-of-computational-and-systems-biology-spring-2014/
2. https://www.oreilly.com/library/view/biobuilder/9781491907504/ch01.html

K1-Remember	*K2-Understand*	*K3-Apply*	*K4-Analyze*	*K5-Evaluate*	*K6-Create*

Course desighned by : Dr.P. Boomi

Course Outcome VS Programme Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S(3)	L(1)	S(3)	S(3)	S(3)	M(2)	S(3)	M(2)	S(3)	M(2)
CO2	M(2)	M(2)	L(1)	S(3)	S(3)	L(1)	M(2)	M(2)	L(1)	M(2)
CO3	S(3)	S(3)	S(3)	L(1)	L(1)	M(2)	M(2)	M(2)	S(3)	M(2)
CO4	M(2)	S(3)	S(3)	S(3)	M(2)	S(3)	S(3)	M(2)	S(3)	M(2)
CO5	S(3)	M(2)	S(3)	S(3)	S(3)	S(3)	S(3)	M(2)	S(3)	M(2)
W.AV	2.6	2.2	2.6	2.6	2.4	2.2	2.6	2	2.6	2

S –Strong (3), M-Medium (2), L- Low (1)

Course Outcome VS Programme Specific Outcomes

	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	**S(3)**	**S(3)**	**M(2)**	**S(3)**	**S(3)**
CO2	**S(3)**	**S(3)**	**S(3)**	**S(3)**	**S(3)**
CO3	**S(3)**	**S(3)**	**S(3)**	**S(3)**	**S(3)**
CO4	**S(3)**	**S(3)**	**S(3)**	**S(3)**	**M(2)**
CO5	**S(3)**	**M(2)**	**S(3)**	**S(3)**	**S(3)**
W.AV	**3**	**2.8**	**3**	**3**	**2.8**

S –Strong (3), M-Medium (2), L- Low (1)

Assignment & Seminar – Computational Biology

1. String operation and classification of algorithms
2. Write down the difference of PAM250 and BIOSSM62 matrix.
3. List out the hierarchical classifications of proteins.
4. Hidden Markov models and its application
5. Use of comparative genomics in drug discovery programs.
6. Protein Interaction analysis
7. Write a note on Sequence pattern representations.
8. How will you predict gene using Fourier analysis.
9. Describe the statistics to estimate significance of an alignment.
10. Briefly explain the dynamic programming for multiple sequence alignment.

Program: M.Sc.,	Semester: II (2022 Onwards)
Course Title and Code: Programming in Scripting Languages (PYTHON, PERL & R) Subject Code: (502204)	Class Time: As per Time Table
Name of the Course Teacher	Dr. RM. Vidhyavathi
Mobile: +91 9486031423	E-mail:vidhyavthurm@alagappauniversity.ac.in

Course Brief:

Perl is a general-purpose programming language originally developed for text manipulation and now used for a wide range of tasks including system administration, web development, network programming, GUI development and more.

Python is a language with a simple syntax, and a powerful set of libraries. It is an interpreted language, with a rich programming environment, including a robust debugger and profiler. While it is easy for beginners to learn, it is widely used in many scientific areas for data exploration. This course is an introduction to the Python programming language for students without prior programming experience. We cover data types, control flow, object-oriented programming, and graphical user interface- driven applications. The examples and problems used in this course are drawn from diverse areas such as text processing, simple graphics creation and image manipulation, HTML and web programming, and genomics.

R is rapidly becoming the leading programming language in statistics and data science. R programming builds the proficiency in using R programming language for statistical computing and graphics. R, a language and environment, is gaining popularity in getting insight in complex data. The business analyst and other professionals dealing in large amount of data can derive results using the ready-made functions available in R.

Teaching Methods: The course will be used on the basis of the following teaching and learning methods:

- Lectures covering the theoretical part using PowerPoint presentations
- Case studies
- Review questions

Attendance: Having good attendance record marks the student's sincerity and has an overall positive impact on his/her personality trait development. The students are asked to attend the classes on a regular note and those having a minimum scale of 70-75% attendance are eligible to take up the end-semester examinations as per the University norms.

Punctuality: It is the most important attribute to be followed and maintained by the student throughout his/her life which for sure will lead to the path of success. Students who arrive late by 10mins after the attendance will be marked absent unless there is a valid reason (medical/ personal emergency) at the discretion of the Head of the Department.

Class/Lab Participation: A student's overall growth and personality development is based on his/her involvement in the class not just by mere presence but rather being interactive through questioning that will lead to propagation of ideas, initiation of thought-provoking process and much more that will provide a wholesome enriched classroom experience. Therefore, students are advised to be more attentive so that they learn from one another and develop quality-based knowledge.

Submission of Assignment: Assignments are given to students with just one motive to get more quantitative and qualitative knowledge insights into the assigned topic/chapter that will lead to preparation and completion of the assignment in a constructive manner here just the knowledge provided is not merely counted but also completion prior to proposed deadline will also have a check on the student's serious consideration of the assignments.

Presentation of Seminar: Apart from the assignments the concerned instructors also allocate the students with a topic or based on their interests to present seminar that will aid them built their confidence levels, command over English language to communicate with precision and fluently. In addition, the fellow students are encouraged to pose questions that will instigate interest and provide update in that particular topic besides the information presented helping them to prepare for their examinations that can be taken as added advantage for the students.

Preparedness: At the end of every class, the concerned instructor tells the students what will be taken in the next class using these details the students should be aware of thetopics that will be covered in the upcoming lectures which actually enhance the student's capability to grasp the knowledge and concepts provided much efficiently.

Academic Dishonesty: This is an important aspect that every student should be aware of. Thus, the respective faculty members educate the students of possible means of academic malpractices (plagiarism, violation of copyrights and stealing the patented knowledge) and the following consequences that will make them more vigilant in their academiccareer.

Subject to change clause: Based on the requirement of student's feasibility and meeting the competitive demands of the discipline the syllabus courses will be re-structured and updated accordingly at the discretion of the Professor(s) and Board of studies chairman.

Important dates: Please note down the important dates and stick to the schedule

CIA Test I	**CIA Test II**	**Assignment**	**Seminar**
As per Academic Calendar		After CIA Test-I	

Course Outline: Core: Programming in Scripting Languages (PYTHON, PERL & R)

- Concepts about Regular Expressions, Simple Uses of Regular Expressions, Patterns, More on the Matching Operator, Substitutions, The split and join Functions.
- Object oriented Perl consist-Introduction to modules and Creating Objects.
- The BioPerl keeps Installation procedures, Architecture and that uses.
- Conceptual introduction: installing Python, basic syntax, interactive shell, editing, saving, and running a script.
- The concept of data types; variables, assignments; immutable variables; numerical types; arithmetic operators and expressions; comments in the program; understanding error messages.
- Conditions, Boolean logic, logical operators; ranges; Control statements: if-else, loops (for, while); short-circuit (lazy) evaluation.
- String manipulations: subscript operator, indexing, slicing a string; strings and number system: converting strings to numbers and vice versa. Binary, octal, hexadecimal numbers.
- Understand interpreter and compilers: CPython, PyPy, Cython.
- See demonstration of IDE's: IDLE, IPython, IPython Notebook, hosted environments.
- Clear understanding of Statistical programming and R environment
- In-depth knowledge of basic features, functions, operators available with R
- Comprehensive information about programming statistical graphics
- Ways of using simulation and numerical optimization

- Extract data from R objects, perform reading and writing of Data, and handle databases
- Use subscripting, character manipulation, and reshaping of data
- Find probability, distributions, regression and correlation
- Significance of sample size and its calculation
- Advance data handling technique

More books for Reading and Referencing

MySQL and Perl for the Web, Paul DuBois, **ISBN-10:** 0735710546,Wynand S. Verwoerd; 2001 **ISBN:** 978-87-403-0251-6.
Programming the Perl DBI, By Tim Bunce, Alligator Descartes and Publisher: O'Reilly Media, 2000 **ISBN**: 978-1-56592-699-8, | ISBN 10: 1-56592-699-4.
Developing Web Applications with Apache, MySQL, memcached, and Perl, Patrick Galbraith, 2009 **ISBN**: 978-0-470-41464-4.
The Fundamentals of Python: First Programs- Kenneth A. Lambert, Cengage Learning, 2011. **ISBN:** 978-1111822705.
R Programming for Bioinformatics, Robert Gentleman, CRC Press,2008, **ISBN:** 1420063685, 9781420063684

Semester-II					
Core-VIII	**Course Code 502204**	**Programming in Scripting Languages (PYTHON, PERL & R)**	**T**	**Credits:5**	**Hours:5**

Unit-I		
Objective - 1	To introduce students to pros and cons of scripting vs. compiled programming languages.	
PERL: Scalar data, Numbers, Strings, Variables, Operators, Hierarchy of operators, Variable interpolation, **Basic I/O, Lists and Arrays:** Literal Representation, Variables, Array Operators and Functions, Scalar and List Context, **Control Structures:** Statement Blocks, The If control structure, While control structure, Hashes, Hash Functions, Use of Hashes, Pointers, Database Connections and Database Operations.		
Outcome - 1	Illustrate the basics of Perl and Python to develop python programs with conditional controls and loops.	**K2**

Unit-II		
Objective - 2	To give students a thorough understanding of the Python programming language and it's rich set of libraries.	
Introduction to Python: Python interpreter and interactive mode, values and data types, variables, expressions, statements, tuple assignment, precedence of operators, comments, modules and functions, function definition and use, flow of execution, parameters and arguments, **Control Flow, Functions: Conditionals:** Boolean values and operators, if, if- else, if-elif-else, Iteration: state, while, for, break, continue, pass, **Fruitful Functions:** return values, parameters, local and global scope, function composition, recursion, **Strings:** string slices, immutability, string functions and methods, string module, Lists as arrays.		
Outcome - 2	Understand the pros and cons on scripting languages vs. classical programming languages (at a high level)	**K2**

Unit-III		
Objective - 3	To expose students to applications where Python programming is effective (e.g. application development, scripting, systems administration).	
Functions (Subroutines) in Python: Function Definition, Calling a Function, Passing Parameters, Local Variables, Returning Values, Special Variables and its Types, File handle Special Variables, Local and Global Special Variables, **Regular Expressions:** Concepts About Regular Expressions, Simple Uses of Regular Expressions, Patterns Matching, Match Operator, Simple Matching, Literal Matching, The Split and Join Functions, Substituting, Splitting, Quantifiers, Meta characters, Assertions, Character Classes, Alternatives, Transliteration.		
Outcome - 3	Relate Python features as a data analysis tool	**K4**

Unit-IV		
Objective - 4	Recognize similarities and common characteristics of programming languages.	
Python-Lists, Tuples, and Dictionaries: Lists: operations, slices, methods, loop, mutability, aliasing, cloning, parameters, **Tuples:** assignment, tuple as return value,		
Dictionaries: operations and methods, advanced list processing, list comprehension, **Illustrative programs:** selection sort, insertion sort, mergesort. **Files, Modules, and Packages: Files and exception:** text files, reading and writing files, format operator, command line arguments, errors and exceptions, handling exceptions, modules, packages. Graph Algorithms, Balanced Search Tree, Greedy Algorithms, Stack and Queue, String or Pattern Matching Algorithms		
Outcome - 4	Explore data-sets to create testable hypotheses and identify appropriate statistical tests.	**K4**

Unit-V		
Objective - 5	Identify appropriate statistical methods for the data or problems andconduct their own analysis using the R environment	
Introduction to R-Programming: Introduction R Nults and Bolts (I), R Nults and Bolts (II), Getting Data In and Out of R, Control Structures and Functions, Loop Functions, Data Manipulation, String Operations, Packaging, Debugging and Object Oriented Programming, Data Visualization, Clustering, Regression and Classification, Data Analytics.		
Outcome - 5	Create and edit visualizations with R.	**K6**

Suggested Readings:

Perl Larry Wall, Tom Christiansen, & Randal Schwartz, (2012) "Programming Perl", O-Reilly, Fourth Edition.

Hans PetterLangtangen, (2006)," Python Scripting for Computational Science", Springer Science & Business Media.

Seema Acharya, (2018), "Data Analytics Using R", McGraw Hill Education, First edition.

David Till, (1996),"Teach Yourself Perl 5 in 21 days ", Sams Publishing, Second Edition.

Tom Christiansen & Nathan Torkington, (1998),"Perl Cookbook", O'Reilly Media First Edition.

Kaladhar DSVGK, (2014),"Basics in PERL and BioPERL", GRINVerlag**.**

Jeff Chang, Brad Chapman, Iddo Friedberg, Thomas Hamelryck, (2017),"BiopythonTutorial and Cookbook".

Robert Sedgewick, Kevin Wayne, Robert Dondero, (2016), "Introduction to Programmingin Python: An Inter-disciplinary Approach", Pearson India Education Services Pvt. Ltd.

Timothy A. Budd, (2015) "Exploring Python", Mc-Graw Hill Education (India) Private Ltd.

Guido van Rossum and Fred L. Drake Jr. (2011), "An Introduction to Python – Revised andupdated for Python 3.2", Network Theory Ltd.

SandipRakshit, (2017) "R Programming for Beginners", McGraw Hill Education, FirstEdition.

Jared P. Lander, (2018) "R for Everyone: Advanced Analytics and Graphics", Pearson Education, Second edition.

Online Resources:

1. https://www.greenteapress.com/thinkpython/thinkpython.pdf
2. http://ndl.ethernet.edu.et/bitstream/123456789/26985/1/Larry%20Wall.pdf
3. https://web.itu.edu.tr/~tokerem/The_Book_of_R.pdf

K1-Remember	*K2-Understand*	*K3-Apply*	*K4-Analyze*	*K5-Evaluate*	*K6-Create*

Course designed by: Dr.RM.Vidhyavathi

Course Outcome VS Programme Outcomes

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S(3)	S(3)	S(3)	M(2)	M(2)	S(3)	M(2)	M(2)	M(2)	M(2)
CO2	S(3)	S(3)	S(3)	M(2)	M(2)	L(1)	L(1)	L(1)	M(2)	M(2)
CO3	S(3)	M(2)	S(3)	M(2)	M(2)	L(1)	L(1)	L(1)	M(2)	M(2)
CO4	S(3)	M(2)	S(3)	M(2)	M(2)	L(1)	L(1)	L(1)	M(2)	L(1)
CO5	S(3)	S(3)	S(3)	S(3)	L(1)	L(1)	L(1)	L(1)	L(1)	L(1)
W.AV	3	2.6	3	2.2	1.9	1.4	1.2	1.2	1.8	1.6

S –Strong (3), M-Medium (2), L- Low (1)

Course Outcome VS Programme Specific Outcomes

CO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	S(3)	S(3)	M(2)	L(1)	M(2)
CO2	S(3)	M(2)	L(1)	S(3)	S(3)
CO3	S(3)	M(2)	L(1)	L(1)	L(1)
CO4	S(3)	M(2)	L(1)	L(1)	M(2)
CO5	S(3)	L(1)	L(1)	L(1)	M(2)
W.AV	3	2	1.2	1.4	2

S –Strong (3), M-Medium (2), L- Low (1)

Assignment & Seminar Programming in Scripting Languages (PYTHON, PERL & R)

1. Decision making process in PERL programming.
2. Illustrates Regular Expressions with an example.
3. Discuss in detail about CGI Programming.
4. Describe about Database Manipulation.
5. Program to string processing in sub-routines.
6. Convert a DNA fast a file to RNA fasta file (using File Handling).
7. CGI-Perl program to submit a DNA sequence and validate the sequence.
8. CGI-Perl program to perform the Translation process for user given sequence.
9. Types of Operators in python Programming with an Example.
10. Chained conditional (if-elif-else), state, while, for, break, continue, pass, Fruitful.
11. Tuple assignment, tuple as return value.
12. Files and exception handling and its Packages.
13. Database search using Biopython.
14. Debugging and Object Oriented Programming, Loop Functions, Data Analytics.
15. Structures and Functions, Loop Functions of R.

Program: M.Sc.,	Semester : II (2022 Onwards)
Course Title: Lab – II Molecular Biology and Biochemical Techniques Subject Code**:** 502205	Class Time: As per Time Table
Name of Course Teacher	Dr. M. Karthikeyan Dr. J. Joseph Sahayarayan
Moble: +91 9486981874 + 91 9047564087	E-mail: karthikeyanm@alagappauniversity.ac.in josephj@alagappauniversity.ac.in

Course Brief:

This course begins with a review of basic bio-analytical technique and an introduction to general terminologies along with their theory, working principles, common instrumentation and possible applications which will be equally beneficial to various scientific areas including, life science, chemical science, material science and environmental science.

Understanding of molecular structure & function is of central importance to students undertaking a major biological or chemical field. This course focuses on concepts of DNA/RNA, protein, lipid & carbohydrate comprehending the aspects from structure to function. Some content and assignments are based on current literature describing recent DNA, protein structures and how structure can be utilized to conclude the function of it. Laboratory work will emphasize the techniques required to analyze biomolecules. Students will integrate theoretical knowledge with experimental data.

Teaching Methods: The mode of teaching of delivering the courses are as follows through these below mentioned methodologies:

- Delivering the lectures in the form of presentation using advanced technologies devices such as smart board.
- Video-conferencing for lectures that will be sought from experts belonging to overseas reputed institutions
- Case-studies and Review questions

Attendance: Having good attendance record marks the student's sincerity and has an

< 50 Marks in all	50 < Your Marks < 59	60 < Your Marks < 75	Your Marks ≥ 75

overall positive impact on his/her personality trait development. The students are asked to attend the classes on a regular note and those having a minimum scale of 70-75% attendance are eligible to take up the end-semester examinations as per the University norms.

Punctuality: It is the most important attribute to be followed and maintained by the student throughout his/her life which for sure will lead to the path of success. Students who arrive late by 10mins after the attendance will be marked absent unless there is a valid reason (medical/ personal emergency) at the discretion of the Head of the Department.

Class Participation: A student's overall growth and personality development is based on his/her involvement in the class not just by mere presence but rather being interactive through questioning that will lead to propagation of ideas, initiation of thought-provoking process and much more that will provide a wholesome enriched classroom experience. Therefore, students are advised to be more attentive so that they learn from one another and develop quality-based knowledge.

Submission of Assignment: Assignments are given to students with just one motive to get more quantitative and qualitative knowledge insights into the assigned topic/chapter that will lead to preparation and completion of the assignment in a constructive manner here just the knowledge provided is not merely counted but also completion prior to proposed deadline will also have a check on the student's serious consideration of the assignments.

Presentation of Seminar: Apart from the assignments the concerned instructors also allocate the students with a topic or based on their interests to present seminar that will aid them built their confidence levels, command over English language to communicate with precision and fluently. In addition, the fellow students are encouraged to pose questions that will instigate interest and provide update in that particular topic besides the information presented helping them to prepare for their examinations that can be taken as added advantage for the students.

Preparedness: At the end of every class, the concerned instructor tells the students what will be taken in the next class using these details the students should be aware of the topics that will be covered in the upcoming lectures which actually enhance the student's capability to grasp the knowledge and concepts provided much efficiently.

Academic Dishonesty: This is an important aspect that every student should be aware of. Thus, the respective faculty members educate the students of possible means of academic malpractices (plagiarism, violation of copyrights and stealing the patented knowledge) and the following consequences that will make them more vigilant in their academic career.

Subject to change clause: Based on the requirement of student's feasibility and meeting the competitive demands of the discipline the syllabus courses will be re-structured and updated accordingly at the discretion of the Professor(s) and Board of studies chairman.

Important dates: Please note down the important dates and stick to the schedule

CIA Test I	**CIA Test II**	**Assignment**	**Seminar**
As per Academic Calendar		After CIA Test-I	

Course Outline: Lab-II: Molecular Biology and Biochemical Techniques

1. Collect samples from environment.
2. Extract and purify DNA from collected samples.
3. Use PCR to amplify specific regions from the chloroplast or mitochondrial DNA that are short but highly variable.
4. Analyze the proteins by using various Chromatographic methods.
5. Analyze PCR product by agarose-gel electrophoresis.
6. Use BLAST to identify sequences in database to taxonomically assign the sample.
7. PCR using primers specific for identification of species.
8. Construct genomic DNA libraries from wild-type.
9. Isolate plasmid DNA from surviving clones and obtain DNA sequence to identify the mutated gene.
10. Use bioinformatics to determine sequence differences between wild-type and mutant strains and compare to sequences recovered by functional complementation.

More books for Reading and Referencing:

Biochemical Calculations Paperback by Irwin H. Segel, 2010 **ISBN: 10: 8126526432; ISBN: 13: 978-8126526437**
Laboratory Manual of Biochemistry: Methods and Techniques by R. S. Sengar, 2014 **ISBN: 10: 9383305029**
Student Solutions Manual for Molecular Cell Biology by Harvey Lodish, 2012 **ISBN: 13: 978-1464102301**

Semester- II					
Core-IX	**Course Code: 502205**	**Lab-II: Molecular Biology and iochemical Techniques**	**P**	**Credits:3**	**Hours:6**

Unit – I		
Objective - 1	Carryout various types of practical laboratory work (chemical, biochemical and molecular genetics) in a safe way by means of oral and written laboratory instructions and be able to analyze, interpret and present the results with theoretical background informs of different laboratory reports.	
ApproachestoBiochemicalTechniques: Bio-safety rules and regulations and Good Laboratory Practice (GLP), Material safety Data sheets (MSDS). Preparation of Reagents, buffers, pHAnalysis,Various Centrifugation methods, Quality and Quantity analysis of nucleicacids by Spectro photometer, Bio Photometer, nanodrop. Quantification of Proteins by Lowry'sand Bradford'smethods.		
Outcome - 1	Remember the principles of good laboratory practices andbasics of biochemical techniques	**K1**
Unit – II		
Objective - 2	Data interpretation, including standard curve interpolation (graphing)and determining molecular weight of an unknown protein or genotype.	
Isolation and Separation Techniques: Cell culture, Isolation and Separation of GenomicDNA fromplants/ human /microorganisms; Plasmids isolationfrom microorganisms; RNA from cells; Agarose Gel Electrophoresis; Isolation, separation and analysis of Proteins by Native- PAGE and SDS-PAGE.		
Outcome - 2	Understand the process of DNA isolation and separationtechniques	**K2**
Unit – III		
Objective - 3	Genetic engineering in microorganisms (e.g., bacteria, yeast). DNA analysis, including DNA extraction, use of restriction enzymes.	
Amplification of Genes and Molecular Markers: Gene amplification and Screening techniques: Primer Design, PCR; Realtime PCR(RTqPCR) /analysis, Blotting techniques: Southern, Northern and Western Blots; BioProbe (Demonstration) and Radio active probe (Theory). Molecular Markers by RFLP, AFLP,RAPDmethods(Demo).		
Outcome - 3	Acquire the knowledge of gene amplification and blottingmethods	**K3**
Unit – IV		
Objective - 4	Students will acquire knowledge about various chromatographictechniques.	
Chromatography Techniques: Chromatography: Partition Chromatography, Ion Exchange Chromatography, Gel filtration Chromatography, Affinity Chromatography, HPLC and FPLC (Demonstration). Separation of amino acids/compounds by Paper Chromatography, Thin Layer Chromatography.		
Outcome - 4	Analyze the basic principles and significance of chromatography and its types	**K4**
Unit – V		
Objective - 5	Microscopy procedures and identification of cellular components.	
Microscopes and immune techniques: Microscopes and immune techniques: Visualization of cells and subcellular components by lightmicroscopy, resolving powers of different microscopes, microscopy of living cells, scanning and transmission microscopes. Antigen and Antibody preparation, immune precipitation, Immuno histochemistry, ELISA & its applications, Flow cytometry and Immunofluores cence microscopy, Confocal microscopy and FISH (Theory).		
Outcome - 5	Evaluate the antigen-antibody interactions through immunetechniques and microscopic analysis	**K5**

Suggested Readings:

John M. Walker and Ralph Rapley,(2002)"Molecular Biology and Biotechnology";University of Hertfordshire, Hatfield,UK, Fourth Edition

Bansal, M.P.(2013)"Molecular Biology and Biotechnology":Basic Experimental Protocols, NewDelhi:TERI**.**

R.H.Burdon, P.H.Van Knippenberg,(1990)"Laboratory techniques in Biochemistry and Mol ecular biology"; Elsevier Amsterdam. NewYork.Oxford, Second Edition, volume 8.

Rodney and Royer, (2004)"Modern Experimental Biochemistry";Pearson education, India. Hans-WalterHeldt, (2004)"Plant Biochemistry";Elsevier Academic Press, Third edition.

James M. Miller, (2005) "Chromatography: Concepts and Contrasts"; Wiley- Interscience, Second Edition.

Richard I. Gumport, Jeremy M.Berg, Nancy Counts Gerber, (2006) "Biochemistry- A Student Companion"; I.K. International Pvt, Ltd. Sixthedition.

Eisenthal, R. and Danson, M.J. (2006) "Enzymeassays"; Oxford University Press. DonaldVoet, JudithG.Voet, (2010) "Biochemistry"; John Wiley & Sons Inc;4th Edition.

Keith Wilson, John Walker, (2010)" Principles and Techniques of Biochemistry and Molecula r Biology"; Cambridge University Press;7th Edition.

Michael R.Green, Joseph Sambrook, (2012) "Molecular cloning: a laboratory manual"; Cold Spring Harbor, N.Y.:Cold Spring Harbor Laboratory Press,4th Edition.

Michael M. Cox, Michael O' Donnell, Jennifer Duodena, (2015) "Molecular Biology: Principlesand Practice Hardcover";WH Freeman;1st Edition.

DavidL. Nelson, Michael, (2017) "Lehninger Principles of Biochemistry:International Edition,W H Freeman, 7th Edition, ISBN:9781319108243,1319108245.

Sambrook, J.,Fritsch, E.,& Maniatis,T.(2012). Molecularcloning (5th ed.). Cold Spring Harbor: Cold Spring Harbor LaboratoryPress.

Wilson, K., & Walker, J. (2007). Principles and techniques of biochemistry and molecular biology (5th ed.).Cambridge: Cambridge University Press.

Online Resources:

1. https://link.springer.com/book/10.1007/978-3-642-56968-5
2. https://link.springer.com/book/10.1007/978-94-010-9363-7

K1-Remember	*K2-Understand*	*K3-Apply*	*K4-Analyze*	*K5-Evaluate*	*K6-Create*

Course designed by: Dr. M. Karthikeyan

Course Outcome VS Programme Outcomes

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S(3)	S(3)	S(3)	S(3)	S(3)	S(3)	S(3)	S(3)	M(2)	M(2)
CO2	S(3)	S(3)	M(2)	S(3)	S(3)	M(2)	L(1)	S(3)	M(2)	S(3)
CO3	S(3)	M(2)	S(3)	S(3)	M(2)	S(3)	L(1)	L(1)	L(1)	M(2)
CO4	S(3)	M(2)	S(3)	M(2)	L(1)	S(3)	S(3)	S(3)	M(2)	S(3)
CO5	S(3)	S(3)	M(2)	L(1)	M(2)	S(3)	S(3)	M(2)	L(1)	M(2)
W. AV	3	2.6	2.6	2.4	2.2	2.8	2.2	2.4	1.6	2.4

S-Strong (3), M-Medium (2), L-Low (1)

Course Outcome Vs Program Specific outcomes

CO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	L(1)	S(3)	S(3)	M(2)	M(2)
CO2	M(2)	S(3)	S(3)	M(2)	L(1)
CO3	S(3)	M(2)	M(2)	M(2)	L(1)
CO4	M(2)	L(1)	L(1)	S(3)	M(2)
CO5	L(1)	M(2)	M(2)	M(2)	L(1)
W. AV	1.8	2.2	2.2	2.2	1.4

S-Strong (3), M-Medium (2), L-Low (1)

Assignment, Seminar & Practicals – Biochemical and Molecular Biology Techniques

1. Quantification of proteins by Lowry's and Bradford's methods.
2. Preparation of reagents buffers and adjust pH.
3. Acquisition of basic laboratory techniques.
4. Working under sterile conditions.
5. Isolation, separation and analysis of Proteins by Native-PAGE and SDS-PAGE
6. Pipetting.
7. Primer Design.
8. Chromatography and its types.
9. Protein assay (standard curve).
10. RNA extraction.
11. DNA isolation conventional PCR.
12. Blotting techniques.

SEMESTER –III

Genetics and Genetic Engineering

Program: M.Sc.,	Semester : III (2022 Onwards)
Course Title: Genetics and Genetic Engineering Subject Code: 502301	Class Time: As per Time Table
Name of Course Teacher	Dr. M. Karthikeyan Dr. J. Joseph Sahayarayan
Moble: +91 9486981874 + 91 9047564087	E-mail: karthikeyanm@alagappauniversity.ac.in josephj@alagappauniversity.ac.in

Course Brief:

Genetic and Genetic Engineering, also called "Recombinant DNA technology"

is one of the main branches of biological sciences that deal with the manipulation of genetic material of any organism. This important course will explain to the students to understand the mechanism of genetic changes, techniques used for genetic modifications. The course also highlights basic and advanced molecular techniques such as polymerase chain reaction (PCR), DNA sequencing-which covers conventional first generation sequencing technology (Sanger Sequencing) to high throughput second (Pyrosequencing & Illumina) and third sequencing technologies (Nanopore, SMRT sequencing), blotting techniques, chromosomal changes and DNA profiling. The proposed course will cover topics starting from manipulation of organisms at genome level to use of that organism at various fields including agriculture, medical and pharmaceutical industries.

Teaching Methods: The mode of teaching of delivering the courses are as follows through these below mentioned methodologies:

- Delivering the lectures in the form of presentation using advanced technologies devices such as smart board.
- Video-conferencing for lectures that will be sought from experts belonging to overseas reputed institutions
- Case-studies and Review questions

Attendance: Having good attendance record marks the student's sincerity and has an overall positive impact on his/her personality trait development. The students are asked to attend the classes on a regular note and those having a minimum scale of 70-75% attendance are eligible to take up the end-semester examinations as per the University norms.

Punctuality: It is the most important attribute to be followed and maintained by the student throughout his/her life which for sure will lead to the path of success. Students who arrive late by 10mins after the attendance will be marked absent unless there is a valid reason (medical/ personal emergency) at the discretion of the Head of the Department.

Class Participation: A student's overall growth and personality development is based on his/her involvement in the class not just by mere presence but rather being interactive through questioning that will lead to propagation of ideas, initiation of thought-provoking process and much more that will provide a wholesome enriched classroom experience. Therefore, students are advised to be more attentive so that they learn from one another and develop quality-based knowledge.

Submission of Assignment: Assignments are given to students with just one motive to get more quantitative and qualitative knowledge insights into the assigned topic/chapter that will lead to preparation and completion of the assignment in a constructive manner here just the knowledge provided is not merely counted but also completion prior to proposed deadline will also have a check on the student's serious consideration of the assignments.

Presentation of Seminar: Apart from the assignments the concerned instructors also allocate the students with a topic or based on their interests to present seminar that will aid them built their confidence levels, command over English language to communicate with precision and fluently. In addition, the fellow students are encouraged to pose questions that will instigate interest and provide update in that particular topic besides the information presented helping them to prepare for their examinations that can be taken as added advantage for the students.

Preparedness: At the end of every class, the concerned instructor tells the students what will be taken in the next class using these details the students should be aware of the topics that will be covered in the upcoming lectures which actually enhance the student's capability to grasp the knowledge and concepts provided much efficiently.

Academic Dishonesty: This is an important aspect that every student should be aware of. Thus, the respective faculty members educate the students of possible means of academic malpractices (plagiarism, violation of copyrights and stealing the patented knowledge) and the following consequences that will make them more vigilant in their academic career.

Subject to change clause: Based on the requirement of student's feasibility and meeting the competitive demands of the discipline the syllabus courses will be re-structured and updated accordingly at the discretion of the Professor(s) and Board of studies chairman.

Important dates: Please note down the important dates and stick to the schedule

CIA Test I	CIA Test II	Assignment	Seminar
As per Academic Calendar		After CIA Test-I	

Course Outline: Core: Genetics and Genetic Engineering

1. Understand and think about the basics of Genetic and Genetic Engineering.
2. To understand the role, use and types of different DNA modifying enzymes viz. Polymerases, Nucleases, restriction endonuclease, ligases etc.
3. Acquire basic knowledge of DNA sequencing methods from conventional (Sanger sequencing) to High throughput Next generation sequencing technology, their principle, chemistry, theory and types.
4. Syllabus will also provide plethora of information to students regarding basic molecular biology techniques like blotting and its different types, DNA foot printing as well as description of industrial application of genetic engineering Technology, therapeutic and enzymatic products and deployment of Genetics and Genetic Engineering in diagnosis and disease.

More books for Reading and Referencing:

An Introduction to genetic engineering third edition – Desmond S.T.Nicholl
Genetic Engineering (Oxford Higher Education) Paperback – 8 Jul 2009
Genetic Engineering Paperback – 1 Jul 2017 by Sandhya Mitra

Semester – III					
Core-X	**Course Code: 502301**	**Genetics and Genetic Engineering**	**T**	**Credits: 5**	**Hours :5**
Unit - I					
Objective -1	To define and explain basic concepts of genetics including phenotypes, alleles, dominance, inheritance patterns and mutations.				
Basics of Genetics: Definition and scope of Genetics, Definitions- Phenotypes, Alleles, Dominance, Incomplete Dominance, co-dominance, Recessiveness, Homozygous, Heterozygous, Hemizygous , Penetrance and Expressivity. Mendelian genetics: Mendel's experiments, Law of segregation, monohybrid crosses, Law of independent assortment and exceptions, introduction to linkage and recombination, Inheritance in families, pedigree symbols, autosomal dominant, autosomal recessive X-linked inheritances. Multi-factorial, Mitochondrial and complex inheritance.					
Outcome -1	Develop a strong foundation in the basics of genetics, including Mendelian genetics, inheritance patterns, and pedigree analysis.				**K2**
Unit – II					
Objective -2	To describe gene interactions including complementary, supplementary, epistatic and non-epistatic interactions.				

Gene Mutations and Interactions: Structure and organization of human genome: chromosomes, mitochondria. Definition and types of mutation, Eye color in Drosophila, Blood groups and Rh factor in Human. Genetic problems related. **Gene interactions**: Deviations from Mendelism: Inter Allelic-Complementary gene interaction Ex. *Lathyrus odoratus.* Supplementry gene interaction Ex. Grain color in Maize. Epistasis: - Dominant –Ex. Fruit color in *Cucurbita pepo*. Epistasis: - Recessive –Ex. Coat color in Mice. Inter allelic Non Epistatic: Ex. Comb pattern in Fowl.

Outcome -2	Understand the facts about the gene mutations, interactions, and their implications in various organisms, including humans.	**K2**

Unit – III

Objective -3	To explain mechanisms of gene expression in prokaryotes and eukaryotes and methods to study gene expression.

Gene Expression Studies: Prokaryotic and Eukaryotic Systems, Prokaryotic and Eukaryotic genome organization, structure and mechanisms of gene expression, factors involved in gene regulation, Basic concepts of replication, Regulation of translation, Post transcriptional modifications, processing of DNA, RNA and proteins methods for studying gene expression and regulatory sequences, large-scale expression analysis, Recombinant DNA technology, over expression-Isolation and purification of proteins-various techniques, Mechanisms of genome alterations.

Outcome -3	Master the concepts of gene expression, regulation, and recombinant DNA technology in prokaryotic and eukaryotic systems.	**K5**

Unit – IV

Objective -4	To describe methods of genetic transfer and mapping as well as apply concepts of population genetics.

Gene Transfer methods and Population studies: Genetic variations and polymorphism at genome level, Epigenetic mechanisms of inheritance, Methods of genetic transfers – transformation, conjugation, transduction and sexduction, mapping genes by interrupted mating, fine structure analysis of genes. Basic Human genetics: Pedigree analysis, linkage testing, karyotypes, genetic disorders, Population genetics, Hardy Weinberg Principle.

Outcome -4	Acquire knowledge of gene transfer methods, population genetics, and human genetics, including genetic disorders and karyotypes.	**K3**

Unit-V

Objective -5	To elucidate genetic engineering strategies for plants and animals including *Agrobacterium*-mediated transformation, applications and safety issues.

Genetic Engineering Strategies: Genetic transformation by using *Agrobacterium tumefaciens*, virulence, Ti and Ri plasmids, binary vectors and their utility, T DNA transfer, *Agrobacterium* mediated gene delivery, selectable markers, Monocot and dicot transformation, Management of transgenic plants, Applications of plant genetic engineering, Abiotic and biotic stress resistance, Pest Resistance, Herbicide Resistance, Mechanism of gene action, fruit ripening process, Improvement of the nutritional quality of seeds, Edible vaccines, Issues in Genetic Engineering, Bio and Environmental safety of transgenic products. Methods of gene transfer to animal cell culture, Selectable markers for animal cells - Isolation and manipulation of mammalian embryonic stem cells.

Outcome -5	Know the aspects of genetic engineering strategies for plant and animal improvement, addressing issues related to bio and environmental safety.	**K3**

Suggested Readings:

Sandy B., Primrose and Richard Twyman. (2016). Principles of Gene Manipulation and genomics; Wiley-Blackwell. 7th Edition

Brown T. A. (2016). Gene cloning and DNA analysis, An introduction; Wiley-Blackwell, 7th edition.

Watson, J. D, Gilman, M., Witkowski, J., and Zoller, M. (2007) Recombinant DNA: Genes and Genomes: A Short Course, W.H. Freeman and Co., New York, N.Y., U.S.A. 3rd Edition.

Gunder. (2010) Essentials of Medical Genetics Jones and Bartlett learning 1st edition. Strachan T, and Read AP. (2012) "Human Molecular Genetics"; Garland Science Publisher 4th edition.

Bruce. R. Korf. (2013) Human Genetics and genome 4th edition kindle edition.

Jin Kim. (2017) Cancer Genetics and Genomics for Personalized Medicine 2nd edition.

Online Resources:

1. https://www.google.com/search?q=Principles+of+Gene+Manipulation+and+genomics
2. https://link.springer.com/chapter/10.1007/978-3-642-61462-0_1

K1-Remember	*K2-Understand*	*K3-Apply*	*K4-Analyze*	*K5-Evaluate*	*K6-Create*

Course designed by:Dr. J. Joseph Sahayarayan

Course Outcome VS Programme Outcomes

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S(3)	S(3)	S(3)	M(2)	M(2)	S(3)	M(2)	S(3)	M(2)	S(3)
CO2	S(3)	S(3)	S(3)	M(2)	M(2)	S(3)	M(2)	S(3)	M(2)	S(3)
CO3	S(3)	S(3)	S(3)	M(2)	M(2)	S(3)	M(2)	S(3)	M(2)	S(3)
CO4	S(3)	S(3)	S(3)	M(2)	M(2)	S(3)	M(2)	S(3)	S(3)	S(3)
CO5	S(3)	S(3)	S(3)	M(2)	M(2)	S(3)	M(2)	S(3)	S(3)	S(3)
W. AV	3	3	3	2	2	3	2	3	2.4	3

S –Strong (3), M-Medium (2), L- Low (1)

Course Outcome VS Programme Specific Outcomes

CO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	M(2)	M(2)	M(2)	S(3)	S(3)
CO2	M(2)	M(2)	M(2)	S(3)	S(3)
CO3	M(2)	M(2)	M(2)	S(3)	S(3)
CO4	M(2)	M(2)	M(2)	S(3)	S(3)
CO5	M(2)	M(2)	M(2)	S(3)	S(3)
W.AV	2	2	2	3	3

S –Strong (3), M-Medium (2), L- Low (1)

Assignment & Seminar – Genetics and Genetic Engineering

1. Mendel's experiments.
2. Sex linked inheritance.
3. Pedigree Analysis.
4. Types of mutation.
5. Blood groups, Rh factor in Human, Epistasis.
6. Genome organization of Prokaryotic and Eukaryotic cell, Regulation of translation, Post transcriptional modifications.
7. Mechanism of genome alteration.
8. Chromosomal abnormalities.
9. Oncogenes, Tumor suppressor genes.
10. Selectable markers, abiotic and biotic stress resistance, fruit ripening, edible vaccines.

Program: M.Sc.,	Semester: III (2022 Onwards)
Course Title: Structural Biology Subject Code: 502302	Class Time: As per Time Table
Name of the Course Teacher	Prof. J. Jeyakanthan
Mobile: +91 - 97898 09245	Email: jjeyakanthan@alagappauniversity.ac.in

Course Brief:

Protein structure forms a central hub to the modern understanding of biological processes and is used in various biotechnological applications including the design of medicines and vaccines, agrochemicals and enzymes for industrial processes. This course aims to extend the discussions on protein structure and function present in microbes, insects, animals and human models and to use this knowledge to gain an understanding of the essential processes of molecular biology. The course covers two principle themes: Small molecular X-ray crystallography: topics include Crystal growth and its techniques, Crystallization of synthetic compounds, X-ray data collection and direct methods to refine the structure. Macromolecular X-ray crystallography topics include - structure and function of different classes of proteins, cloning, expression, purification, crystallization, data collection and structure solution/ determination. Protein folding, Protein degradation, development of new therapies, molecular interactions and recognition are covered in this syllabus.

Teaching Methods: The mode of teaching of delivering the courses are as follows through these below mentioned methodologies:

- Delivering the lectures in the form of presentation using advanced technologies devices such as smart board.
- Video-conferencing for lectures that will be sought from experts belonging to overseas reputed institutions
- Case-studies and Review questions

Attendance: Having good attendance record marks the student's sincerity and has an overall positive impact on his/her personality trait development. The students are asked to attend the classes on a regular note and those having a minimum scale of 70-75% attendance are eligible to take up the end-semester examinations as per the University norms.

Punctuality: It is the most important attribute to be followed and maintained by the student throughout his/her life which for sure will lead to the path of success. Students who arrive late by 10mins after the attendance has been taken will be marked absent unless there is a valid reason (medical/ personal emergency) at the discretion of the Head of the Department.

Class Participation: A student's overall growth and personality development is based on his/her involvement in the class not just by mere presence but rather being interactive through questioning that will lead to propagation of ideas, initiation of thought-provoking process and much more that will provide a wholesome enriched classroom experience. Therefore, students are advised to be more attentive so that they learn from one another and develop quality-based knowledge.

Submission of Assignment: Assignments are given to students with just one motive to get more quantitative and qualitative knowledge insights into the assigned topic/chapter that will lead to preparation and completion of the assignment in a constructive manner here just the knowledge provided is not merely counted but also completion prior to proposed deadline will also have a check on the student's serious consideration of the assignments.

Presentation of Seminar: Apart from the assignments the concerned instructors also allocate the students with a topic or based on their interests to present seminar that will aid them built

their confidence levels, command over English language to communicate with precision and fluently. In addition, the fellow students are encouraged to pose questions that will instigate interest and provide update in that particular topic besides
the information presented helping them to prepare for their examinations that can be taken as added advantage for the students.

Preparedness: At the end of every class, the concerned instructor tells the students what will be taken in the next class using these details the students should be aware of the topics that will be covered in the upcoming lectures which actually enhance the student's capability to grasp the knowledge and concepts provided much efficiently.

Academic Dishonesty: This is an important aspect that every student should be aware of. Thus, the respective faculty members educate the students of possible means of academic malpractices (plagiarism, violation of copyrights and stealing the patented knowledge) and the following consequences that will make them more vigilant in their academiccareer.

Subject to change clause: Based on the requirement of student's feasibility and meeting the competitive demands of the discipline the syllabus courses will be re-structured and updated accordingly at the discretion of the Professor(s) and Board of studies chairman.

Important dates: Please note down the important dates and stick to the schedule

CIA Test I	**II CIA Test**	**Assignment**	**Seminar**
As per Academic Calendar		After CIA Test-I	

Course Outline: Structural Biology

- **Small molecular X-ray crystallography:** include Crystal growth and its techniques, Crystallization of synthetic compounds - X-ray data collection and direct methods to refine the structure.
- **Macromolecular X-ray crystallography:** include structure and function of different classes of proteins, cloning, expression, purification, crystallization, datacollection and structure solution/ determination.
- Tools for model building and refinement.
- Structural data repositories: Protein Data Bank, Electron Microscopy Data Bank.
- Tools for homology modeling: WHATIF, AutoRickshaw, ARP/wARP, and other software.
- Tools and resources for drug discovery: ChEMBL, GOLD for protein-ligand docking, PDBeChem, PDBeMotif.
- Tools and resources for protein analysis and classification: Pfam, CATH, SCOP, InterPro, PDBeFold, ProFunc.

More books for Reading and Referencing

Macromolecular Crystallography with Synchrotron Radiation by John R. Helliwell; 2004, **ISBN:0521334675**
Principles of X-ray Crystallography by Li-ling Ooi; 2010, **ISBN:9780199539045**
International Tables for Crystallography, Volume C: Mathematical, Physical AND Chemical Tables edited by E. Prince, 2004, **ISBN:1-4020-1900-9**

Semester – III					
Core-XI	**Course Code: 502302**	**Structural Biology**	**T**	**Credits: 5**	**Hours :5**

Unit I

Objectives -1	To and comprehend basic knowledge underlying the demonstrate central concepts in the structural biology through theoretical andpractical methodologies**.**

Introduction to Crystallography: General concepts, overview of Crystals and their properties. Single crystal, powder crystal and Amorphous solid. Unit cell, Lattices, Planes and Indices, stereographic projection of point groups and space groups. Crystal systems and Symmetry. X-ray generator, diffraction and its applications; Laue equations, Braggs' Law and its applications in X-ray diffraction, Atomic scattering factor, Structure factor and Electron density calculations, phase problem

Outcome - 1	Understanding the basic ideas of structural biology andexplain the X – ray to describe the crystal systems.	**K2**

Unit – II

Objective - 2	To study the fundamentals of proteomics based research and solution structure determination of biomolecules.

Structure Determination Techniques: Synchrotron radiation and its implications in structure determination. Introduction to X-ray Free Electron Laser technology (XFEL), importance and applications. Cryo-electron microscopy, Fiber, Powder and Neutron diffraction. NMR-Introduction and general aspects of structure determination. NMR Sample preparation. Importance of NMR in Structural Biology, Cryo-EM.

Outcome - 2	Creating the basic experiments and research methods to identify the gene/protein, isolate, purify and explain the functions of proteins.	**K5**

Unit – III

Objective - 3	To approach of structure and function relationships of biomolecules and methods to solving the Small molecule crystal structures.

Small Molecule X-ray Crystallography: Crystal growth - various techniques, Crystallization of small molecules from synthetic compounds, Single crystal X-ray data collection, data reduction. Structure solution–Application of direct methods of solving a small molecule, Patterson method. Refinement of crystal structure – Fourier refinement, Fourier synthesis and least squares techniques. Structure validation and analysis

Outcome - 3	Describe the *in vitro* analysis that aid to determine the smalland macromolecular structures.	**K5**

Unit – IV

Objective - 4	To identify its therapeutic impacts by making a thorough detailed study on its atomistic structure and its correlation with function delivered in biological process.

Protein X-ray Crystallography: Crystallization methods (sitting, hanging drop, microbatch methods etc.,), Soaking and Co-Crystallization methods, Heavy atoms screening, X-ray data collection, data reduction and Integration, various Protein structure determination methods, interpretation of electron density maps, structure solution, structure refinement, Structure Validation and Analysis. Structural Classification, Folds and Motifs, Deposition of structure in Protein Data Bank (PDB).

Outcome - 4	Demonstrate the document in proper computational andexperimental approaches.	**K4**

Unit-V

Objective - 5	To acquire knowledge on the various aspects of the protein crystalstructure and molecular aspects of theprotein crystal structure

Molecular Geometries and Interactions: R-factors, B-factors, Density fit, Unit map, Bulk-solvent corrections. Internal geometry of molecule (Bond lengths, Bond angles and Torsion angles), Conformation of small and macromolecule structures, Ramachandran Plot, thermal motion analysis. Planarity, Chirality, covalent and non-covalent interactions-hydrogen bonds, hydrophobic, van der Waals forces, disulphide bonds etc.
Application of X-ray crystallography in drug design.

Outcome - 5	Create a power point presentation with animation, audio and video of interactions between the complexprotein structures	**K5**

Suggested Readings:

Giacovazzo, C. Monaco, H.L. Artioli, G. Viterbo, D. Milanesio, M. Ferraris, G. Gilli, G. Gilli, P. Zanotti, G. Catti, M. (2011) "Fundamentals of Crystallography - Third Edition"; International Unioin of Crystallography; Oxford [u.a.]: Oxford Univ. Press, OxfordScience Publications

Carl Branden and John Tooze (1991) "Introduction to Protein Structure": Garland Publishing Inc

Amit Kessel and Nir Ben Tal (2018). "Introduction to Proteins. Structure, Function and Motion - Second Edition"; CRC Press - Taylor and Francis Group.

Toshiya Senda and Katsumi Maenaka (2016). "Advanced Methods in Structural Biology"; Springer.

Bernhard Rupp (2010). "Biomolecular Crystallography - Principles, Practice and Application to Structural biology"; GS - Garland Science - Taylor and Francis Group.

George H. Stout, Lyle H. Jensen (1989) "X-Ray Structure Determination": John Wiley & Sons

Jan Drenth (1994) "Principles of Protein Crystallography"; Springer-Verlag New York,Inc

Bourne, P. E. & Weissig, H. (2003) "Structural bioinformatics"; Wiley-Liss

Christopher Hammond (2009) "The Basics of crystallography and diffraction" Oxford. Liljas, A., Liljas, L., Piskur, J., Lindblom, G. Nissen, P. Kjeldgaard, M. (2009) "Textbook of structural biology"; Hackensack, N.J. World Scientific.

Dmitri I. Svergun (2013) "Small angle X-Ray and neutron scattering from solutions of biological macromolecules" Oxford.

Marcus Frederick Charles Ladd and Rex Alfred Palmer, (2013), Structure Determination by X-ray Crystallography, Springer.

David Blow., and Jan Denth (2014) "Macromolecular crystallography"

Li-ling Ooi, (2014), Principles of x-ray crystallography, Oxford University Press

F. C. Philips "An Introduction to Crystallography", Cambridge

Online Resources:

1. https://www.sciencedirect.com/topics/materials-science/crystallography
2. https://www.sciencedirect.com/topics/engineering/protein-crystallization

K1-Remember	*K2-Understand*	*K3-Apply*	*K4-Analyze*	*K5-Evaluate*	*K6-Create*

Course designed by:Dr. J. Jeyakanthan

Course Outcome VS Programme Outcomes

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	M(2)	M(2)	M(2)	M(2)	M(2)	M(2)	S(3)	M(2)	M(2)	S(3)
CO2	M(2)	M(2)	M(2)	M(2)	M(2)	M(2)	M(2)	M(2)	M(2)	S(3)
CO3	M(2)	M(2)	M(2)	M(2)	M(2)	S(3)	M(2)	M(2)	M(2)	M(2)
CO4	M(2)	S(3)	S(3)	S(3)	M(2)	M(2)	S(3)	M(2)	M(2)	M(2)
CO5	M(2)	M(2)	M(2)	M(2)	M(2)	M(2)	M(2)	M(2)	M(2)	M(2)
W.AV	2	2.2	2.2	2.2	2	2.2	2	2	2	2.4

S –Strong (3), M-Medium (2), L- Low (1)

Course Outcome VS Programme Specific Outcomes

CO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	S(3)	S(3)	S(3)	S(3)	S(3)
CO2	S(3)	S(3)	S(3)	S(3)	S(3)
CO3	S(3)	M(2)	S(3)	S(3)	S(3)
CO4	S(3)	S(3)	S(3)	S(3)	S(3)
W. AV	3	3	3	3	3

S –Strong (3), M-Medium (2), L- Low (1)

Assignment & Seminar - Structural Biology

1. X-ray and its properties; X-ray generation diffraction and its applications.
2. Structure factor, Electron density calculations and phase problem.
3. Point group, Space group, Crystal systems and Symmetry.
4. Synchrotron radiation and its implications in structure determination.
5. NMR- Introduction and general aspects of structure determination.
6. Application of direct methods over Patterson method of solving a small molecule.
7. Protein structure determination methods - Molecular Replacement technique (MR), Single Isomorphous Replacement method (SIR), Multiple Isomorphous Replacement Method (MIR), Single wavelength Anomalous Diffraction method (SAD) and Multi wavelength Anomalous Diffraction method (MAD).
8. Application of X-ray crystallography in drug design.
9. Conformation of small and macromolecule structures and thermal motionanalysis.
10. list out the places for Synchrotron and NMR facilities available for ProteinStructure Determination.

Pharmacogenomics

Program: M.Sc.,	Semester: III (2022 Onwards)
Course Title: Pharmacogenomics Subject Code: 502303	Class Time: As per Time Table
Name of the Course Teacher	Dr. M. Karthikeyan
Moble: +91 9486981874	E-mail: karthikeyanm@alagappauniversity.ac.in

Course Brief:

The course will provide an introduction to the application of genetic and genomic methods to the study of drug response and the genetic basis for variation in that response. It will give students a broad perspective on the emergence ofPharmacogenomics as a new field and provide them with insight into the growing importance it will play in clinical therapeutics and future drug design. The latest advancement in NGS sequencing will be much helpful to students to gain insights into Pharmacogenomics.

Teaching Methods: The mode of teaching of delivering the courses are as follows through these below mentioned methodologies:

- Delivering the lectures in the form of presentation using advanced technologies

devices such as smart board.

- Video-conferencing for lectures that will be sought from experts belonging to overseas reputed institutions
- Case-studies and Review questions

Attendance: Having good attendance record marks the student's sincerity and has an overall positive impact on his/her personality trait development. The students are asked to attend the classes on a regular note and those having a minimum scale of 70-75% attendance are eligible to take up the end-semester examinations as per the University norms.

Punctuality: It is the most important attribute to be followed and maintained by the student throughout his/her life which for sure will lead to the path of success. Students who arrive late by 10mins after the attendance has been taken will be marked absent unless there is a valid reason (medical/ personal emergency) at the discretion of the Head of the Department.

Class Participation: A student's overall growth and personality development is based on his/her involvement in the class not just by mere presence but rather being interactive through questioning that will lead to propagation of ideas, initiation of thought-provoking process and much more that will provide a wholesome enriched classroom experience. Therefore, students are advised to be more attentive so that they learn from one another and develop quality-based knowledge.

Submission of Assignment: Assignments are given to students with just one motive to get more quantitative and qualitative knowledge insights into the assigned topic/chapter that will lead to preparation and completion of the assignment in a constructive manner here just the knowledge provided is not merely counted but also completion prior to proposed deadline will also have a check on the student's serious consideration of the assignments.

Presentation of Seminar: Apart from the assignments the concerned instructors also allocate the students with a topic or based on their interests to present seminar that will aid them built their confidence levels, command over English language to communicate with precision and fluently. In addition, the fellow students are encouraged to pose questions that will instigate interest and provide update in that particular topic besides the information presented helping them to prepare for their examinations that can be taken as added advantage for the students.

Preparedness: At the end of every class, the concerned instructor tells the students what will be taken in the next class using these details the students should be aware of the topics that will be covered in the upcoming lectures which actually enhance the student's capability to grasp the knowledge and concepts provided much efficiently.

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Subject to change clause: Based on the requirement of student's feasibility and meeting the competitive demands of the discipline the syllabus courses will be re-structured and updated accordingly at the discretion of the Professor(s) and Board of studies chairman.

Important dates: Please note down the important dates and stick to the schedule

CIA Test I	II CIA Test	Assignment	Seminar
As per Academic Calendar		After CIA Test-I	

Course Outline: Core: Pharmacogenomics

- Basic concepts of pharmacogenomics and genetics diseases.
- Pharmacogenomics necessity in drug designing.
- Polymorphisms and their importance in drug designing.
- Structural influence in the Drug response.
- Prediction of structural changes among sequences by the influence of polymorphisms.
- Tools for pharmacogenomic analysis. Pharmacokinetics (PK), Pharmacodynamics (PD).
- Target Structure optimization, Validation, lead identification, ADME prediction.
- Synthesis, assay, and clinical trials for the identification of novel drug.
- Allele-Specific Variation in Human Gene Expression and Genome-Wide Analysisof Allele-Specific Gene Expression.
- Expression study using Oligo Microarrays, Roche Ampli Chip, HaploChIP.
- NGS technology and application in Pharmacogenomics.
- Association Studies in Pharmacogenomics - Pharmacogenomics of Anticoagulation drugs.
- Ethical issues for Pharmacogenomics.
- Pharmacogenomics and Future of Pharmaceuticals.

More books for Reading and Referencing

Molecular analysis and Genome discovery; John Willey & Sons, Ltd. by Rapley, R. & Harbron, S. 2012, **ISBN: 978097758779**
Comparative genomics: empirical and analytical approaches to gene orderdynamics, map alignment and the evolution of gene families; Netherlands, Kluwer Academic Publishers by Sankoff, D. & Nadeau, J.H. 2000, **ISBN:978-0-7923-6584-6, 978-94-011-4309-7**

Semester-III					
Core-XII	**Course Code 502303**	**Pharmacogenomics**	**T**	**Credits:4**	**Hours:5**
Unit-I					
Objective - 1	To understand the principles of human genetics and genomics as they apply to improving the problems in drug therapy optimization and patient care.				
Introduction and Concepts in Genomics: Large scale genome sequencing strategies, Genome assembly and annotation, Genome databases of plants, animals and pathogens. Metagenomics: Gene networks: basicconcepts, computational model such as Lambda receptor and lac operon Prediction of genes, promoters, splice sites, regulatory regions: basicprinciples, application of methods to prokaryotic and eukaryotic genomes and interpretationof results, Basic concepts on identification of disease genes, role of bioinformatics-OMIM database, reference genome sequence, integrated genomic maps, gene expression profiling; Identification of SNPs, SNP database(DbSNP).					
Outcome - 1	Understanding the principles of pharmacogenomics and its significance in drug therapy				**K2 &K4**
Unit-II					
Objective - 2	To gain a knowledge about comparative and functional genomics				

Comparative genomics: Basic concepts and applications, BLAST2, Mega Blast algorithms, PipMaker, AVID,Vista, MUMmer, applications of suffix tree in comparative genomics, synteny and gene order comparisons, Comparative genomics databases: Clusters of Orthologous Groups (COGs) Functional genomics: Application of sequence based and structure-based approaches to assignment of gene functions – e.g. sequence comparison,structure analysis(especially active sites, binding sites) and comparison, pattern identification, etc. Use of various derived databases in function assignment, Polymorphisms Introduction, types and importance in Drug targets. Prediction of structural changes among sequences by the influence of polymorphisms.		
Outcome - 2	Understanding the structural and functional aspects of polymorphisms.	**K2 &K4**
Unit-III		
Objective - 3	To improve patient outcomes by maximizing efficacy and minimizing toxicity of drug therapy through research, teaching and service focusedon genetically-guided drug therapy decision-making, drug discovery and drug development.	
Pharmacogenomics Overview, Concepts and Applications: Introduction, basic concepts about genetics diseases. Personalized medicine- introduction and importance. The genetics of therapeutic targets and gene-based targets. Pharmacogenomics necessity in drugdesigning. Drug response to patients, Structural influence in the Drug response. Efficacy and metabolism of drugs. Pharmacogenomics vs. Structural Pharmacogenomics. Drug metabolism pathways and adverse drug reactions. Tools for pharmacogenomic analysis. Pharmacokinetics (PK), Pharmacodynamics (PD). Process in Structural Pharmacogenomics – Target Structure optimization, Validation, leadidentification, ADME prediction, synthesis, assays and Clinicaltrials.		
Outcome - 3	Understand the pharmacodynamics and pharmacokinetics properties of the drug.	**K2**
Unit-IV		
Objective - 4	To help students to gain knowledge about the NGS technologies andvarious techniques useful in Personalized drug designing.	
Pharmacogenomics analysis, Techniques and Case study: Role of SNP in Pharmacogenomics, SNP arrays DNA microarray: database and basic tools, Gene Expression Omnibus(GEO), Array Express, SAGE databases. DNA microarray: understanding of microarray data, normalizing microarray data, detecting differential gene expression, correlation of gene expression data to biological process and computational analysis tools(especially clustering approaches). Application of NGS in Pharmacogenomics: Emergence of Next generation sequencing, Illumina Genome Analyzer, Nanopore Sequencing, Single Molecule Real Time DNA sequencing, Comparison of Next generation sequencing techniques, Drawbacks of NGS, NGS File formats, & applications. Ethical issues for Pharmacogenomics; Future of Pharmaceuticals.		
Outcome - 4	Discuss about the NGS techniques and its applications in Pharmacogenomics.	**K4**
Unit-V		
Objective - 5	Case study examples and concepts will help students to understand the current scenario in therapeutic treatment.	

Case Study Examples-Cancer Pharmacogenomics: Concepts of cancer genomics, Bioinformatics in cancer diagnosis, prognosis and treatment, cancer specific databases: TCGA, ICGC, COSMIC, importance of copy number alterations in Cancer, Bioinformatics methods for detecting copy number alterations, correlating clinical outcomes with genomic data, Survival analysis and use of bioinformatics for personal medicine.

Outcome - 5	Application of various computational tools to analyze gene expression data.	**K5**

Suggested Readings:

Falconer,D.S.,Mackay,T.F.C.,(1996)"Introduction to Quantitative Genetics".Pearson Ed ucation Ltd,4th Edition

Yan, Qing.(2014)."Pharmacogenomics in Drug Discovery and Development"; Springer–Verlag, NewYork, LLC, 2nd Edition.

Yui-Wing, LCavallari. (2013)."Pharmacogenomics-Challenges and Opportunities in Therapeutic Implementation"Academic Press,1st Edition.

Sankoff, D. & Nadeau, J.H. (2000) "Comparative genomics: empirical and analytical approaches togene order dynamics, mapalignment and theevolution of gene families";Netherlands, Kluwer Academic Publishers.

Richard, J.R.(2003)"AnalysisofGenesandGenomes";WileyPublications.

Mount, D. (2004) "Bioinformatics: Sequence and Genome Analysis";2nd edition, Cold Spring Harbor Laboratory Press, New York.

Online Resources:

1. https://www.genome.gov/genetics-glossary/Pharmacogenomics
2. https://www.cancer.net/navigating-cancer-care/how-cancer-treated/personalized-and-targeted-therapies/understanding-pharmacogenomics
3. www.sciencedirect.com/topics/medicine-and-dentistry/pharmacogenomics

K1-Remember	*K2-Understand*	*K3-Apply*	*K4-Analyze*	*K5-Evaluate*	*K6-Create*

Course designed by: Dr. M. Karthikeyan

Course Outcome Vs Program Outcomes

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S(3)	S(3)	S(3)	S(3)	S(3)	-	-	M(2)	S(3)	S(3)
CO2	S(3)	M(2)	L(1)	L(1)	S(3)	-	S(3)	S(3)	L(1)	L(1)
CO3	S(3)	S(3)	S(3)	S(3)	L(1)	-	M(2)	S(3)	M(2)	L(1)
CO4	L(1)	M(2)	M(2)	M(2)	M(2)	S(3)	S(3)	M(2)	S(3)	L(1)
CO5	M(2)	M(2)	S(3)	M(2)	S(3)	L(1)	S(3)	S(3)	M(2)	L(1)
W. AV	2.4	2.4	2.4	2.2	2.4	0.8	2.2	2.6	2.2	1.4

S-Strong (3), M-Medium (2), L-Low (1) Mapping

Course Outcome Vs Program Specific outcomes

CO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	L(1)	L(1)	S(3)	-	-
CO2	L(1)	-	S(3)	L(1)	L(1)
CO3	S(3)	-	L(1)	M(2)	S(3)
CO4	M(2)	S(3)	M(2)	M(2)	L(1)
CO5	S(3)	M(2)	S(3)	M(2)	M(2)
W. AV	2	1.2	2.4	1.4	1.4

S-Strong (3), M-Medium (2), L-Low (1)

Assignment & Seminar: Pharmacogenomics

I. Objective type Questions. Choose the correct or most correct alternatives

1. Potential outcomes of pharmacogenetic research include all the following except

A) lower incidence of adverse drug effects.

B) new drug development.

C) higher health care costs.

D) improved treatment outcomes.

E) pretreatment screening for genetic polymorphisms.

2. The most commonly occurring variant in the human genome is

A) tandem-repeat polymorphism.

B) premature stop codon.

C) nucleotide base insertion.

D) single-nucleotide polymorphism.

E) defective gene splicing.

3. Genetic variations in drug targets may contribute to which drug property?

A) Bioavailability

B) Half-life

C) Racial differences in response

D) Peak-dose area under the curve

E) Entry into the central nervous system

4. CYP2D6 polymorphism can affect:

A) drug efficacy.

B) drug toxicity.

C) drug interaction potential.

D) drug delivery.

E) a, b, and c.

II. Write short notes for the following questions

5. Explain the role of Bioinformatics in Pharmacogenomics.

6. Students should complete one large sequence analysis projects during the course.

7. What is polymorphism? and explain its importance in drug targeting.

8. Prepare a Glossary for any 25 Cyp enzymes involved in Pharmacogenomics.

9. How pharmacogenomics aims to improve drug efficacy and toxicity?

10. Explain about Single Nucleotide Polymorphism and its role in Pharmacogenomics.

11. Describe personalized medicine and its importance.

Lab-III: Computer Aided Drug Design (CADD)

Program: M.Sc., Bioinformatics	Semester : III (2022 Onwards)
Course Title: Lab-III: Computer Aided Drug Design (CADD) Subject Code: 502304	Class Time: As per Time table
Name of Course Teacher	Dr. Sanjeev Kumar Singh
Mobile: +91-9894429800	Email : sksingh@alagappauniversity.ac.in

Course Brief:

The course depicts the core concepts of Computer Aided Drug Designing methods. It covers a vast range of methods and computational tools used in drug designing which includes, virtual screening methods, structure similarity searching method, protein structure prediction, molecular dynamics simulation, different types of molecular docking and its related software(s), pharmacophore concepts, combinatorial synthesis, QSAR and its theory. This course serves the students not only provides hands on experience on various computational tools but also offer sound knowledge on understanding the merits and demerits of the methods and tools available. This course also serves the students to get prepared for the extensive research in the field of Computer Aided Drug Designing.

Teaching Methods: The mode of teaching is based on the following learning activities:

- Lectures covering the theoretical part will be delivered using PowerPoint presentations.
- A set of laboratory exercises to analyze biological problems using softwares and tools to develop student's interests in scientific discovery.
- Case studies in informatics-based research.

Attendance: The students are expected to attend the classes regularly, since regular attendance is essential to gain academic achievement. As per the University norms, the students having a minimum scale of 70-75% attendance are only qualified to write their end-semester examinations.

Punctuality: Punctuality is the most important quality for the student to be followed and maintained to achieve success. Students who arrive late by 10 mins to the class without any vital reason will be marked absent in the attendance register. On the other hand, valid excuse including personal or medical emergency is acceptable, with prior consent by the Head of the Department.

Class Participation: A student's overall growth and personality development is based on

his/her involvement in the class not just by mere presence but rather being interactive through questioning that will lead to propagation of ideas, initiation of thought-provoking practice and much more that will provide a wholesome enriched classroom experience. When students participate, they learn from one another and gain their knowledge better.

Submission of Assignment: Assignments are given to students in order to apply the concepts for deeper understanding of the subject. Therefore, each student will be allocated two assignments for the course, covering the entire topic. Students will be given deadline to submit the assignment by the course instructor and good preparationof assignment will help the students for their final exams.

Presentation of Seminar: Apart from the assignments, students are supposed to give an oral presentation during the class seminar hours in their assigned topic. The concerned instructor will encourage the participants to ask valid questions during seminar presentation in order to put up their confidence levels and communication skills. In addition, students will be able to gain information and can be updated in their course.

Preparedness: At the end of every class, the concerned instructor conveys the students about the details that will be handled in the next class to increase the student's awareness related to the topics.

Academic Dishonesty: Academic dishonesty is a completely unacceptable mode of conduct and every student should be aware of this important aspect. Thus, the respective faculty members educate the students of possible means of academic malpractices (plagiarism, violation of copyrights and stealing the patented knowledge) and the following consequences that will make them more vigilant in their academic career.

Subject to change clause: Depending upon the requirement of student's possibility, the course syllabus will be re-structured and updated accordingly at the discretion of the Professor(s) and Board of studies chairperson.

Important dates: Scheduled dates for the various activities related to the course

CIA Test I	**CIA Test II**	**Assignment I**	**Seminar**
As per Academic Calendar		After CIA Test -I	

Course Outline: Lab III: Computer Aided Drug Design

- Energy minimization, geometry optimization, conformational analysis, global conformational minima determination; Bioactive vs. global minimum conformations
- Automated methods of conformational search; Advantages and limitations ofavailable software; Molecular graphics;
- Computer methodologies behind molecular modeling, High throughput virtual Screening. Screening of Potential Compounds from database. Structure similarity searching. *De novo* drug designing. ADME/T for predicted ligand.
- Ramachandaran plot, Protein structure prediction software's, Protein structural visualization. Molecular dynamics simulation of native and complex protein structures. Molecular dynamics simulation of docked complex (Protein-Ligand, Protein-Protein, Protein- Metal, Protein-Nucleic acid and Protein - Substrate simulation).
- Molecular docking- different types of docking, rigid docking, flexible docking and partially rigid and partially flexible docking, manual docking Protein – ligand docking, Protein- Protein docking.

- Pharmacophore generation and analysis, pharmacophore mapping, methods of conformational search used in pharmacophore mapping
- QSAR and QSPR, QSAR Methodology, Various Descriptors used in QSARs: Electronic; Topology; Quantum Chemical based Descriptors.

More books for Reading and Referencing

Computational Drug Discovery and Design – **Riccardo Baron** Publisher: Springer Publication, 2012. ISBN: 978-1-61779-464-3
Computer-Aided Drug Design: Methods and Applications - **T. J. Perun & C. L. Propst** Publisher: CRC Press, 1989. ISBN: 978-0824780371

Semester-III					
Core-XIII	**Course Code 502304**	**Lab - III Computer Aided Drug Design (CADD)**	**P**	**Credits:4**	**Hours:5**
Unit-I					
Objective - 1	To provide hands on experience on various computational tools used in drug designing				
Molecular modeling and Virtual Screening: Energy minimization and optimization, conformational analysis, global and local minima; Bioactive vs. global minimum conformations; Automated methods of conformational search; Molecular graphics; Computer methodologies behind molecular modeling, High throughput virtual Screening; Shape based virtual screening; Structure similarity searching; ADME/T Property prediction; Structural Fingerprint search.					
Outcome - 1	The students would be able to perform all the computational methods on their own				**K3**
Unit-II					
Objective - 2	To make them learn about virtual screening and its types				
Pharmacophore: Concept of Pharmacophore generation and analysis, pharmacophore mapping, methods of conformational search used in pharmacophore mapping; Comparison between the popular pharmacophore methods like catalyst, HipHop, DiscoTech, GASP, etc. with practical examples. Structure based and Energy based pharmacophore models.					
Outcome - 2	They would be able to explain the concepts of molecular modeling, pharmacophore, virtual screening, molecular docking, 3D QSAR etc.,				**K2 &K3**
Unit-III					
Objective - 3	To let them understand the advantages and limitations of available molecular modeling software				
Quantitative Structure Activity relationship (QSAR): QSAR Methodology, QSPR, Various Descriptors used in QSARs: Electronic; Topology; Quantum Chemical based Descriptors. Experimental and theoretical approaches for the determination of physico-chemical property; parameter inter-dependence; linearity versus non-linearity; importance of biological activity; Regression analysis, 2D-QSAR, 3D-QSAR with case studies. CoMFA and CoMSIA; Tools for QSAR studies					
Outcome - 3	They would be well aware of the advantages and limitations of the available computational tools for Drug ddiscovery				**K3**

Unit-IV		
Objective - 4	To learn them protein prediction methods and its validation	
Molecular Docking and Molecular Dynamics Simulations: Different types of molecular docking; Rigid docking; flexible docking; Protein- Protein docking. Induced fit docking with case studies. QM/MM docking; Constraints and restraints in Molecular Docking. Significance of partial charges in molecular docking. Molecular Dynamics using simple models; Molecular Dynamics with continuous potentials and at constant temperature and pressure; Solvent effects in Molecular Dynamics; Conformational changes in Molecular Dynamics. Biomolecular Simulations; Free energy Calculations; Restraint Potentials, Importance of Force Field in Dynamics, Conformational Sampling: Energy Minimization, Monte Carlo Simulations, Membrane Simulation, Metadynamics		
Outcome - 4	Various strategies to design and develop new drug likemolecules.	**K4**
Unit-V		
Objective - 5	To clear concepts of Molecular docking, Molecular dynamics simulation pharmacophore and 3D QSAR methods	
Hands on training: Energy Minimization and Optimization techniques, In silico Virtual screening techniques: Structure based, Shape based, Pharmacophore based, etc, Structural similarity and Finger print search, ADME/T Property prediction, Molecular Docking: Rigid, Flexible and QM/MM 2D and 3D QSAR along with CoMFA and CoMSIA, Pharmacophore Derivation and Pharmacophore Mapping, Molecular Electrostatic Potential (MESP) analysis, Protein-Protein Interaction and Protein-peptide Interaction, Molecular Dynamics Simulation using Protein, Protein-ligand and Protein-DNA complexes		
Outcome - 5	Working with molecular modeling softwares to design newdrug molecules	**K4**

Suggested Readings:

Marx D and Hutter J (2012) "Ab Initio Molecular Dynamics: Basic Theory and Advanced Methods", Cambridge University Press, ISBN: 978-1107663534

Young DC (2009) "Computational Drug Design: A Guide for Computational and Medicinal Chemists", ISBN: 978-0470126851

Bohm HJ (2000) "Virtual Screening for Bioactive Molecules, Volume 10", Wiley-VCH, ISBN: 978-3527301539

Leach, A. R. (2001) "Molecular Modeling – Principles and Applications"; Second Edition, PrenticeHall, USA, ISBN-13: 978-0582382107

Holtje HD (2003) "Molecular Modeling: Basic Principles and Applications", Wiley-VCH, ISBN: 978-3527305896.

Kubinyl H, Folkers G and martin YC (2004). "3D QSAR in Drug Design Volume 2 Ligand-ProteinInteractions and Molecular Similarity", Bethany House Pub, ISBN-13: 978-0306468575.

Alvarez J (2005) "Virtual Screening in Drug Discovery", CRC Press, ISBN-13: 978-0824754792

Bannwarth W, Felder E (2008). "Combinatorial chemistry: A Practical Approach", WILEY-VCHVerlag GmbH, ISBN: 9783527301867

Marx D, Hutter J (2009) "*Ab Initio* Molecular Dynamics: Basic Theory and Advanced Methods",Cambridge University Press, ISBN-13: 978-0521898638

Anthonsen, T. (2009). "Strategies of Organic Drug Synthesis and Design. By Daniel Lednicer",Wiley-VCH, Weinheim Publisher, ISBN: 978-047019039-5

Young DC (2009). "Computational Drug Design: A Guide for Computational and Medicinal Chemists", Wiley-Blackwell Publishers, ISBN-13: 978-0470451847

Saxena A and Sahay B (2010) "Computer Aided Engineering Design", Springer; ISBN-13: 978-9048166794

Nag A and Dey B (2010) "Computer Aided Drug Design and Delivery systems" Mc Grahill Edition,ISBN-13: 978-0071701242

Yan B, zhang B (2010). "Analytical Methods in Combinatorial Chemistry, 2nd Edition". CRC Press.ISBN: 9780203909966

Sotriffer C (2011) "Virtual Screening: Principles, Challenges, and Practical Guidelines", Wiley-VCH,ISBN: 978-3527326365

Magnasco V (2013) "Elementary Molecular Quantum Mechanics", Second Edition, Elsevier, ISBN:978-0444626479

Cavasatto C N (2015) "*In silico* Drug Discovery and Design – Theory, Methods, Challenges andApplications" CRC Press 1st Edition, ISBN-13: 978-1482217834.

Cavasotto CN (2016). "*In Silico* Drug Discovery and Design: Theory, methods, Challenges, andApplications" CRC Press, ISBN-13: 978-1482217858.

Grover A (2017). "Drug Design: Principles and Applications" Springer Nature Singapore Pte Ltd,

ISBN-13: 978-9811051869

Sarkar J (2017). "Computer Aided Design: A conceptual Approach" CRC Press, ISBN-13: 978-1138885448

Gore M, Jagtap U B (2018). "Computational Drug Discovery and Design" Springer Protocols, ISBN:978-1-4939-7756-7

Online Resources:

1. https://www.wiley.com/enbr/Virtual+Screening%3A+Principles%2C+Challenges%2C+and+Practical+Guidelines-p-9783527633340
2. https://www.wiley.com/enin/Molecular+Modeling%3A+Basic+Principles+and+Applications% 2C+3rd+Edition-p-9783527315680

K1-Remember	*K2-Understand*	*K3-Apply*	*K4-Analyze*	*K5-Evaluate*	*K6-Create*

Course designed by: Dr. Sanjeev Kumar Singh

Course Outcome VS Programme Outcomes

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S(3)	M(2)	S(3)	S(3)	S(3)	L(1)	M(2)	-	L(1)	-
CO2	S(3)	S(3)	S(3)	S(3)	S(3)	M(2)	-	S(3)	S(3)	S(3)
CO3	S(3)	M(2)	S(3)	S(3)	S(3)	S(3)	S(3)	S(3)	S(3)	S(3)
CO4	S(3)	S(3)	S(3)	M(2)	S(3)	S(3)	S(3)	S(3)	S(3)	S(3)
CO5	S(3)	S(3)	S(3)	S(3)	S(3)	S(3)	S(3)	S(3)	S(3)	S(3)
W.AV	3	2.6	3	3	3	2.4	2.2	2.2	2.6	2.4

S –Strong (3), M-Medium (2), L- Low (1)

Course Outcome VS Programme Specific Outcomes

CO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	S(3)	S(3)	S(3)	S(3)	S(3)
CO2	S(3)	M(2)	S(3)	S(3)	S(3)
CO3	M(2)	S(3)	S(3)	M(2)	M(2)
CO4	S(3)	S(3)	S(3)	S(3)	S(3)
CO5	S(3)	S(3)	S(3)	S(3)	S(3)
W.AV	2.8	2.8	3	2.8	2.8

S –Strong (3), M-Medium (2), L- Low (1)

Practical, Assignment & Seminar - Lab - III Computer Aided Drug Design (CADD)

1. Energy Minimization and its application.
2. Advantages and disadvantages of available molecular modeling softwares.
3. *De novo* drug designing.
4. Protein Structure Prediction.
5. Molecular Dynamics Simulation.
6. Molecular Docking and its types.
7. Monte Carlo Simulations.
8. Pharmacophore and Generation of Common Pharmacophore hypothesis.
9. Combinatorial synthesis.
10. 3D QSAR.

SEMESTER-IV

Machine Learning and Artificial Intelligence

Program: M.Sc.,	Semester: IV (2022 Onwards)
Course Title: Machine Learning and Artificial Intelligence Subject Code: 502401	Class Time: As per Time Table
Name of the Course Teacher	Dr. RM.Vidhyavathi
Mobile: +91 – 9444835869	Email: vidhyavathirm@alagappauniversity.ac.in

Course Brief:

Machine Learning mainly focuses on the enhancement and development of the computer programs, which has the property to get changed when it comes in the interaction to the new data. However, this is a kind of artificial intelligence, the Introduction to Machine Learning course enlightens the students with the algorithms that proves to be helpful for the IP professionals in analyzing the data set with ease. In modules algorithms such as: regression, clustering, classification, and recommendation have been introduced, all these helps the candidates in supervising the advanced data programming techniques.

AI has been a source of innovative ideas and techniques in computer science, and has been widely applied to many information systems. This course provides a comprehensive, graduate-level introduction to artificial intelligence, emphasizing advanced topics such as

advanced search, reasoning and decision-making under uncertainty, and machine learning.

Teaching Methods: The mode of teaching is based on the following learning activities:

- Lectures covering the theoretical part will be delivered using PowerPoint presentations.
- A set of laboratory exercises to analyze biological problems using softwares andtools to develop student's interests in scientific discovery.
- Case studies in informatics-based research.

Attendance: The students are expected to attend the classes regularly, since regular attendance is essential to gain academic achievement. As per the University norms, the students having a minimum scale of 70-75% attendance are only qualified to write their end-semester examinations.

Punctuality: Punctuality is the most important quality for the student to be followed and maintained to achieve success. Students who arrive late by 10 mins to the class without any vital reason will be marked absent in the attendance register. On the other hand, valid excuse including personal or medical emergency is acceptable, with prior consent by the Head of the Department.

Class Participation: A student's overall growth and personality development is based on his/her involvement in the class not just by mere presence but rather being interactive through questioning that will lead to propagation of ideas, initiation of thought-provoking practice and much more that will provide a wholesome enriched classroom experience. When students participate, they learn from one another and gain their knowledge better.

Submission of Assignment: Assignments are given to students in order to apply the concepts for deeper understanding of the subject. Therefore, each student will be allocated two assignments for the course, covering the entire topic. Students will be given deadline to submit the assignment by the course instructor and good preparation of assignment will help the students for their final exams.

Presentation of Seminar: Apart from the assignments, students are supposed to give an oral presentation during the class seminar hours in their assigned topic. The concerned instructor will encourage the participants to ask valid questions during seminar presentation in order to put up their confidence levels and communication skills. In addition, students will be able to gain information and can be updated in their course.

Preparedness: At the end of every class, the concerned instructor conveys the students about the details that will be handled in the next class to increase the student's awareness related to the topics.

Academic Dishonesty: Academic dishonesty is a completely unacceptable mode of conduct and every student should be aware of this important aspect. Thus, the respective faculty members educate the students of possible means of academic malpractices (plagiarism, violation of copyrights and stealing the patented knowledge) and the following consequences that will make them more vigilant in their academic career.

Subject to change clause: Depending upon the requirement of student's possibility, the course syllabus will be re-structured and updated accordingly at the discretion of the Professor(s) and Board of studies chairperson.

Important dates: Scheduled dates for the various activities related to the course

CIA Test I	CIA Test II	Assignment I	Seminar

As per Academic Calendar	After CIA Test -I

Course Outline: Machine Learning and Artificial Intelligence

- Determine the various applications of machine learning algorithms.
- Develop an understanding classification data and models.
- Learn the how to implement the unsupervised learning algorithms, which includes deep learning, clustering, and recommendation systems.
- How to perform the supervised learning techniques, such as: linear and logisticregression.
- Understanding how to create the environment for self driving Car.
- Understanding the procedure of building the AI.
- Understanding how could a trainee provide support to the Data Scientist.
- Temporal Probabilistic Reasoning and Dynamic Bayesian Networks.

More books for Reading and Referencing

Artificial Intelligence and Machine Learning, Chandra S.S.V , Prentice Hall India Learning Private Limited, 2014, **ISBN-10:** 8120349342, **ISBN-13:** 978-8120349346.
Artificial Intelligence By Example: Develop machine intelligence from scratch using real artificial intelligence use cases , Denis Rothman, Packt Publishing Limited,2018, **ISBN-10:** 1788990544,**ISBN-13:** 978-1788990547.

Semester-IV					
Core-XIV	**Course Code 502401**	**Machine Learning and Artificial Intelligence**	**T**	**Credits:4**	**Hours:4**
Unit-I					
Objective -1	To create appreciation and understanding of both the achievements of AI and the theory underlying those achievements.				
Introduction to AI and Production Systems: Introduction to AI-Problem formulation, Problem Definition -Production systems, Control strategies, Search strategies. Problem characteristics, Production system characteristics, Specialized production system, Problem solving methods, Problem graphs, Matching, Indexing and Heuristic functions, Hill Climbing, Depth first and Breath first, Constraints satisfaction, Related algorithms, Measure of performance and analysis of search algorithms.					
Outcome - 1	Understand basic Knowledge in AI				**K2**
Unit-II					
Objective -2	To create an understanding of the basic issues of knowledge representation and Logic and blind and heuristic search, as well as an understanding of other topics such as minimal, resolution, etc. thatplay an important role in AI programs.				
Representation of Knowledge: Game playing, Knowledge representation, Knowledge representation using Predicate logic, Introduction to predicate calculus, Resolution, Use of predicate calculus, Knowledge representation using other logic, Structured representation of knowledge.					

Outcome - 2	Demonstrate knowledge of the building blocks of AI aspresented in terms of intelligent agents	**K2**
	Unit-III	
Objective -3	Machine Learning, in particular focusing on the core concepts of supervised and unsupervised learning.	
Introduction to Machine Learning: Learning Problems, Perspectives and Issues, Concept Learning, Version Spaces and Candidate Eliminations, Inductive bias, Decision Tree learning, Representation, Algorithm, Heuristic Space Search.		
Outcome - 3	Formulate and solve problems with uncertain information using Bayesian approaches.	**K6**
	Unit-IV	
Objective - 4	Students will learn the algorithms which underpin many popular Machine Learning techniques, as well as developing an understanding of the theoretical relationships between these algorithms.	
Classification in Machine Learning: Naïve Bayes Classifier, Probability estimation, Required data processing, Feature selection: Mutual information, Classifier, K-Nearest Neighbors, K-Nearest Neighbor algorithm, Support Vector Machines, Linear learning machines and Kernel space, SVM for classification and regression problems. **Clustering:** Distance measures, Different clustering methods (Distance, Density, Hierarchical), Iterative distance-based clustering, K-Medoids, k-Mode and density-based clustering.		
Outcome - 4	Develop an appreciation for what is involved in learningfrom data	**K6**
	Unit-V	
Objective - 5	The practicals will concern the application of machine learning to a range of real-world problems.	
Advanced Learning : Learning Sets of Rules – Sequential Covering Algorithm – First Order Rules – Sets of First Order Rules – Induction on Inverted Deduction – Inverting Resolution – Analytical Learning – Perfect Domain Theories – Explanation Base Learning – FOCL Algorithm – Reinforcement Learning – Task – Q-Learning – Temporal Difference Learning.		
Outcome - 5	Explain familiar in Expert system and its architectures anddevelop a small expert system.	**K5**

Suggested Readings:

Kevin Night and Elaine Rich, Nair B, (2008) "Artificial Intelligence (SIE)", Tata Mc Graw Hill, Third Edition.

EthemAlpaydin, Francis Bach, (2014) "Introduction to Machine Learning" Hardcover, Third Edition.

Stuart Russel, Peter Norvig (2007) "AI – A Modern Approach", Pearson Education, Second Edition.

Tom M. Mitchell, (2017) "Machine Learning", McGraw-Hill Education, First Edition.

EthemAlpaydin, (2004) "Introduction to Machine Learning (Adaptive Computation and Machine Learning), The MIT Press.

Stephen Marsland, (2009), "Machine Learning: An Algorithmic Perspective", CRC Press.

SaikatDutt, Subramanian Chandramouli, Amit Kumar Das, (2018) "Machine Learning", Pearson Education, First edition.

Online Resources:

1. https://www.atariarchives.org/2bml/
2. https://vtda.org/books/Computing/Programming/Introduction To Artificial Intelligence 2nd

Ed_PhilipCJacksonJr.pdf					
K1-Remember	***K2-Understand***	***K3-Apply***	***K4-Analyze***	***K5-Evaluate***	***K6-Create***
Course designed by: Dr.RM.Vidhyavathi					

Course Outcome VS Programme Outcomes

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO 7	PO8	PO9	PO10
CO1	M(2)	M(2)	M(2)	S(3)	M(2)	L(1)	M(2)	M(2)	M(2)	M(2)
CO2	S(3)	S(3)	M(2)	S(3)	L(1)	S(3)	M(2)	S(3)	M(2)	L(1)
CO3	M(2)	M(2)	M(2)	S(3)	L(1)	M(2)	M(2)	S(3)	M(2)	M(2)
CO4	S(3)	M(2)	M(2)	S(3)	L(1)	S(3)	M(2)	S(3)	M(2)	M(2)
CO5	M(2)	M(2)	M(2)	S(3)	S(3)	M(2)	M(2)	S(3)	M(2)	M(2)
W.AV	2.4	2.2	2	3	1.6	2.2	2	2.8	2	1.8

S –Strong (3), M-Medium (2), L- Low (1)

Course Outcome VS Programme Specific Outcomes

CO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	S(3)	S(3)	M(2)	S(3)	S(3)
CO2	S(3)	S(3)	L(1)	S(3)	S(3)
CO3	M(2)	M(2)	L(1)	S(3)	S(3)
CO4	M(2)	S(3)	L(1)	S(3)	S(3)
CO5	S(3)	S(3)	L(1)	S(3)	S(3)
W.AV	2.6	2.8	1.2	3	3

S –Strong (3), M-Medium (2), L- Low (1)

Assignment & Seminar – Machine Learning and Artificial Intelligence

1. Introduction to AI-Problem formulation, Problem Definition, Hill Climbing, Depth first and Breath first, Constraints satisfaction.
2. Knowledge representation using Predicate logic, Resolution, Use of predicate calculus.
3. Version Spaces and Candidate Eliminations, Decision Tree learning.
4. Feature selection, Different clustering method.
5. Sets of First Order Rules, FOCL Algorithm, Temporal Difference Learning.

Program: M.Sc.,	Semester : IV (2022 Onwards)
Course Title: Systems Biology Subject Code: 502402	Class Time: As per Time Table
Name of Course Teacher	Dr. J. Joseph Sahayarayan Dr. P. Boomi
Mobile: +91 – 9047564087 +91 - 9486031423	E-mail: josephj@alagappauniversity.ac.in boomip@alagappauniversity.ac.in

Course Brief:

Systems biology is a broad field which explores the world of genomes and post genomic datasets and large databases. The goal of systems biology is to comprehensively understand development, physiology, metabolic and gene regulatory networks, by looking at all genes, proteins and metabolites in an organism simultaneously, rather than focusing on just one or two. An emerging engineering approach applied to biological scientific research, systems biology is a biology-based inter-disciplinary field of study that focuses on complex interactions within biological systems, using a holistic approach holism instead of the more traditional reductionism) to biological research. One of the outreaching aims of systems biology is to model and discover emergent properties, properties of cells, tissues and organisms functioning as a system whose theoretical description is only possible using techniques which fall under the remit of systems biology. These typically involve metabolic networks or cell signaling networks. Biology is moving from molecular to modular. As our knowledge of our genome and gene expression deepens and we develop lists of molecules (proteins, lipids, ions) involved in cellular processes, we need to understand how these molecules interact with each other to form modules that act as discrete functional systems. These systems underlie core subcellular processes such as signal transduction, transcription, motility and electrical excitability. In turn these processes come together to exhibit cellular behaviors such as secretion, proliferation and action potentials. What are the properties of such subcellular and cellular systems? What are the mechanisms by which emergent behaviors of systems arise? What types of experiments inform systems-level thinking? Why do we need computation and simulations to understand these systems?

Teaching Methods: The mode of teaching of delivering the courses are as follows through these below mentioned methodologies:

- Delivering the lectures in the form of presentation using advanced technologies devices such as smart board.
- Video-conferencing for lectures that will be sought from experts belonging to overseas reputed institutions.
- Case-studies and Review questions.

Attendance: Having good attendance record marks the student's sincerity and has an overall positive impact on his/her personality trait development. The students are asked to attend the classes on a regular note and those having a minimum scale of 70-75% attendance are eligible to take up the end-semester examinations as per the University norms.

Punctuality: It is the most important attribute to be followed and maintained by the student throughout his/her life which for sure will lead to the path of success. Students who arrive late by 10mins after the attendance will be marked absent unless there is a valid reason (medical/ personal emergency) at the discretion of the Head of the Department.

Class Participation: A student's overall growth and personality development is based on his/her involvement in the class not just by mere presence but rather being interactive through questioning that will lead to propagation of ideas, initiation of thought-provoking process and much more that will provide a wholesome enriched classroom experience. Therefore, students are advised to be more attentive so that they learn from one another and develop quality-based knowledge.

Submission of Assignment: Assignments are given to students with just one motive to get more quantitative and qualitative knowledge insights into the assigned topic/chapter that will lead to preparation and completion of the assignment in a constructive manner here just the knowledge provided is not merely counted but also completion prior to proposed deadline will also have a check on the student's serious consideration of the assignments.

Presentation of Seminar: Apart from the assignments the concerned instructors also allocate the students with a topic or based on their interests to present seminar that will aid them built their confidence levels, command over English language to communicate with precision and fluently. In addition, the fellow students are encouraged to pose questions that will instigate interest and provide update in that particular topic besides the information presented helping them to prepare for their examinations that can be taken as added advantage for the students.

Preparedness: At the end of every class, the concerned instructor tells the students what will be taken in the next class using these details the students should be aware of thetopics that will be covered in the upcoming lectures which actually enhance the student's capability to grasp the knowledge and concepts provided much efficiently.

Academic Dishonesty: This is an important aspect that every student should be aware of. Thus, the respective faculty members educate the students of possible means of academic malpractices (plagiarism, violation of copyrights and stealing the patented knowledge) and the following consequences that will make them more vigilant in their academiccareer.

Subject to change clause: Based on the requirement of student's feasibility and meeting the competitive demands of the discipline the syllabus courses will be re-structured and updated accordingly at the discretion of the Professor(s) and Board of studies chairman.

Important dates: Please note down the important dates and stick to the schedule

CIA Test I	**CIA Test II**	**Assignment**	**Seminar**
As per Academic Calendar		After CIA Test-I	

Course Outline: Core: Systems Biology

1. This lecture examines how the 'mega data' technologies now possible through genomics, transcriptomics and proteomics can be brought together to provide a whole organism understanding of biology.
2. This lecture will cover the basic concepts of genome sequencing, why it is important and what there is still left to learn – a basic introduction to put the remainder of the course in context.
3. The lecture will cover technologies for genome sequencing, conserved genes and proteins and the 'minimal gene content', hypothetical and unique genes and proteins.
4. This lecture will cover the use of changes in mRNA expression in different biological circumstances, including technical aspects.

5. How have the technologies learned in the above lectures been applied, particularly to the study of human disease? This lecture examines what we have gained by taking a genomics-based approach.

More books for Reading and Referencing:

Handbook of Glycomics; Editors: Richard Cummings J. Pierce; 2009 **ISBN: 9780123736000**
Essentials of Glycobiology; Editors: Ajit Varki, Richard D Cummings, Jeffrey DEsko, Hudson H Freeze, Pamela Stanley, Carolyn R Bertozzi, Gerald W Hart, and Marilynn E Etzler; 2009, **ISBN: 13: 9780879697709**
Evolutionary Genomics and Systems Biology; Gustavo Caetano-Anollés; 2010 **ISBN: 978-0-470-19514-7**
Principles of Biochemistry; By David L. Nelson, Michael M. Cox; 2012 **ISBN: 9788808035868**

Semester – IV					
Core-XV	**CourseCode 502402**	**Systems Biology**	**T**	**Credits: 4**	**Hours: 4**
Unit - I					
Objective -1	To describe proteomic techniques including mass spectrometry, 2D gel electrophoresis, protein microarrays and qRT-PCR. To explain how proteomics can be applied to clinical studies and biomarker discovery.				
Introduction and scope of proteomics: Components of a complex mixture and Protein sequencing; MALDI TOF MS, QTrap MS/MS, 2D Gel electrophoresis and Protein microarrays. qRT PCR and Proteomics. Proteomic approach for Clinical studies: Protein Biomarker Discovery and Validation - Body fluid profiles, blood disease profiles, diabetes profiles, infectious diseases. ITC.					
Outcome -1	Explain the components of a complex mixture, protein sequencing techniques, and the role of proteomics in clinical studies.				**K2**
Unit – II					
Objective -2	To explain the basic principles of protein arrays and computationalmethods for analyzing proteomics data.				
Protein arrays: basic principles, Computational methods for identification of polypeptides, Bioinformatics-based tools for analysis of proteomics data (Tools available at ExPASy Proteomics server); databases (such as Inter Pro), Protein-protein interactions: databases such as STRINGS and DIP; PPI Modeling in biological systems.					
Outcome -2	Utilize computational methods and bioinformatics tools for protein array analysis and protein-protein interactionmodeling.				**K3**
Unit – III					
Objective -3	To analyze protein complexes and interaction networks using tools like Cytoscape and Python. To understand concepts like network theory and algorithms.				
Protein complexes and Networks: Protein binding site analysis, Protein interaction networks, Regulatory networks, Structures of regulatory networks, Neural Network models.Network theory and algorithms. Protein network analysis in Cytoscape and Python.					

Outcome -3	Analyze protein binding sites, interaction networks, and regulatory networks using network theory and algorithms.	**K4**
	Unit – IV	
Objective -4	To describe glycomics techniques like glycan microarrays and explain the challenges and promise of glycomics. To understand related omics fields like lipidomics, fluxomics and metabolomics.	
Glycomics: The Challenge and Promise of Glycomics, Identification of carbohydrates, Glycolipids, Glycoproteins, Glycan Microarrays and Glycan Determinants, Metaglycomes, Glycan Recognition Molecules, Lipidomics, Fluxomics, Biomics: systems analysis of the biome. Transcriptomics &Metabolomics and its applications.		
Outcome -4	Identify and characterize carbohydrates, glycolipids, glycoproteins, and other biomolecules in the context of glycomics, lipidomics, and fluxomics.	**K4**
	Unit-V	
Objective -5	To explain key concepts in systems biology like integrating networks, random and scale-free networks, and computer simulation of whole cells. To understand databases related to metabolic pathways and signaling networks.	
Systems Biology: Introduction, Integrating Networks. Random and Scale-free Networks. Computer Simulation of the whole Cell. Human Erythrocyte Model and its applications. Software for Modeling, E-CELL, V-CELL and GROMOS. Simulation of cellular subsystems, network of metabolites and enzymes, Signal transduction networks, Gene 5 regulatory networks, metabolic pathways: databases such as KEGG, EMP, MetaCyc, AraCyc.		
Outcome -5	Understand the principles of systems biology, including random and scale-free networks, and apply computer simulation techniques to model cellular subsystems.	**K2**

Suggested Readings:

Alberghina, L. and Westerhoff, H, (2005) "Systems Biology: Definitions and Perspectives, Topics in Current Genetics"; Springer Verlag, ISBN 978-3540229681.

Debmalya Barh Vasco Azevedo, (2017) "Omics Technologies and Bio-engineering"; Academic Press, Volume 1: Towards Improving Quality of Life, 1st Edition, ISBN: 9780128047491.

Julio Collado-Vides, Ralf Hofestadt, (2002) "Gene Regulation and Metabolism: Postgenomic Computational Approaches"; MIT Press.

Sandy B. Primrose & Richard M. Twyman, (2004) "GENOMICS: Applications in Human Biology"; Blackwell Publishing Ltd.,

Andrew Carmen, Darryl León, Scott Markel, (2006) *"In Silico* Technologies in Drug Target Identification and Validation"; CRC Press Taylor and Francis Group, LLC, ISBN-13: 978-1-57444-478-0.

A. Malcolm Campbell & Laurie J. Heyer Laurie J. Heye, (2007) "Discovering Genomics, Proteomics and bioinformatics"; Pearson, Second Edition.

Marcus, Frederick, (2008) "Bioinformatics and Systems Biology"; Springer-Verlag Berlin Heidelberg, ISBN: 978-3-540-78352-7.

Sangdun Choi, (2010) "Introduction to Systems Biology"; Paperback Publisher: HumanaPress, 1st Edition.

Marian Walhout Marc VidalJob Dekker, (2012) "Handbook of Systems Biology"; Academic Press, 1st Edition, ISBN: 9780123859440.

Lin, Ren-Jang, (2016) "RNA-Protein Complexes and Interactions Methods and Protocols"; Humana Press, 1st Edition.

Online Resources:

1. https://link.springer.com/book/10.1007/978-3-540-78353-4
2. https://link.springer.com/book/10.1007/978-1-59745-440-7
3. https://www.routledge.com/Systems-Biology-and-Bioinformatics-A-Computational-

Approach/Najarian-Najarian-Gharibzadeh-Eichelberger/p/book/9781138118034					
K1-Remember	***K2-Understand***	***K3-Apply***	***K4-Analyze***	***K5-Evaluate***	***K6-Create***
Course designed by:Dr. J. Joseph Sahayarayan					

Course Outcome VS Programme Outcomes

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**
CO1	**S(3)**	**S(3)**	**S(3)**	**S(3)**	**S(3)**	**S(3)**	**S(3)**	**S(3)**	**S(3)**	**S(3)**
CO2	**S(3)**	**S(3)**	**S(3)**	**S(3)**	**S(3)**	**S(3)**	**S(3)**	**S(3)**	**S(3)**	**S(3)**
CO3	**S(3)**	**S(3)**	**S(3)**	**S(3)**	**S(3)**	**S(3)**	**S(3)**	**S(3)**	**S(3)**	**S(3)**
CO4	**S(3)**	**S(3)**	**S(3)**	**S(3)**	**S(3)**	**S(3)**	**S(3)**	**S(3)**	**S(3)**	**S(3)**
CO5	**S(3)**	**S(3)**	**S(3)**	**S(3)**	**S(3)**	**S(3)**	**S(3)**	**S(3)**	**S(3)**	**S(3)**
Average Score	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**

S –Strong (3), M-Medium (2), L- Low (1)

Course Outcome VS Programme Specific Outcomes

	PSO1	**PSO2**	**PSO3**	**PSO4**	**PSO5**
CO1	**S(3)**	**S(3)**	**S(3)**	**S(3)**	**S(3)**
CO2	**S(3)**	**S(3)**	**S(3)**	**S(3)**	**S(3)**
CO3	**S(3)**	**S(3)**	**S(3)**	**S(3)**	**S(3)**
CO4	**S(3)**	**S(3)**	**S(3)**	**S(3)**	**S(3)**
CO5	**S(3)**	**S(3)**	**S(3)**	**S(3)**	**S(3)**
Average Score	**3**	**3**	**3**	**3**	**3**

S –Strong (3), M-Medium (2), L- Low (1)Assignment

& Seminar: Systems Biology

1. Techniques in proteomics.
2. Gene expression.
3. 2D Gel electrophoresis and protein array.
4. Mass Spectrometry.
5. Protein sequences.
6. qRT PCR and proteomics.
7. MALDI TOP MS, QTrap MS/MS.
8. Identification and measurement of all small molecules.
9. Glycomics.
10. Lipidomics.
11. Flucomics.
12. Biomics.
13. E-CELL, V-CELL and GROMOS.

Lab-IV Small and Macromolecular Crystallography

Program: M.Sc.,	Semester: IV (2022 Onwards)
Course Title and Code: Lab IV-Small and Macromolecular Crystallography Subject Code: 502403	Class Time: As per Time Table
Name of the Course Teacher	Prof. J. Jeyakanthan
Mobile: +91 - 97898 09245	Email: jjeyakanthan@alagappauniversity.ac.in

Course Brief:

X-ray crystallography is the only available technique that enables us to visualize protein structures at the atomic level and enhances our understanding of protein function. Specifically we can study how proteins interact with other molecules, how they undergo conformational changes, and how they perform catalysis in the case of enzymes. Armed with this information we can design novel drugs that target a particular protein, or rationally engineer an enzyme for a specific industrial process. This syllabus is framed on the basis that the students will have a technical knowledge in handling the small and macromolecules techniques such as - crystallization, diffraction, data collection and structure solution.

Teaching Methods: The mode of teaching of delivering the courses are as follows through these below mentioned methodologies:

- Delivering the lectures in the form of presentation using advanced technologies devices such as smart board.
- Having an enriched professional experience on handling associated molecular biology experiments (Isolation, cloning, expression and crystallization) with sophisticates equipments and accessories
- Handling advanced Polarized microscopes to view crystallized biomolecules with better fine resolution to proceed further accordingly.
- Case-studies and Review questions

Attendance: Having good attendance record marks the student's sincerity and has an overall positive impact on his/her personality trait development. The students are asked to attend the classes on a regular note and those having a minimum scale of 70-75% attendance are eligible to take up the end-semester examinations as per the University norms.

Punctuality: It is the most important attribute to be followed and maintained by the student throughout his/her life which for sure will lead to the path of success. Students who arrive late by 10mins after the attendance has been taken will be marked absent unless there is a valid reason (medical/ personal emergency) at the discretion of the Head of the Department.

Class/Lab Participation: A student's overall growth and personality development is based on his/her involvement in the class not just by mere presence but rather being interactive through questioning that will lead to propagation of ideas, initiation of thought-provoking process and much more that will provide a wholesome enriched classroom experience. Therefore, students are advised to be more attentive so that they learn from one another and develop quality-based knowledge.

Submission of Assignment: Assignments are given to students with just one motive to get more quantitative and qualitative knowledge insights into the assigned topic/chapter that will

lead to preparation and completion of the assignment in a constructive manner here just the knowledge provided is not merely counted but also completion prior toproposed deadline will also have a check on the student's serious consideration of the assignments.

Presentation of Seminar: Apart from the assignments the concerned instructors also allocate the students with a topic or based on their interests to present seminar that will aid them built their confidence levels, command over English language to communicate with precision and fluently. In addition, the fellow students are encouraged to pose questions that will instigate interest and provide update in that particular topic besides the information presented helping them to prepare for their examinations that can be taken as added advantage for the students.

Performing Lab Practicals: The basic techniques concerning subjects such as Molecular or Cell biology are taught with much clarity and every student is given the opportUNITy to have hands on experience with these techniques using sophisticated instruments under the supervision of experienced/ trained personnel. After training, lab practicals are conducted to assess the student's skills to handle equipments and performing experiments with ease and maintaining the time constraints.

Preparedness: At the end of every class, the concerned instructor tells the students what will be taken in the next class using these details the students should be aware of the topics that will be covered in the upcoming lectures which actually enhance the student's capability to grasp the knowledge and concepts provided much efficiently.

Academic Dishonesty: This is an important aspect that every student should be aware of. Thus, the respective faculty members educate the students of possible means of academic malpractices (plagiarism, violation of copyrights and stealing the patented knowledge) and the following consequences that will make them more vigilant in their academic career.

Subject to change clause: Based on the requirement of student's feasibility and meeting the competitive demands of the discipline the syllabus courses will be re-structured and updated accordingly at the discretion of the Professor(s) and Board of studies chairman.

Important dates: Please note down the important dates and stick to the schedule

CIA Test I	**CIA Test II**	**Assignment**	**Seminar**
As per Academic Calendar		After CIA Test I	

Course Outline: Lab-IV: Small and Macromolecular Crystallography

- The course will lead to determine the crystal structures of small and macromolecules.
- On completion of this course students will be able to describe the differences in properties of small and macro molecular crystals.
- The Course content includes - X-ray sources and types of detectors, diffraction experiment based on the Evald construction, process diffraction images, and data validation. Phase problem solving, protein model construction based on experimental electron density maps and choose proper algorithms for structure refinement. Usage of specific crystallographic software for structure visualization and refinement and Validate the final structures.

More books for Reading and Referencing

Introduction to Macromolecular Crystallography by Alexander McPherson; 2009,

ISBN:978-0-470-18590-2
Macromolecular Crystallography Protocols, Volume 2 Structure Determination; Editors: Doublie, Sylvie (Ed.); 2007, **ISBN:1-59745-266-1, 978-1-58829-902-4**
Principles of Protein X-Ray Crystallography; Authors: Drenth, Jan, 1999, **ISBN:978-1-4757-3094-4, 978-1-4757-3092-0**
Small Angle X-Ray and Neutron Scattering from Solutions of BiologicalMacromolecules by Dmitri I. Svergun, Michel H. J. Koch, Peter A. Timmins, Roland P. May, 2013, **ISBN:978-0-19-963953-3**

Semester – IV					
Core-XVI	**CourseCode 502403**	**Lab-IV: Small And Macromolecular Crystallography**	**P**	**Credits:4**	**Hours :8**
Unit - I					
Objective - 1	To provide knowledge and Familiarization with methods and techniques in Macromolecular Crystallization, Nucleic acids and Small Biologically Active Compounds.				
Small Molecule Structure Determination: Small molecule crystallization methods, X-ray diffraction data collection, structure determination methods, structure refinement and Validation method, structural analysis, conformations and Interaction analysis.					
Outcome - 1	Design the process steps leading to determination of crystal structures of small molecules and analyze the structural conformation and interaction analysis.				**K3**
Unit - II					
Objective - 2	To understand different crystal systems and classify the crystalsaccordingly depending on their arrangements of the macromolecules				
Macromolecule Structure Determination: Cloning, Expression, Purification of Protein and Nucleic acid. Crystallization methods (Hanging drops, Sitting drops and Micro batch methods etc.,) X-ray diffraction data collection, structure determination methods (MR/ SIR/ MIR/ SAD/ MAD), structure refinement, electron density map calculation, model building and Validation, Structural and Interaction analysis.					
Outcome - 2	Demonstrate the methods for protein crystallization usinghigh resolution structures.				**K3/K5**
Unit - III					
Objective - 3	To provide knowledge about model building methods and structurerefinement using various crystallographic software.				
Hands on Training: Synthetic Compounds- Crystallization using different methods (slow evaporation etc.) in different solvents such as methanol, ethanol etc., Structure determination using SHELXS program, Structure refinement using SHELXL, validation and analysis.					
Outcome - 3	Describe the differences between crystallization of small molecules and macromolecules and Analyze the protein crystals under X-ray sources.				**K1/ K4**
Unit - IV					
Objective - 4	To comprehend with precision of various phase solving methods suchas direct methods, molecular replacement and with the use of heavy atom derivatives that surfaces usually in small/macromolecularcrystallization.				

Hands on Training: Lysozyme protein - Crystallization, Data Collection, Demo of CCP4/CNS programs, Three-Dimensional Structure determination, Structure refinement, electron density map calculation, model building, validation (Ramachandran Plot) and analysis.		
Outcome - 4	Illustrate the algorithms to improve maps and uses specific crystallographic software for structure visualization and refinement and validation of the final structures	**K2/K3**

Suggested Readings:

Marcus Frederick Charles Ladd and Rex Alfred Palmer, (2003), Structure Determination by X-ray Crystallography, Springer.

Giacovazzo, C. Monaco, H.L. Artioli, G. Viterbo, D. Milanesio, M. Ferraris, G. Gilli, G. Gilli, P. Zanotti, G. Catti, M. (2011) "Fundamentals of Crystallography - Third Edition"; International Unioin of Crystallography; Oxford [u.a.]: Oxford Univ. Press, OxfordScience Publications.

Gale Rhodes (1999). "Crystallography Made Crystal Clear: A Guide for users of Macromolecular Models - Second Edition"; Academic Press.

George H. Stout and Lyle H. Jensen (1989). "X-ray Structure Determination - Second Edition"; John Wiley & Sons - A wiley-interscience Publication.

Christopher Hammond (2009). "The Basics of Crystallography and Diffraction - Third Edition"; International Unioin of Crystallography, Oxford University Press.

Car melo Giacovazzo (2014). "Phasing in Crystallography - A Modern Perspective"; Oxford University Press.

Banaszak, L. J. (2000) "Foundations of Structural Biology"; Academic Press Bourne, P.E. & Helge Weissig, H. (2003) "Structural bioinformatics"; Wiley-Liss.

Liljas, A., Liljas, L., Piskur, J., Lindblom, G. Nissen, P. Kjeldgaard, M. (2010) "Textbook of Structural Biology"; Hackensack, NJ: World Scientific.

Online Resources:

1. https://www.mt.com/in/en/home/applications/L1_AutoChem_Applications/L2_Crystallization.html
2. https://berstructuralbioportal.org/x-ray-macromolecular-crystallography
3. https://www.rcsb.org/docs/additional-resources/crystallography-software

K1-Remember	***K2-Understand***	***K3-Apply***	***K4-Analyze***	***K5-Evaluate***	***K6-Create***

Course designed by: Dr. J. Jeyakanthan

Course Outcome VS Programme Outcomes

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	**M(2)**	**M(2)**	**M(2)**	**M(2)**	**M(2)**	**M(2)**	**M(2)**	**M(2)**	**M(2)**	**M(2)**
CO2	**M(2)**	**M(2)**	**M(2)**	**M(2)**	**M(2)**	**M(2)**	**M(2)**	**M(2)**	**M(2)**	**M(2)**
CO3	**M(2)**	**M(2)**	**M(2)**	**M(2)**	**M(2)**	**M(2)**	**M(2)**	**M(2)**	**M(2)**	**M(2)**
CO4	**M(2)**	**M(2)**	**M(2)**	**M(2)**	**M(2)**	**M(2)**	**M(2)**	**M(2)**	**M(2)**	**M(2)**
CO5	**M(2)**	**M(2)**	**M(2)**	**M(2)**	**M(2)**	**M(2)**	**M(2)**	**M(2)**	**M(2)**	**M(2)**
W.AV	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**2**

S –Strong (3), M-Medium (2), L- Low (1)

Course Outcome VS Programme Specific Outcomes

CO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	S(3)	S(3)	S(3)	S(3)	S(3)
CO2	S(3)	S(3)	M(2)	S(3)	S(3)
CO3	S(3)	M(2)	S(3)	S(3)	S(3)
CO4	S(3)	S(3)	S(3)	S(3)	S(3)
W.AV	3	2.75	2.75	S(3)	S(3)

S –Strong (3), M-Medium (2), L- Low (1)

Practical, Assignment & Seminar for Lab-IV Small and Macromolecular Crystallography

1. Small molecule crystallization methods.
2. X-ray diffraction data collection, structure determination, structure refinement and Validation of small molecules.
3. Small molecular compounds isolated from plants or from marine source.
4. Cloning, Expression, Purification of Proteins, Carbohydrates, Nucleic acids.
5. Crystallization methods of macromolecule (Hanging drops, Sitting drops and Micro batch methods etc.,)
6. Macromolecular structure determination methods (MR/ SIR/ MIR/ SAD/ MAD).
7. Structure refinement, structural analysis and Validation of macromolecules.
8. WinGX platform for small molecule structure determination.

Project work

Program: M.Sc.,	Semester: IV (2022 Onwards) Credits: 6
Course Title and Code: Project work Subject Code: 502999	Class Time: As per Time Table
Name of the Course Teacher	Prof. J. Jeyakanthan
Mobile: +91 - 97898 09245	E-mail: jjeyakanthan@alagappauniversity.ac.in
Name of the Course Teacher	Prof. Sanjeev Kumar Singh
Mobile: +91 - 98944 29800	E-mail: sksingh@alagappauniversity.ac.in
Name of the Course Teacher	Dr. M. Karthikeyan
Mobile: +91 - 94869 81874	E-mail: karthikeyanm@alagappauniversity.ac.in
Name of the Course Teacher	Dr. RM. Vidhyavathi
Mobile: +91 - 94448 35869	E-mail: vidhyavathirm@alagappauniversity.ac.in
Name of the Course Teacher	Dr. J. Joseph Sahayarayan
Mobile: +91 - 90475 64087	E-mail: josephj@alagappauniversity.ac.in

Name of the Course Teacher	Dr. P. Boomi
Mobile: +91 -9486031423	E-mail: boomip@alagappauniversity.ac.in

Major Research Areas

- Small and Macro molecule X-ray Crystallography.
- 3D Quantitative Structure - Activity Relationship (3D-QSAR).
- Human Molecular Genetics.
- Pharmacogenomics.
- Cheminformatics.
- Quantum Pharmacology.
- Computer Aided Drug Designing (CADD).
- Data mining, Data warehousing and Networking.
- Plant tissue Culture, Genetic Transformation, Plant Molecular Biology, Virology and Plant Pathology.
- Molecular Oncology, Pharmacology and Environmental Toxicology.

Course Brief:

The study of PG course in bioinformatics includes a six months project work in the thrust areas of specialization which is broadly classified into six categories keeping in mind the number of faculties present. First, is the Structural Biology and Bio - Computing where Molecular Biology concepts such as Protein Cloning, Expression, Purification and Crystallization are performed to work on the isolation of the desired protein where the structural and functional characteristics that are yet to be explored. Hence, through X-ray Crystallography one can deduce the same and collect the insight details based on these inputs computational studies such as screening, molecular dynamics simulation, quantum based approaches, structure based drug design, QSAR etc (Drug Discovery and Design, CADD & Structural Bioinformatics) are performed to identify suitable leads from commercial/natural sources for a disease – associated targets. Either way, leads identified by targeting the molecular fingerprints of an individual known as Personalized medicine (Pharmacogenomics & CADD) as this sought to be the most preferred, selected and specific approaches by the Pharma related Industries to further validate the compounds with the aid of assay to estimate its inhibitory potential against that target conferring to life-threatening diseases such as cancer, TB, Diabetes, HIV, Inference of Vitamin D – Deficiency on population through genetic studies, Implications of *Vibrio* species to the aquaculture residential species by the application of phage therapy. Additionally, these collected inputs such as the availability of different targets in association in many pathways (cross-talk), established compounds based on experimental evidences either commercially or from natural sources (Isolation from plants that is claimed to have therapeutic significance) is well collected, documented and maintained in the form of databases and also the information that are collected from several sources are also included. Thus, the scholars can frame their thesis based on these areas mentioned above along with updated working of methodologies within the stipulated period of time.

Reference/Text Books:

As per the area of study taken

Course Objectives: To make the students:

- Demonstrate knowledge and understanding of the molecular machinery of livingcells.
- Demonstrate knowledge and understanding of the principles and basicmechanisms of the research area.
- Use basic laboratory skills and apparatus to obtain reproducible data from biochemical experiments.
- Implement experimental protocols, and adapt them to plan and carry out simple investigations.

Course Outcomes: The student shall be able to:

- Analyze, interpret, and participate in reporting to their peers on the results of their laboratory experiments.
- Participate in and report orally on team work investigations of problem-based assignments.
- Build on their knowledge and understanding in tackling more advanced and specialized courses, and more widely to pursue independent, self-directed and critical learning.
- Formulate hypotheses based on current concepts in the field and design, conduct, and interpret their own research projects.
- Present research results in peer-reviewed publications and in a dissertation.
- Communicate research results effectively through oral presentations at scientific seminars, conferences, and other venues.
- Write a competitive application for research funding.
- Develop ancillary skills, where necessary, to obtain positions outside of scientific research.

Teaching Methods:

- Literature review, analysis and data collection
- Case-studies and Review questions
- Allowed for interaction with Research scholars
- Daily guidance and monitoring the work flow
- Presentation

Attendance: Having good attendance record marks the student's sincerity and has an overall positive impact on his/her personality trait development. The students are asked to attend the classes on a regular note and those having a minimum scale of 70-75% attendance are eligible to take up the end-semester examinations as per the University norms.

Semester – IV				
Core	**CourseCode 502999**	**Project Work**	**Credits:6**	**Hours :12**

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Major Electives
General Chemistry

Program: M.Sc., Bioinformatics	Semester : I (2022 Onwards)
Course Title: Elective –I General Chemistry Subject Code: 502501	Class Time: As per Time Table
Name of Course Teacher:	Dr. P. Boomi
Mobile: +91-9486031423	Email : boomip@alagappauniversity.ac.in

Course Brief:

Chemistry is a branch of science that deals with the study of the composition, properties, and reactivity of matter that includes organic chemistry, in-organic chemistry, physical chemistry etc. In bioinformatics, chemistry has a pivotal role to systematic investigation of the properties, structure, behavior of matter and the changes matter undergoes. The student will need to improve the basic aspects of chemistry andit will expose to develop in related disciplines like interaction between the chemical compounds and the bio-molecules. Hence, the syllabus is framed to provide sound knowledge and understanding of chemistry to divulge biological and biomedical science. The purpose of this syllabus is to develop scientific temper and analytical capability through learning physical concepts and their applications in pharmaceutical. This syllabus for the course covers with organic chemistry, inorganic chemistry, nano- chemistry, bio-organic chemistry, bio-inorganic chemistry and important analytical techniques to gain an insight into the basics of knowledge of chemistry. This course highlights the information regarding synthesis of drug compound using organic and in- organic materials for drug discovery, therapy, imaging and diagnosis. It will also guide the students to understand how chemistry will be used for a high technology area of Bioinformatics.

Teaching method:

- There are a number of different teaching methods used such as:
- Lecture using power point presentation
- Discussion (Boards and Blogs)
- Case studies
- Review questions

Attendance: Having good attendance record marks the student's sincerity and has an overall positive impact on his/her personality trait development. The students are asked to attend the classes on a regular note and those having a minimum scale of 70-75% attendance are eligible to take up the end-semester examinations as per the University norms.

Punctuality: It is the most important attribute to be followed and maintained by the student throughout his/her life which for sure will lead to the path of success. Students who arrive late by 10mins after the attendance has been taken will be marked absent unless there is a valid reason (medical/ personal emergency) at the discretion of the Head of the Department.

Class Participation: A student's overall growth and personality development is based on his/her involvement in the class not just by mere presence but rather being interactive through questioning that will lead to propagation of ideas, initiation of thought-provoking process and much more that will provide a wholesome enriched classroom experience. Therefore, students are advised to be more attentive so that they learn from one another and develop quality-based knowledge.

Submission of Assignment: Assignments are given to students with just one motive to get more quantitative and qualitative knowledge insights into the assigned topic/chapter that will lead to preparation and completion of the assignment in a constructive manner here just the knowledge provided is not merely counted but also completion prior to proposed deadline will also have a check on the student's serious consideration of the assignments.

Presentation of Seminar: Apart from the assignments the concerned instructors also allocate the students with a topic or based on their interests to present seminar that will aid them built their confidence levels, command over English language to communicate with precision and fluently. In addition, the fellow students are encouraged to pose questions that will instigate interest and provide update in that particular topic besides the information presented helping them to prepare for their examinations that can be taken as added advantage for the students.

Preparedness: At the end of every class, the concerned instructor tells the students what will be taken in the next class using these details the students should be aware of thetopics that will be covered in the upcoming lectures which actually enhance the student's capability to grasp the knowledge and concepts provided much efficiently.

Academic Dishonesty: This is an important aspect that every student should be aware of. Thus, the respective faculty members educate the students of possible means of academic malpractices (plagiarism, violation of copyrights and stealing the patented knowledge) and the following consequences that will make them more vigilant in their academiccareer.

Subject to change clause: Based on the requirement of student's feasibility and meeting the competitive demands of the discipline the syllabus courses will be re-structured and updated accordingly at the discretion of the Professor(s) and Board of studies chairman.

Important dates: Please note down the important dates and stick to the schedule

CIA Test I	**CIA Test II**	**Assignment**	**Seminar**
As per Academic Calendar		After CIA Test-I	

Course Outline: Elective: General chemistry

- **Organic chemistry:** can be describing the aromatic substances that involve the study of carbon and its compounds**.** It includes aromaticity, synthesis of organic compound and heterocyclic compound.
- **Chemical bonding:** It is one of the most important basic fundamentals of chemistry that explains how compounds form based on the electrostatic interaction and other concepts such as various bonding theory. Chemical Bonding and Acid base theory
- **Nano Chemistry:** It is an emerging field that involves study of unique properties associated with assemblies of atoms or molecules of nanoscale, the types of nano structures such as one, two and three dimensional. **Polymer chemistry and pharmaceutical chemistry** include classification of polymer with their uses and applications.
- **Bio-inorganic chemistry:** It examines the role of metals in biology**,** which covers the metalloprotein like hemoglobin and myoglobin, Electron transfer proteins: Active site structure and functions of ferredoxin, rubridoxin and cytochromes.
- **Medicinal Chemistry:** It involes the drug action and synthesis of various drug such as anyibacterial, antibiotics, antifungal and anticancer agent.

More books for Reading and Referencing

Amit Arora, "Organic Chemistry: Aromatic, Alcohols Aldehydes & Acids", (2006), Publisher- Discovery Publishing House, (**ISBN:8183561896, 9788183561891**)
John A. Joule and Keith Mills, "Heterocyclic Chemistry", (2013), Publisher- John
Wiley & Sons, (**ISBN: 1118681649, 9781118681640**)
Marye Anne Fox, James K. Whitesell, "Organic chemistry", (2004), Publisher-Jones & Bartlett Learning, (**ISBN: 763721972, 9780763721978**)
Paul M. Dewick, "Essentials of Organic Chemistry: For Students of Pharmacy,Medicinal Chemistry and Biological Chemistry", (2006), Publisher-John Wiley & Sons, (**ISBN: 0470016655, 9780470016657**)
J. Newton Friend, "A text book of in-organic chemistry" (2012), Publisher-Hardpress, (**ISBN: 290327793, 9781290327794**)
I. David Brown, "The Chemical Bond in Inorganic Chemistry" (2006), Publisher-Oxford University Press, (**ISBN: 0199298815, 9780199298815**)
John C. Kotz, Paul M. Treichel and John Townsend, "Chemistry and Chemical Reactivity", (2014), 9th Edition, Publisher- Cengage Learning, (**ISBN:1305176464, 9781305176461**)
Geoffrey A. Ozin, and Andre C. Arsenault, (Nanochemistry: A Chemical Approach to Nanomaterials", (2015), Publisher- Royal Society of Chemistry, (**ISBN:1782626263, 9781782626268**)
Kenneth J. Klabunde, and Gleb B. Sergeev "Nanochemistry " (2013) 2nd Edition, Publisher- Newnes, (**ISBN: 0444594094, 9780444594099**)
A. Ravve, " Principles of Polymer Chemistry", (2013), Pubisher- Springer Science & Business Media, (**ISBN: 1489912835, 9781489912831**)
Gauri Shankar Misra, "Introductory Polymer Chemistry", (1993), (**ISBN: 8122404715, 9788122404715**)
S. M. Khopkar, "Basic Concepts Of Analytical Chemistry", (1998), Publisher-New Age International, (**ISBN: 8122411592, 9788122411591**)
John Kenkel, "Analytical Chemistry for Technicians, Fourth Edition", (2013), Publisher-CRC Press, (**ISBN: 1439881065, 9781439881064**)
David Van Vranken and Gregory Weiss, "Introduction to Bioorganic Chemistry and Chemical Biology", (2012), Publisher- Garland Science, (**ISBN: 1135054827, 9781135054823**)
K. Hussain Reddy "Bioinorganic Chemistry", (2007), Publisher-New Age International, (**ISBN: 8122414370, 9788122414370**)
Ivano Bertini, "Biological Inorganic Chemistry: Structure and Reactivity", (2007), Publisher-University Science Books, (**ISBN: 1891389432, 9781891389436**)

I - Semester					
DSE- 1	**Course Code: 502501**	**General Chemistry**	**T**	**Credits:5**	**Hours:5**

Unit-I		
Objective - 1	To learn about basic idea of aromaticity, acid base theory andorganic synthesis.	
Chemical Bonding and Acid base theory: Chemical Bonding: Bond theory, hydrogen bonding, ionic bond, metallic bond, covalent bond, sigma bond, pi-bond, bond length, bond strength, delocalization, conjugation, resonance, hyperconjugation, and Vander- Waals forces. Free electron theory, Molecular orbital theory, conductor, insulators and semiconductors. Acid base theory: Arrhenius theory, acids and bases in protic solvents, Bronsted-Lowry theory, Lewis theory, acid-base strength, theoretical basis of hardness and softness, electronegativity.		
Outcome - 1	Describe the synthesis the organic compounds and elloboatre the basic pharmaceutical polymer and nano chemistry.	**K2**

Unit-II		
Objective - 2	To understand the biological molecule present in the bio-organicand bio-inorganic compounds	
Aromaticity, Heterocyclic Compounds and Spectroscopy techniques: Aromaticity: Concept of aromaticity, non-aromaticity and anti-aromaticity, Huckel's rule, annulenes, fulvenes. Organic Synthesis: Synthesis of alcohols, phenols, aldehydes and ketones. Heterocyclic Compound: Synthesis of aromatic heterocyclic compounds. Spectroscopy: UV-Vis Spectroscopy-Beer-Lambert's law and its limitations, transmittance, Absorbance, and molar absorptivity.Infra red spectroscopy-Basic Principle, Characteristic absorption bands of various functional groups.		
Outcome - 2	Gaining the knowledge about hetrocyclic Compound, Spectroscopy and nanochmeistry.	**K3**

Unit-III		
Objective - 3	To understand the biological molecule present in the bio-organicand bio-inorganic compounds.	
Nanochemistry and Polymer Science: Nano Chemistry: Definition, One-Dimensional, Two-Dimensional and Three-Dimensional nanomaterials, stability, properties (nanowire, nanorod and nanotube), self assembly nanoparticles, Fundamentals of Drug Nanoparticles, combination of drugs with their controlled drug delivery system. Polymer chemistry: Basic concepts of polymers, classification: Natural, synthetic, linear, cross linked, network, plastics, elastomers and fibres. Structure and uses of pharmaceutical polymers such as cyclodextrin, Ethyl cellulose, polymethacrylate, polyvinyl alcohol and polyvinyl pyrrolidone.		
Outcome - 3	Understanding the biological molecule present in the bio-inorganic compounds and drug compound with theiracitons.	**K2**

Unit-IV		
Objective - 4	To Study the heme protein, non heme protein and electrontransfer proteins.	

Bioinorganic Chemistry: Essential Trace Element for Human body, Biological Oxidation and Reduction Reactions for trace element. Overview of Heme and non-heme proteins-Structure and functions of Hemoglobin, Myoglobin, Hemerythrin and Hemocyanin. Structure and functions of electron transfer proteins such as Iron-sulphur proteins (Ferredoxins, Rubredoxin and Cytochromes). Copper iron proteins-Blue copper proteins (Azurin and Plastocyanin) and Superoxide dismutase. Structure and function of vitamin B12.

Outcome - 4	acquiring knowledge about how to synthesis the antibiotics and other infectious disease related drugs	**K4**

Unit-V

Objective - 5	To sudy the sthtnesis of various small maolecues and its uses

Medicinal Chemistry: Introduction to Drugs-Definition, Sources and classification of drugs, Drug action in human body, Chemistry of antibiotics and related drugs with their mode of action and side effects (Benzathine penicillin, Ampicillin, cis-platin, Chloroquine and Amodiaquine). Synthesis of the representative drugs of the following classes: Antiinflammatory agents (Aspirin, paracetamol), Antibiotics (Chloramphenicol), Antibacterial and Antifungal agents (Sulphonamides; Sulphanethoxazol, Sulphacetamide), Antiviral agents (Acyclovir) and Anticancer agent (Chlorambucil).

Outcome - 5	Explain the and differentiate the different antibiotics andit uses	**K3**

Suggested Readings:

Gowariker, V. R., Viswanathan, N. V., Jayadev Sreedhar, N. V. (2008). Polymer Science. (1st Ed). New Age International Pvt. Ltd.

Gopalan, R. (2009). Inorganic Chemistry. Universities Press.

Cammack, R. (1999). Iron-Sulfur Proteins. Academic Press.

Eldik, R. V. (2004). Advances in Inorganic Chemistry. Vol-55, Publisher-Elsevier.

Ahuja, S., Jespersen, N. (2006). Modern Instrumental Analysis. Vol-47, Elsevier.

Agrawal, J. P., Hodgson, R. D. (2007). Organic Chemistry of Explosives. John Wiley & Sons Ltd.

McMurry, J. (2008). Organic Chemistry. (7th Ed,), Thomson Higher Education. Brechignac, C., Houdy P., Lahmani, M. (2008). Nanomaterials and Nanochemistry. Springer Science & Business Media.

Lewis, A. (2009). Drug-Device Combination Products: Delivery Technologies and Applications. Woodhead Publishing series in Biomaterials. Elsevier,

Thassu, D., Deleers, M., Pathak, Y. (2007). Nanoparticulate Drug Delivery Systems. Edition-Informa Healthcare USA, Inc.

Atul, S. (2010). The Pearson Guide to Objective Chemistry for the AIEEE. Pearson Education India.

Watson, D. G. (2011). Pharmaceutical Chemistry E-Book. Publisher-Elsevier Health Sciences.

Bhattacharjee, M. K. (2016). Chemistry of Antibiotics and Related Drugs. Publisher-Springer

House, J. E. (2012). Inorganic Chemistry. (2nd Ed.) Publisher-Academic Press.

Clayden, J., Greeves, N., Warren, S. (2012). Organic Chemistry. (2nd Ed.). OUP Oxford.

Kaim, W. Schwederski, B. Klein, A. (2013). Bioinorganic Chemistry-Inorganic Elements in the Chemistry of Life: An Introduction and Guide. (2nd Ed.). John Wiley & Sons.

Online Resources:

1. https://www.geeksforgeeks.org/chemical-bonding/
2. https://www.scimagojr.com/journalsearch.php?q=25786&tip=sid&clean=0

K1-Remember	***K2-Understand***	***K3-Apply***	***K4-Analyze***	***K5-Evaluate***	***K6-Create***

Course designed by: Dr.P.Boomi

Course Outcome VS Programme Outcomes

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S(3)	M(2)	S(3)	M(2)	S(3)	S(3)	M(2)	S(3)	S(3)	S(3)
CO2	S(3)	S(3)	S(3)	M(2)	S(3)	M(2)	L(1)	S(3)	M(2)	M(2)
CO3	M(2)	M(2)	M(2)	M(2)	M(2)	S(3)	S(3)	M(2)	L(1)	M(2)
CO4	S(3)	M(2)	L(1)	M(2)	L(1)	S(3)	M(2)	L(1)	M(2)	S(3)
CO5	M(2)	L(1)	L(1)	L(1)	M(2)	S(3)	L(1)	M(2)	L(1)	L(1)
W.AV	2.6	2	2	1.8	2.2	2.8	1.8	2.2	1.8	2.2

S –Strong (3), M-Medium (2), L- Low (1)

Course Outcome VS Programme Specific Outcomes

CO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	S(3)	S(3)	S(3)	S(3)	S(3)
CO2	M(2)	M(2)	M(2)	S(3)	S(3)
CO3	L(1)	M(2)	M(2)	S(3)	S(3)
CO4	S(3)	L(1)	M(2)	S(3)	S(3)
CO5	L(1)	S(3)	L(1)	S(3)	S(3)
W.AV	2	2.2	2	3	3

S –Strong (3), M-Medium (2), L- Low (1)

Assignment & Seminar – General Chemistry

1. Write a brief note on aromaticity and anti-aromaticity.
2. Explain the detail about annulenes and fulvenes.
3. How to synthesis of primary and secondary alcohol.
4. Define the structure and application of pyrrole, and imidazole.
5. Give a detailed account on $SN1$ and $SN2$ reaction and mechanism.
6. Discus the Bimolecular reaction and mechanism.
7. Define neighboring group participation and leaving group.
8. Describe the Vander-Waals forces and Molecular orbital theory.
9. Types of chemical bonding.
10. Structure and uses of polymethacrylate, polyvinyl alcohol.

Program: M.Sc.,	Semester: --- (2022 Onwards)
Course Title and Code: Fundamentals of Computing (Elective-I) Subject Code: 502502	Class Time: As per Time Table
Name of the Course Teacher	Dr. RM. Vidhyavathi
Mobile: +91 9444835869	E-mail: vidhyavathirm@alagappauniversity.ac.in

Course Brief:

Computer technology's has impacts on individuals and our world. It helps to access worldwide sources of information; presenting ideas orally, graphically and in writing. This course examines the interaction between information and methods of communication technology. It explores the impact that technology has on individuals and organizations and the effects of current technology infrastructure plus use, duplication and transmission of information in our world. The course links technology with communication to provide students with access to a wealth of data and information, both locally and globally. The fundamental of computing is designed to familiarize students with computers and their applications. It will help students to learn fundamental concepts of computer hardware and software and become familiar with a variety of computer applications. Students will investigate internet based application and also includes activities that explore social and ethical issues related to computers. Students will exhibit proficiency with software applications and demonstrate knowledge of computer technology and components to aide in their understanding of data and information. After learning this course, it helps students in the development of applications related to data-analytical and theoretical methods, mathematical modeling and computational simulation techniques to study of biological, behavioral and social system. It also help biology student to learn the complicated biological systems and to organize, share or visualize the vast amount of biological data.

Technical Publications

1. Curtis Frye, (2003) Step by Step Microsoft Excel 2003, Microsoft Press.
2. Leon, A., Leon, M. (2000) "Introduction to Computers"; Vikas Publishing House.

Teaching Methods: The mode of teaching of delivering the courses are as follows through these below mentioned methodologies:

- Delivering the lectures in the form of presentation using advanced technologies devices such as smart board.
- Case-studies and Review questions

Attendance: Having good attendance record marks the student's sincerity and has an overall positive impact on his/her personality trait development. The students are asked to attend the classes on a regular note and those having a minimum scale of 70-75% attendance are eligible to take up the end-semester examinations as per the University norms.

Punctuality: It is the most important attribute to be followed and maintained by the student throughout his/her life which for sure will lead to the path of success. Students who arrive late by 10mins after the attendance has been taken will be marked absent unless there is a valid reason (medical/ personal emergency) at the discretion of the Head of the Department.

Class Participation: A student's overall growth and personality development is based on his/her involvement in the class not just by mere presence but rather being interactive through questioning that will lead to propagation of ideas, initiation of thought-provoking process and much more that will provide a wholesome enriched classroom experience. Therefore, students are advised to be more attentive so that they learn from one another and develop quality-based knowledge.

Submission of Assignment: Assignments are given to students with just one motive to get more quantitative and qualitative knowledge insights into the assigned topic/chapter that will lead to preparation and completion of the assignment in a constructive manner here just the knowledge provided is not merely counted but also completion prior to proposed deadline will also have a check on the student's serious consideration of the assignments.

Presentation of Seminar: Apart from the assignments the concerned instructors also allocate the students with a topic or based on their interests to present seminar that will aid them built their confidence levels, command over English language to communicate with precision and fluently. In addition, the fellow students are encouraged to pose questions that will instigate interest and provide update in that particular topic besides the information presented helping them to prepare for their examinations that can be taken as added advantage for the students.

Preparedness: At the end of every class, the concerned instructor tells the students what will be taken in the next class using these details the students should be aware of the topics that will be covered in the upcoming lectures which actually enhance the student's capability to grasp the knowledge and concepts provided much efficiently.

Academic Dishonesty: This is an important aspect that every student should be aware of. Thus, the respective faculty members educate the students of possible means of academic malpractices (plagiarism, violation of copyrights and stealing the patented knowledge) and the following consequences that will make them more vigilant in their academiccareer.

Subject to change clause: Based on the requirement of student's feasibility and meeting the competitive demands of the discipline the syllabus courses will be re-structured and updated accordingly at the discretion of the Professor(s) and Board of studies chairman.

Important dates: Please note down the important dates and stick to the schedule

CIA Test I	**CIA Test II**	**Assignment**	**Seminar**
As per Academic Calendar		After CIA Test-I	

Course Outline: Elective-I: Fundamentals of computing

- On completion of the course the students will be able to understand the fundamentals of computer and its organization.
- It will also allow student to concentrate on computer networking and datasecurity.
- Also gives knowledge to the student about internet and its applications.

More books for Reading and Referencing

Fundamentals Of Computer Algorithms - 1998 Horowitz, Galgotia Publications and **(ISBN: 8175152575, 9788175152571)**
Fundamentals of Computing and Programing – 2008 A.P.Godse, D.A.Godse, Technical Publications and **(ISBN: 8184315090, 9788184315097)**
Computer Fundamentals – 2004 Larry Long, Dreamtech Press and **(ISBN : 8177223674, 9788177223675)**

Major Elective					
DSE	**Course Code: 502502**	**Fundamentals of Computing**	**T**	**Credits:5**	**Hours:5**

Unit-I		
Objective - 1	Identify types of computers, how they process information and how individual computers interact with other computing systems and devices.	
Overview and Organization of a Computer: Computer system, storage, devices, memory, etc, Types of Processing: Batch, Real-Time, Online, Offline, Types of modern computers: The workstation, The Minicomputer, Mainframe Computers, Parallel Processing Computer, The Super Computer, etc		
Outcome - 1	Understand the basics of computer system, its architecture, database and networks	**K2**
Unit-II		
Objective - 2	Identify how to maintain computer equipment and solve commonproblems relating to computer hardware	
Software Concepts: Concepts of flowcharting, Algorithm development, Relationship between hardware and software, Types of software: System software and Application software.**Operating Systems:** Introduction, Process management, Memory management, File management, Device management and Security. Introduction to Windows/Unix/Linux		
Outcome - 2	Apply the basic concepts, terminology of computer scienceand familiar with the use of IT tools.	**K3**
Unit-III		
Objective - 3	Identify network fundamentals and the benefits and risks of networkcomputing	
Computer Networking: OSI Reference Model, topologies and protocols, designing networks, Networking gadgets (Router, Switch, etc); Data Communication (ISDN, VPN, DSL, cable modem, cellular modem, etc); Communication Links (Wire pairs, Coaxial cables, Fiber optics, Microwave, Satellite, etc).		
Outcome - 3	Explore new IT techniques in various applications and toidentify the issues related to security.	**K4**
Unit-IV		
Objective - 4	Identify the relationship between computer networks, other communications networks (like the telephone network) and theInternet	
Data Security: Data security fundamentals: types of attacks, firewall, packet filtering, classification of data security threats, protection mechanism (authentication, access control and access rules), Encryption/Decryptions techniques, An overview of Computer viruses: How do they get transmitted? What are the dangers? General Precautions to be taken, Current & future technologies (Grid Computing, VPN, wireless, mobile computing, biometrics etc.		
Outcome - 4	Demonstrate basic file management techniques	**K2**
Unit-V		
Objective - 5	Identify different types of information sources on the Internet.	
Internet: The Internet and its Resources, Internet protocols, services, and related terminologies. Web browsers, customizing browsers, Blocking popup windows, Internet programming languages.		
Outcome - 5	Use CCRI online tools.	**K6**

Suggested Readings:

V. Rajaraman, Neeharika Adabala (2014) "Fundamentals of Computers"; PHI learningPrivate limited, New Delhi, Sixth Edition.

ITL Education Solutions Limited, 2011, "Introduction to Computers", Pearson Education India, Second Edition.

Andrew S. Tanenbaum, David J. Wetherall. (2012) "Computer Network"; PearsonEducations.

Danny Briere, Walter R. Bruce, (2011)," Wireless Home Networking For Dummies", John Wiley & Sons, Third Edition.

John R. Levine, (2010),"The Internet For Dummies", John Wiley & Sons Twelfth Edition.John, R., Levine, Young, M.L and Baroudi, C. (2007) "The Internet for Dummies", Willy Publishing Inc, Eleventh Edition.

Jan Vitek, Christian D. Jense, (2007),"Secure Internet Programming", Springer.

R.G. Dromey, (2007), "How to Solve it by Computer", Pearson Education, Fourth Reprint.Chris McNab, (2007)," Network Security Assessment ", O'Reilly Media, Second Edition.

D.A. Godse A. P.Godse, (2006),"Computer Organization and Architecture"

Online Resources:

1. https://testbook.com/computer-awareness/computer-fundamentals
2. https://www.disputesoft.com/the-fundamentals-of-data-security/

K1-Remember	*K2-Understand*	*K3-Apply*	*K4-Analyze*	*K5-Evaluate*	*K6-Create*

Course designed by: Dr.RM.Vidhyavathi

Course Outcome VS Programme Outcomes

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	M(2)	M(2)	-	L(1)	M(2)	M(2)	-	L(1)	-	S(3)
CO2	M(2)	M(2)	L(1)	L(1)	M(2)	M(2)	-	L(1)	-	M(2)
CO3	S(3)	M(2)	M(2)	L(1)	M(2)	M(2)	L(1)	-	-	L(1)
CO4	M(2)	M(2)	M(2)	M(2)	M(2)	S(3)	L(1)	L(1)	-	L(1)
CO5	M(2)	M(2)	L(1)	M(2)	S(3)	S(3)	M(2)	L(1)	M(2)	M(2)
W.AV	2.2	2	1.2	1.4	2.2	2.4	0.8	0.8	0.4	1.8

S –Strong (3), M-Medium (2), L- Low (1)

Course Outcome VS Programme Specific Outcomes

CO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	M(2)	S(3)	M(2)	M(2)	S(3)
CO2	L(1)	M(2)	L(1)	M(2)	S(3)
CO3	L(1)	M(2)	L(1)	S(3)	S(3)
CO4	L(1)	M(2)	M(2)	M(2)	S(3)
CO5	L(1)	M(2)	M(2)	M(2)	S(3)
W.AV	1.2	2.2	1.6	2.2	3

S –Strong (3), M-Medium (2), L- Low (1)

Assignment & Seminar - Fundamentals of computing

1. Describe the organization of computer.
2. Brief about software and its applications.
3. Explain computer networking and data communication in detail.
4. An overview of computer viruses.
5. Internet and its resources.
6. Encryption/Decryptions techniques.
7. Internet protocols.
8. OSI Reference Model.
9. Types of modern computers.
10. Different types of web browsers.

IPR, Bio-safety and Bioethics

Program: M.Sc., Bioinformatics	Semester : --- (2022 Onwards)
Course Title: IPR, Biosafety and Bioethics Subject Code: (502503)	Class Time: As per Time Table
Name of Course Teacher	Dr. J. Joseph Sahayarayan
Mobile: +91 9047564087	E-mail:josephj@alagappauniversity.ac.in

Course Brief:

The course introduces students to Intellectual Property (IP) Law in general and its two common categories: Industrial Property (mostly patents) and Copyright. Intellectual Property is undoubtedly perceived as one of the core fields in the emerging area of law, the need specialized professionals. The course provides an overview of the
main principles and legal rules of IP Law, focusing specifically on the theoretical connections between IP and academic/scientific works/studies and on the IP issues with which the students are likely to come into contact in their different areas of knowledge. The course on Intellectual Property Rights, Biosafety and Bioethics covers all aspects of creations of the intellect (Images, inventions, literary works, artistic works etc.), Patent application, rules essential for patents, genetically modified crops and plants with their impacts, general ethical issues in handling transgenic plants, animals and microorganisms at laboratory etc. It also deals with new and upcoming areas like ethical issues associated with embryonic stem cells, genetic testing and regulatory approval to conduct human clinical trials. This course has been designed to give the students a holistic understanding of the subject. The concept of IP, its creation and how it should be protected are the major key points which will be discussed during this course.

Teaching Methods: The mode of teaching is based on the following learning activities:

- Lectures covering the theoretical part will be delivered using PowerPoint presentations.
- A new set of problems and issues that are worthy of exploration related to this course will be conversed.
- Case studies and questions.

Attendance: The students are expected to attend the classes regularly, since regular attendance is essential to gain academic achievement. As per the University norms, the students having a minimum scale of 70-75% attendance are only qualified to write their end-semester examinations.

Punctuality: Punctuality is the most important quality for the student to be followed and maintained to achieve success. Students who arrive late by 10 mins to the class without any vital reason will be marked absent in the attendance register. On the other hand, valid excuse including personal or medical emergency is acceptable, with prior consent by the Head of the Department.

Class Participation: A student's overall growth and personality development is based on his/her involvement in the class not just by mere presence but rather being interactive through questioning that will lead to propagation of ideas, initiation of thought-provoking practice and much more that will provide a wholesome enriched classroom experience. When students participate, they learn from one another and gain their knowledge better.

Submission of Assignment: Assignments are given to students in order to apply the concepts for deeper understanding of the subject. Therefore, each student will be allocated two assignments for the course, covering the entire topic. Students will be given deadline to submit the assignment by the course instructor and good preparation of assignment will help the students for their final exams.

Presentation of Seminar: Apart from the assignments, students are supposed to give an oral presentation during the class seminar hours in their assigned topic. The concerned instructor will encourage the participants to ask valid questions during seminar presentation in order to put up their confidence levels and communication skills. In addition, students will be able to gain information and can be updated in their course.

Preparedness: At the end of every class, the concerned instructor conveys the students about the details that will be handled in the next class to increase the student's awareness related to the topics.

Academic Dishonesty: This is an important aspect that every student should be aware of. Thus, the respective faculty members educate the students of possible means of academic malpractices (plagiarism, violation of copyrights and stealing the patented knowledge) and the following consequences that will make them more vigilant in their academic career.

Subject to change clause: Depending upon the requirement of student's possibility, the course syllabus will be re-structured and updated accordingly at the discretion of the Professor(s) and Board of studies chairman.

Important dates: Scheduled dates for the various activities related to the course

CIA Test I	CIA Test II	Assignment	Seminar
As per Academic Calendar		After CIA Test I	

Course Outline: Elective: IPR, Bio-safety and Bioethics

- An outline of Intellectual property rights- World Trade Organisation (WTO) - WTO Agreements- General Agreement on Tariffs and Trade (GATT) - General Provisions and Basic Principles-Protection of different types of plant variety.
- Types of Intellectual property rights-TRIPs -Trademarks and copyrights-act and law. Procedures for GMOs intended for direct use-risk assessment-risk management-handling, transport, packaging and identification of GMOs.

- Patenting and the Procedures Involved in the Application for Grading of a Patent

  -Steps to a Patent - Compulsory Licenses - Patent Cooperation Treaty (PCT)- Some case studies-Beneficial role of Transgenic plants and animals.
- Rules for the manufacture, use/import/export and storage of hazardous microorganisms/genetically engineered organisms or cell.
- An Overview of the Legal and Socio-economic Impacts of Biotechnology - Biosafety Regulations-Good laboratory practices-Different types of containment.
- Bioethics introduction-Various ethical issues related to genetic studies, human genome project-stem cell applications and ethical issues in stem cell research-cloning- instrumentality.

More books for Reading and Referencing

An Introduction to Intellectual Property Rights-**Manju Pathak** Publisher: New India Publishing Agency, 2013. **(ISBN: 978-93-833-0512-4)**
Intellectual Property Rights- **Neeraj Pandey, Khushdeep Dharni** Publisher: PHI Learning Pvt. Ltd-New Delhi, 2014. **(ISBN: 978-81-203-4989-6)**
WIPO Intellectual Property Handbook- **Wipo Publication** Publisher: WIPO 2004, Second Edition. **(ISBN: 978-92-805-1291-5)**
Bioethics and Biosafety- **M. K. Sateesh** Publisher: I. K. International Pvt Ltd, 2008. **(ISBN: 978-81-906-7570-3)**
Bioethics and Biosafety in Biotechnology-**V. Sree Krishnan** Publisher: New Age International (P) Limited, New Delhi, 2007. **(ISBN: 978-81-224-2248-1)**
IPR, Biosafety and Bioethics- **Deepa Goel, Shomini Parashar** Publisher: Pearson Publication, First edition, 2013. **(ISBN: 978-93-325-1424-9)**
Patent law - **P Narayanan** Publisher: Eastern Law House; 3rd edition, 1998. **(ISBN: 978-81-717-7090-8)**
Introduction to Bioethics- John A. Bryant, Linda Baggott la Velle, John F. Searle Publisher: Wiley publications, 2005. **(ISBN: 978-0-470-02198-9)**

Major Elective					
DSE	**CourseCode: 502503**	**Bio-safety, Bioethics and IPR**	**T**	**Credits: 5**	**Hours :5**

Unit - I		
Objective -1	To describe the role of international institutions like WTO, WIPO, and IBSC in relation to intellectual property rights. To understand agreements like TRIPS and acts like the Plant Variety and Farmers' Rights Act.	
Concept and Role of International Institutions: Introduction of IPR, General Agreement on Trade and Tariff (GATT) and World Trade Organizations. Establishment and functions of GATT, World Trade Organization (WTO) and World International Property Organization (WIPO). WTO Summits, Role of Integrated Business Solution Center (IBSC) and Review Committee on Genetic Manipulation (RCGM), Production of Plant variety and formers right act.		
Outcome -1	Explain the concepts and roles of international institutions, such as GATT, WTO, and WIPO, in the context of IPR and biosafety**.**	**K2**
Unit – II		
Objective -2	To define different types of intellectual property rights like patents,trademarks, copyrights, and trade secrets.	
Patent and Copyright: TRIPS, Different types of intellectual property rights (IPR), Patents, Trade mark, Trade secret copy right, Geographical distribution on biological diversity, Obligations, Production of Traditional Knowledge, Impact of GM Crops and GM Foods.		
Outcome - 2	Understand different types of intellectual property rights and their implications on biological diversity and traditional knowledge.	**K2**
Unit – III		
Objective -3	To explain Indian patent law and discuss case studies of patents on biological resources. To understand the benefits of transgenic plants and animals.	
Patent Law: Patent application, Rules governing patents, Licensing - Flavr Savr™ tomato as a model case. Case studies on patents (Basmati rice, Turmeric, Neem, etc.). Indian Patent Act, 1970. Benefits of transgenic plants and animals.		
Outcome -3	Analyze patent applications, rules governing patents, and case studies on patents, such as Basmati rice, Turmeric, and Neem.	**K4**
Unit – IV		
Objective -4	To describe different levels of biosafety and containment. To understand national biosafety policies, GLP, and GMP in relation to biotechnology intellectual property.	
Intellectual property in Biotechnology: Introduction and different levels of biosafety, Microorganism according to pathogenecity, rDNA research in India, General guidelines for research in transgenic plants, Good Laboratory Practices (GLP). Containments- Types, National biosafety policies and law, Germplasm conservation and Cross border movement.Introduction to GMP (Good Manufacturing Practices).		
Outcome -4	Know the application facts about biosafety guidelines, good laboratory practices (GLP), and good manufacturing practices (GMP) in biotechnology research andproduction.	**K3**
Unit-V		
Objective -5	To discuss about general ethical issues related to the release of transgenic organisms and the use of technologies like stem cells, genetic testing, and human clinical trials from a bioethics perspective.	
Bioethics: Introduction of bioethics, General ethical issues related to environmental release of transgenic plants, animals and microorganisms, Ethical issues related to embryonic stem cells, Genetic testing and screening, human clinical trials and drug testing.		

Outcome -5	Evaluate the ethical implications of biotechnology research, including environmental release of transgenic organisms, embryonic stem cells, and human clinical trials.	**K2**

Suggested Readings:

Recombinant DNA safety guidelines, (1990), Department of Biotechnology, Ministry of Science & Technology, Government of India, New Delhi.

Deepa Goel; Shomini Parashar, (2015) IPR, Biosafety and Bioethics, Pearson India, ISBN: 9789332514249.

Revised guidelines for research in transgenic plants, (1998), Department of Biotechnology, Ministry of Science & Technology, Government of India, New Delhi.

Subbaram, N. (2007) "Patent Law Practices and Procedures" Pharma Book Syndicate, Hyderabad, 2nd Edition.

M. K. Sateesh, (2008) Bioethics and Biosafety, K. International Pvt Ltd.

Robert Dingwall, (2008) Cambridge textbook of bioethics, Cambridge University Press, Cambridge, ISBN -13: 978-0-521-69443-8.

Glick, B.R., and Pasternack, J.J. (2010) "Molecular Biotechnology"; ASM Press, Washington, DC, 4th Edition. Chawla, H.S. (2011) "Introduction to Plant Biotechnology"; Oxford & IBH Publishing Co. Pvt. Ltd. 3rd Edition.

Shomini Parashar, Deepa Goel, (2013) IPR, Biosafety and Bioethics, Pearson India, ISBN: 9788131774700.

Online Resources:

1. ttps://www.taylorfrancis.com/books/edit/10.1201/9781003179177/biosafety-bioethics - biotechnology
2. https://www.google.com/search?q=IPR%2C+Biosafety+and+Bioethics&sca

K1-Remember	***K2-Understand***	***K3-Apply***	***K4-Analyze***	***K5-Evaluate***	***K6-Create***

Course designed by: Dr. J. Joseph Sahayarayan

Course Outcome VS Programme Outcomes

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	M(2)	M(2)	S(3)	L(1)	-	S(3)	-	S(3)	S(3)	S(3)
CO2	M(2)	S(3)	S(3)	L(1)	L(1)	S(3)	L(1)	S(3)	S(3)	S(3)
CO3	M(2)	S(3)	S(3)	M(2)	-	S(3)	-	S(3)	S(3)	S(3)
CO4	M(2)	S(3)	S(3)	M(2)	L(1)	S(3)	L(1)	S(3)	S(3)	S(3)
CO5	M(2)	S(3)	S(3)	M(2)	M(2)	S(3)	L(1)	S(3)	S(3)	S(3)
W.AV	2	2.8	3	1.6	0.8	3	0.6	3	3	3

S –Strong (3), M-Medium (2), L- Low (1)

Course Outcome VS Programme Specific Outcomes

CO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	L(1)	-	L(1)	S(3)	S(3)
CO2	L(1)	L(1)	M(2)	S(3)	S(3)
CO3	M(2)	L(1)	M(2)	S(3)	S(3)
CO4	M(2)	L(1)	M(2)	S(3)	S(3)
CO5	M(2)	M(2)	M(2)	S(3)	S(3)
W.AV	1.6	1	1.8	3	3

S –Strong (3), M-Medium (2), L- Low (1)

Assignment & Seminar Elective:

1. Establishment and functions of GATT, WTO and WIPO.
2. Explain transgenic plants and its beneficiary role.
3. Write short notes on Biosafety and its different levels.
4. Derive the government patent rules.
5. Give an account on FLAVA SAVR^{tm} turmeric as model case.
6. Explain WTO summit and WTO agreements.
7. Write a short note on environmental impact of genetically modified plants.
8. Explain the ethical issues related to research in embryonic stem cell cloning.
9. Impact of GM crops in agriculture.
10. Discuss about GATT's principle of reciprocal tariff liberalization.

Biosensor

Program: M.Sc.,	Semester :---- (2022 Onwards)
Course Title: Biosensor Subject Code: 502504	Class Time: As per Time Table
Name of Course Teacher:	Dr. P. Boomi
Mobile: +91 9486031423	E-mail : boomip@alagappauniversity.ac.in

Course Brief:

Biosensor comprises a hybrid course that integrates a natural bio-recognition element like cell, enzyme, antibody etc. Biosensors are emerging analytical tools for the analysis of bio-material samples to gain an understanding of their bio-composition, structure and function by converting a biological response into an electrical signal. This course can be providing diverse applications like medicine, biomedical research, drug discovery, diabetes, environmental monitoring, security and military. The syllabus is focused on sensor, biosensor, nanomaterials based biosensor, medical biosensor and enzyme based biosensor. This course is also providing in the general principles of

sampling analysis, statistical presentation and manipulation of data. It provides the basic science concepts required to understand the design and application of biosensors for the students. It is expected that students will get ample scope to learn and update knowledge through their active students in the lectures, discussions or demonstrations and suitable hands-on experiments. Also assignments and case studies will be conducted to stimulate research motivation of the students.

Teaching method will be based on the following activities:

- Lecture using power point
- Discussion (Boards and Blogs)
- Case studies
- Review questions

Attendance: Attendance and participation are vital to the student's success in this course. Students are expected to attend class every day. Minimum attendance to be eligible to take end-

semester-examination is 80%. It is also essential that the students study regularly.

Punctuality: Punctuality is very important in the course, because if student are late, you not only waste your time, but other student's. You will also disturb others when you go into the lecture class or laboratory after the class begins. Therefore, please arrive at the class on time. Names of late students will be recorded by mentor and marks from Course performance will be deducted. An excuse for being absent from class shall be a medical or personal emergency acceptable at the discretion of the Head of the Dept.

Class Participation: Class participation and interaction helps to form a complete educational experience. However, class participation and interaction is to be relevant to course content and context. Deviant behavior may lead to dismissal or suspension.

Submission of Assignment: Assignments are given to students with just one motive to get more quantitative and qualitative knowledge insights into the assigned topic/chapter that will lead to preparation and completion of the assignment in a constructive manner here just the knowledge provided is not merely counted but also completion prior to proposed deadline will also have a check on the student's serious consideration of the assignments.

Presentation of Seminar: Apart from the assignments the concerned instructors also allocate the students with a topic or based on their interests to present seminar that will aid them built their confidence levels, command over English language to communicate with precision and fluently. In addition, the fellow students are encouraged to pose questions that will instigate interest and provide update in that particular topic besidesthe information presented helping them to prepare for their examinations that can be taken as added advantage for the students.

Preparedness: At the end of every class, the concerned instructor tells the students what will be taken in the next class using these details the students should be aware of the topics that will be covered in the upcoming lectures which actually enhance the student's capability to grasp the knowledge and concepts provided much efficiently.

Academic Dishonesty: This is an important aspect that every student should be aware of. Thus, the respective faculty members educate the students of possible means of academic malpractices (plagiarism, violation of copyrights and stealing the patented knowledge) and the following consequences that will make them more vigilant in their academiccareer.

Subject to change clause: Based on the requirement of student's feasibility and meeting the competitive demands of the discipline the syllabus courses will be re-structured and updated accordingly at the discretion of the Professor(s) and Board of studies chairman.

Important dates: Please note down the important dates and stick to the schedule

CIA Test I	**CIA Test II**	**Assignment**	**Seminar**
As per Academic Calendar		After CIA Test-I	

Course Outline: Biosensor (502504)

- The course is to give a general overview of basic aspects and classification of **sensor** and **biosensor.**
- **Nanomaterials based Biosensor:** Nanomaterials fabrication can be utilized to manufacture nano-biosensors, which have very high sensitivity and can be applied in biomedical diagnostic.
- **Medical biosensor:** it covers the biosensors for medical oriented applications and types of medical biosensors.

- **Enzyme based biosensor:** it can be used to study, how to apply the variety of enzyme as biosensor and also study the glucose monitoring in blood sample.

More books for Reading and Referencing

Donald G. Buerk, "Biosensors: Theory and Applications", (1995), Publisher-CRC Press, **ISBN: 0877629757, 9780877629757**
Xueji Zhang, Huangxian Ju and Joseph Wang, "Electrochemical Sensors, Biosensors and their Biomedical Applications" (2011), Publisher- Academic Press, **ISBN: 008055489X, 9780080554891**
Jon S. Wilson, "Sensor Technology Handbook", (2005), Publisher-Newnes, **ISBN: 0750677295, 9780750677295**
Alexandru Grumezescu, "Nanobiosensors", (2016), Publisher- Academic Press, **ISBN: 0128043725, 9780128043721**
Zoraida P. Aguilar,"Nanomaterials for Medical Applications", (2012), Publisher-Newnes, **ISBN: 0123850894, 9780123850898**
Seamus Higson, "Biosensors for Medical Applications", (2012), Publisher-Elsevier, **ISBN: 0857097180, 9780857097187**
Ursula E. Spichiger-Keller, "Chemical Sensors and Biosensors for Medical and Biological Applications" (2008), Publisher- John Wiley & Sons, **ISBN: 3527612262, 9783527612260**
Man Bock Gu, miKg niS-kaH, "Biosensors Based on Aptamers and Enzymes", (2014), Publisher-Springer, **ISBN: 3642541437, 9783642541438**
Zhiwei Zhao, knaiKg niaKg, "Enzyme-based Electrochemical Biosensors", (2010), Publisher-INTECH Open Access, **ISBN: 9537619990, 9789537619992**

DSE	Course Code: 502504	Biosensor	T	Credits:5	Hours: 5
Unit - I					
Objective - 1	To understand the fundamentals of basic biosensor with their principles and technologies.				
Sensor: Introduction and classification, history, principles of physical and chemical, mechanism of mechanical, electrical, thermal, magnetic, optical and chemical sensors. Medical diagnostic and environmental monitoring applications					
Outcome - 1	Be able to know how to use bio-molecules as biosensor.				**K2**
Unit – II					
Objective - 2	Preparing students to build a career in bio-inspired materials and devices.				
Biosensor: Definition, Introduction of Avidin-Biotin mediated biosensor, immobilization of enzyme through the Avidin-Biotin modified system, microbial, biological oxygen demand biosensor, Luminescent and Glucose biosensors.					
Outcome - 2	Be able to analyze what types of material are used for biomedical applications				**K4**
Unit – III					
Objective - 3	Making aware of latest principles and techniques of nanomaterials based biosensor, medical biosensor and enzyme biosensor				
Nanomaterials based Biosensor: Introduction and challenges of biosensor. Nanomaterials and nanodevices, nanocrystalline and carbon nanotube based biosensor.					
Outcome - 3	Be able to use multivariate data analysis.				**K4**
Unit– IV					
Objective - 4	Enriching scientific temper in the field of bio-sensing, bio-imaging for clinical applications.				
Medical Biosensor: Introduction to biosensors for medical applications. Types: wearable sensor, temperature sensors, mechanical sensors, electrical sensors, biosensor for drug testing and discovery. Electrochemical DNA biosensor.					
Outcome - 4	Be able to design a biosensor system for a specific analyte.				**K6**
Unit-V					
Objective - 5	Updating students with the advanced techniques and totally integrated various biosensors.				
Enzyme based Biosensor: Urea, single enzyme, mutable enzyme, organic phase enzyme, biotanical and yeast based biosensors. Theory of enzyme biocatalysis, enzyme immobilization technique, boold glucose monitoring.					
Outcome - 5	Be able to understand the importance of biosensors in the medicaland environmental fields.				**K2**

Suggested Readings:

D.G. Buerk, (1995) "Biosensor:Theory and Apllication", Publisher-CRC press.

M. Alexander, B.R. Bloom, D.A. Hopwood, R. Hull, etc., (2000) "Encyclopedia of Microbiology", Vol-IV,Publisher-Academic Press.

Blum, "Biosensor Principles and Applications", Vol-15, CRC Press, (1991).

J. Vetelino, and A.Reghu, (2010) "Introduction to Sensors", Publisher-CRC Press.

A. Mulchandani and K. Rogers, (2010) "Enzyme and Microbial Biosensors: Techniques and Protocols",Publisher-Humana Press.

S. Higson, (2012) "Biosensors for Medical Applications", Publisher-Elsevier.

J. Li, N. Wu, (2013) "Biosensors Based on Nanomaterials and Nanodevices", Publisher-CRC press.

M. Bock Gu, H-S. Kim, (2014) "Biosensors Based on Aptamers and Enzymes", Springer.

Online Resources:

1. https://www.electronicshub.org/types-of-biosensors/
2. https://www.intechopen.com/chapters/58836

K1-Remember	*K2-Understand*	*K3-Apply*	*K4-Analyze*	*K5-Evaluate*	*K6-Create*

Course designed by: Dr. P. Boomi

Course Outcome VS Programme Outcomes

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	M(2)	L(1)	L(1)	L(1)	M(2)	M(2)	M(2)	M(2)	L(1)	L(1)
CO2	L(1)	-	L(1)	M(2)	M(2)	L(1)	M(2)	L(1)	M(2)	M(2)
CO3	L(1)	L(1)	L(1)	L(1)	L(1)	-	L(1)	L(1)	L(1)	L(1)
CO4	-	L(1)	L(1)	L(1)	-	M(2)	L(1)	M(2)	L(1)	L(1)
CO5	M(2)	L(1)	L(1)	L(1)	L(1)	-	L(1)	M(2)	L(1)	L(1)
W.AV	1.2	0.8	1	1.4	1.4	1	1.4	1.6	1.2	1.2

S –Strong (3), M-Medium (2), L- Low (1)

Course Outcome VS Programme Specific Outcomes

CO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	M(2)	M(2)	-	M(2)	M(2)
CO2	L(1)	-	M(2)	M(2)	L(1)
CO3	L(1)	-	M(2)	L(1)	M(2)
CO4	M(2)	L(1)	-	L(1)	L(1)
CO5	M(2)	L(1)	S(3)	M(2)	L(1)
W. AV	1.6	0.8	1.4	1.6	1.4

S –Strong (3), M-Medium (2), L- Low (1)

Assignment & Seminar - Sensor, Biosensor and Nanomaterials based Biosensor

1. Define sensor and uses.
2. Highlight the principle and application of biosensor.
3. Illustrate with example of optical and chemical sensor.
4. Differentiate between chemical and biological sensor.
5. Define Avidin-Biotin mediated biosensor by electrochemical technique?
6. Write an essay on luminescent and glucose biosensors.
7. Explain the detail about how to immobilization of enzyme through the Avidin-Biotin modified system.
8. Describe the carbon nanotube based biosensor.
9. Differentiate between nanodevice and nanocrystalline biosensor.
10. Write a short note on biological oxygen demand biosensor.

Molecular Interactions

Program: M.Sc.,	Semester: --- (2022 Onwards)
Course Title and Code: **Molecular Interactions** Subject Code: 502505	Class Time: As per Time Table
Name of the Course Teacher	Dr. RM. Vidhyavathi
Mobile: -	Email: -

Course Brief:

Molecular interactions deal with nucleic acids and proteins and how these molecules interact with one another in a cellular environment to promote and regulate the normal physiological processes defining proper growth, division, and development. This course will emphasize on the basics of orbital atom theory, molecular mechanisms of DNA replication, repair, transcription, protein synthesis, and gene regulation followed in different organisms. Techniques and experiments used to discern these mechanisms, often referring to the original scientific literature. An in-depth look at some rapidly evolving molecular processes, including chromatin structure and function, RNA polymerase dynamics, and regulation of gene expression by different types of RNAs.

Teaching Methods: The mode of teaching of delivering the courses are as follows through these below mentioned methodologies:

- Delivering the lectures in the form of presentation using advanced technologies devices such as smart board.
- Video-conferencing for lectures that will be sought from experts belonging to overseas reputed institutions
- Case-studies and Review questions
- Practical Classes.

Attendance: Having good attendance record marks the student's sincerity and has an overall positive impact on his/her personality trait development. The students are asked to attend the classes on a regular note and those having a minimum scale of 70-75% attendance are eligible to take up the end-semester examinations as per the University norms.

Punctuality: It is the most important attribute to be followed and maintained by the student throughout his/her life which for sure will lead to the path of success. Students who arrive late by 10mins after the attendance has been taken will be marked absent unless there is a valid

reason (medical/ personal emergency) at the discretion of the Head of the Department.

Class Participation: A student's overall growth and personality development is based on his/her involvement in the class not just by mere presence but rather being interactive through questioning that will lead to propagation of ideas, initiation of thought-provoking process and much more that will provide a wholesome enriched classroom experience. Therefore, students are advised to be more attentive so that they learn from one another and develop quality-based knowledge.

Submission of Assignment: Assignments are given to students with just one motive to get more quantitative and qualitative knowledge insights into the assigned topic/chapter that will lead to preparation and completion of the assignment in a constructive manner here just the knowledge provided is not merely counted but also completion prior to proposed deadline will also have a check on the student's serious consideration of the assignments.

Presentation of Seminar: Apart from the assignments the concerned instructors also allocate the students with a topic or based on their interests to present seminar that will aid them built their confidence levels, command over English language to communicate with precision and fluently. In addition, the fellow students are encouraged to pose questions that will instigate interest and provide update in that particular topic besides the information presented helping them to prepare for their examinations that can be taken as added advantage for the students.

Preparedness: At the end of every class, the concerned instructor tells the students what will be taken in the next class using these details the students should be aware of the topics that will be covered in the upcoming lectures which actually enhance the student's capability to grasp the knowledge and concepts provided much efficiently.

Academic Dishonesty: This is an important aspect that every student should be aware of. Thus, the respective faculty members educate the students of possible means of academic malpractices (plagiarism, violation of copyrights and stealing the patented knowledge) and the following consequences that will make them more vigilant in their academic career.

Subject to change clause: Based on the requirement of student's feasibility and meeting the competitive demands of the discipline the syllabus courses will be re-structured and updated accordingly at the discretion of the Professor(s) and Board of studies chairman.

Important dates: Please note down the important dates and stick to the schedule

CIA Test I	CIA Test II	Assignment	Seminar
As per academic calendar		After CIA Test-I	

Course Outline: Molecular Interactions

- The course will help to analyze data to identify how molecular interactions affect structural and functional mechanism in detail.
- It enumerates the explanations based on evidence of how variation in molecular UNITs provides cells with a wider range of functions.
- On completion of the course the student will be able to describe the relationship between enzyme structure and function and to predict the effect of various environmental conditions/changes to the function of enzymes.
- Determine the biologically important factors affecting enzyme activity.

- The course content includes Fundamentals of atomic and molecular orbitals; Fundamentals of chemical bonding and non-bonding interactions; Folding pathways; Molecular interactions (protein-protein, protein-DNA, DNA-Drug, Protein-Lipid, Protein-Ligand, Protein-Carbohydrate interaction, Metalloprotein. Pi … Pi interactions, C-H…Pi

interactions) and Spectroscopy.

More books for Reading and Referencing

Physical Chemistry: Quantum Chemistry and Molecular Interactions by Andrew Cooksy; 2013 **ISBN-10: 0321814169, ISBN-13: 978-0321814166**.
Molecular Interactions in Bioseparations; Editors: That T. Ngo; 1993 **ISBN: 978-1-4899-1872-7**
Physical Chemistry, Mastering Chemistry Access Code: Quantum Chemistry and Molecular Interactions by Andrew Cooksy; 2013 **ISBN 10: 0321784405 ISBN 13: 9780321784407**
Electron Dynamics in Molecular Interactions; Principles and Applications; By (author): Frank Hagelberg (East Tennessee State University, USA); 2014 **ISBN: 978-1-84816-487-1**
Chromatographic Determination of Molecular Interactions Applications in Biochemistry, chemistry and Bio-Physics By Tibor Cserhati, Klara Valko; 2010 **ISBN-13: 978-0849344374, ISBN-10: 0849344379**

Major Elective					
DSE	**Course Code: 502505**	**Molecular Interactions**	**T**	**Credits:-5**	**Hours: -5**

Unit - I		
Objective - 1	To explain how ionic, hydrophobic, and hydrogen bonding interactions influence the molecular pattern of Biological processes - comprehend the underlying mechanisms and its associated action.	
Fundamentals of atomic and molecular orbitals: Theory of atomic and molecular orbitals; Linear combination of atomic orbitals; Quantitative treatment of valency bond theory and molecular orbital theory;Resonance structures.		
Outcome - 1	How changes in a DNA nucleotide sequence can result in a change inthe polypeptide produced.	**K1**
Unit – II		
Objective - 2	To determine the structure of nucleic acids and proteins and modulate accordingly the binding specificity between them.	
Fundamentals of chemical bonding and non-bonding interactions: Electrovalent bond, stability of electrovalent bond. Covalent bond – partial ionic character of covalent bonds. Shape of orbitals and hybridization. Coordination bonds, Metallic bond. Molecular geometry-VSEPR Theory, hydrophobic interactions, electrostatic interactions, van der Waals interactions, hydrogen bonds.		
Outcome - 2	Connection between the sequence and the subcomponents of a biological polymer and its properties.	**K2**
Unit – III		
Objective - 3	To determine the structure of nucleic acids and proteins and modulate accordingly the binding specificity between them.	
Protein Folding and stability: Factors determining protein folds- Helices, strands, turns, loops, disulphide bridge. Principles of protein folding, mechanism for protein folding, role of chaperons, Factors determining protein stability		
Outcome - 3	Predict and justify that changes in the subcomponents of abiological polymer affect the functionality of the molecule.	**K1**

Unit – IV		
Objective - 4	To distinguish different molecular biology techniques that are used to isolate, separate, and probe for specific proteins, nucleic acids, and intra molecular interactions.	
Molecular interactions: protein-protein, protein-DNA, DNA-Drug, Protein-Lipid, Protein-Ligand, Protein- Carbohydrate interaction, metal coordination in metalloproteins, Inter and intra molecular interactions		
Outcome - 4	Evaluate scientific questions of the concerning organisms that exhibit complex properties due to the interaction of their constituent parts.	**K4**
Unit-V		
Objective - 5	To identify and overcome limitations of the above mentioned techniques and employ them for a given particular biological question. Additionally, also to use appropriate experimental techniques that are best suited to answer and address for a given biological problem.	
Experimental and Computational methods: Principles, Theory, Instrumentation and Application of ITC, SPR, Fluorescence techniques to bimolecular interactions. Databases and tools like DIP, INTACT etc.,		
Outcome - 5	Define representations and models that illustrate the interactions between biochemistry, parts and reactions.	**K2**

Suggested Readings:

Frenking, G. and Shaik. S. (2014). The Chemical Bond: Fundamental Aspects of Chemical Bonding, WileyPublishers.

Gromiha, M.M. (2010). Protein Bioinformatics: From Sequence to Function, Academic Press, First Edition. Winter, M.J. (2016). Chemical Bonding. Oxford University Press, Inc., New York.

Meyerkord, C.L. and ui , H. (2015). Protein-Protein Interactions: Methods and Applications, Humana Press, second edition

Kangueane, P. (2011). Protein-Protein Interactions. Nova science Publishers.

Mathura, V.S. and Kangueane, P. (2009). Bioinformatics: A Concept-Based Introduction. Springer Bujnicki, J.M. (2009). Prediction of Protein Structures, Functions, and Interactions. John Wiley & Sons Ltd.

Albert cotton, F. (2008). Chemical Application of Group Theory. John Wiley and Sons, Inc. New York. Thirdedition.

Eliel, E. (2001). Stereochemistry of carbon compounds, Tata Mc-Graw-Hill.

Spice, J. E. (1964). Chemical Binding and Structure. Pergamon Press Ltd., Headington Hill Hall, Oxford. 395pp.

Online Resources:

1. https://www.toppr.com/guides/chemistry/chemical-bonding-and-molecular-structure/molecular-orbital-theory/
2. https://www.cryst.bbk.ac.uk/PPS2/course/section7/os_non.html

K1-Remember	*K2-Understand*	*K3-Apply*	*K4-Analyze*	*K5-Evaluate*	*K6-Create*

Course designed by: Dr. RM. Vidhyavathi

Course Outcome VS Programme Outcomes

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	L(1)	L(1)	L(1)	L(1)	-	M(2)	M(2)	L(1)	M(2)	L(1)
CO2	-	L(1)	L(1)	M(2)	L(1)	M(2)	L(1)	M(2)	L(1)	L(1)
CO3	L(1)	L(1)	-	L(1)	-	L(1)	-	L(1)	L(1)	L(1)
CO4	L(1)	-	L(1)	-	L(1)	L(1)	-	L(1)	L(1)	L(1)
CO5	-	L(1)	L(1)	L(1)	-	-	L(1)	L(1)	L(1)	L(1)
W.AV	0.6	0.8	0.8	1	0.2	1.2	0.8	1.2	1.2	1

S –Strong (3), M-Medium (2), L- Low (1)

Course Outcome VS Programme Specific Outcomes

CO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	L(1)	L(1)	L(1)	L(1)	L(1)
CO2	-	-	L(1)	L(1)	L(1)
CO3	M(2)	-	M(2)	L(1)	-
CO4	M(2)	L(1)	L(1)	L(1)	L(1)
CO5	-	-	M(2)	M(2)	L(1)
W.AV	1.4	0.4	1.4	1.2	0.8

S –Strong (3), M-Medium (2), L- Low (1)

Assignment & Seminar - Molecular Interactions

- Theory of atomic and molecular orbitals;
- Valency bond theory and molecular orbital theory;
- Shape of orbitals and hybridization.
- Instrumentation and Application of UV, IR, NMR and Circular dichroism (CD) to macro molecules.
- Stereochemistry of proteins and nucleic acids.
- Molecular interaction between Protein-Carbohydrate; Metalloprotein; Pi…Pi interactions, and C-H…Pi interactions.

Introduction to Neural Networks

Program: M.Sc.,	Semester: --- (2022 Onwards)
Course Title and Code: Introduction to Neural Networks Subject Code: 502506	Class Time: As per Time Table
Name of the Course Teacher	Dr. RM. Vidhyavathi
Mobile: +91 9444835869	E-mail: vidhyavathirm@alagappauniversity.ac.in

Course Brief:

The course introduces the theory and practice of neural computation. It offers the principles of neurocomputing with artificial neural networks widely used for addressing real-world problems such as classification, regression, pattern recognition, data mining, time-series modelling, etc. Two main topics are covered: supervised and unsupervised learning. Supervised learning is studied with linear perception models, and non-linear models such as multilayer perceptrons and radial-basis function networks. Unsupervised learning is studied using Kohonen networks. Recurrent networks of the Hopfield type are briefly covered. There are offered contemporary training techniques for parameter learning in all these neural networks. Program implementations in Mat lab of the studied neural networks are provided. The objective

of this course is to make students learn about concepts of artificial intelligence and applications of artificial intelligence in bioinformatics.

Teaching Methods: The mode of teaching of delivering the courses are as follows through these below mentioned methodologies:

- Delivering the lectures in the form of presentation using advanced technologies devices such as smart board.
- Case-studies and refer question bank

Attendance: Having good attendance record marks the student's sincerity and has an overall positive impact on his/her personality trait development. The students are asked to attend the classes on a regular note and those having a minimum scale of 70-75% attendance are eligible to take up the end-semester examinations as per the University norms.

Punctuality: It is the most important attribute to be followed and maintained by the student throughout his/her life which for sure will lead to the path of success. Students who arrive late by 10mins after the attendance will be marked absent unless there is a valid reason (medical/ personal emergency) at the discretion of the Head of the Department.

Class Participation: A student's overall growth and personality development is based on his/her involvement in the class not just by mere presence but rather being interactive through questioning that will lead to propagation of ideas, initiation of thought-provoking process and much more that will provide a wholesome enriched classroom experience. Therefore, students are advised to be more attentive so that they learn from one another and develop quality-based knowledge.

Submission of Assignment: Assignments are given to students with just one motive to get more quantitative and qualitative knowledge insights into the assigned topic/chapter that will lead to preparation and completion of the assignment in a constructive manner here just the knowledge provided is not merely counted but also completion prior to proposed deadline will also have a check on the student's serious consideration of the assignments.

Presentation of Seminar: Apart from the assignments the concerned instructors also allocate the students with a topic or based on their interests to present seminar that will aid them built their confidence levels, command over English language to communicate with precision and fluently. In addition, the fellow students are encouraged to pose questions that will instigate interest and provide update in that particular topic besides

the information presented helping them to prepare for their examinations that can be taken as added advantage for the students.

Preparedness: At the end of every class, the concerned instructor tells the students what will be taken in the next class using these details the students should be aware of thetopics that will be covered in the upcoming lectures which actually enhance the student's capability to grasp the knowledge and concepts provided much efficiently.

Academic Dishonesty: This is an important aspect that every student should be aware of. Thus, the respective faculty members educate the students of possible means of academic malpractices (plagiarism, violation of copyrights and stealing the patented knowledge) and the following consequences that will make them more vigilant in their academiccareer.

Subject to change clause: Based on the requirement of student's feasibility and meeting the competitive demands of the discipline the syllabus courses will be re-structured and updated accordingly at the discretion of the Professor(s) and Board of studies chairman.

Important dates: Please note down the important dates and stick to the schedule.

CIA Test I	CIA Test II	Assignment	Seminar
As per Academic Calendar		After CIA Test-I	

Course Outline: Introduction to Neural Networks

- Introduction to neural networks.
- Basics of network training.
- Probability density estimation.
- Multi-layer perceptrons.
- Radial basis function networks (RBFNs).
- Committee Machines and Mixtures of Experts.
- Content includes: Support Vector Machines (SVMs), Neural Networks for Robot Control.

More books for Reading and Referencing

Neural Networks, Fuzzy Logic and Genetic Algorithms: Synthesis and Applications **Rajasekaran; 2017**, **ISBN**: 978-812-035-334-3
Neural Networks & Learning Machines Pearson Education India; Third editionHaykin; 2009; **ISBN -10:** 0-13-147-139-2 and **ISBN-13:** 978-0-13-147139-9
Artificial Intelligence 3e: A Modern Approach Russell; 2015, **ISBN-10:** 933-254-351-8 and **ISBN-13:** 978-933-254-351-5
Machine Learning Tom M. Mitchell; 1997 **ISBN:** 0071154671 and **ISBN:** 978-007-115-467-3

Major Elective					
DSE	**Course Code: 502506**	**Introduction to Neural Networks**	**T**	**Credits:5**	**Hours:5**

Unit-I

Objective1	To introduce the neural networks for classification and regression.	
Introduction to Neural Networks: History, Biological Neurons and Neural Networks. Artificial Intelligence (AI) - Artificial Neurons, Networks of Artificial Neurons, Single Layer Perceptrons, Artificial Neural Networks (ANN)		
Outcome 1	Understand the main fundamental principles and techniques of neural network systems.	**K2**

Unit-II

Objective2	To give design methodologies for artificial neural networks.	
Learning and Generalization in Single Layer Perceptions: Hebbian Learning. Gradient Descent Learning, The Generalized Delta Rule. Practical Considerations. Learning in Multi-Layer Perceptrons. Back-Propagation, Learning with Momentum. Conjugate Gradient Learning.		
Outcome 2	Recall and Design the single and multi-layer feed-forward neural networks.	**K1**

Unit-III

Objective 3	To provide knowledge for network tuning and over fitting avoidance.	
Bias and Variance: Under-Fitting and Over-Fitting, Improving Generalization.		
Outcome 3	Understand building blocks of Neural Networks.	**K2**

Unit-IV

Objective 4	To offer neural network implementations in Mat lab.	
Applications of Multi-Layer Perceptrons: Radial Basis Function Networks: Introduction, Radial Basis Function Networks: Algorithms and Applications, Committee Machines.		
Outcome 4	Understand the differences between networks for supervised and unsupervised learning.	**K2**

Unit-V

Objective 5	To demonstrate neural network applications on real-world tasks.	
Self Organizing Maps: Fundamentals, Self Organizing Maps: Algorithms and Applications, Learning Vector Quantisation, Overview of More Advanced Topics.		
Outcome 5	Investigate the principal neural network models and applications.	**K5**

Suggested Readings:

Daniel Graupe (2013). Principles of Artificial Neural Networks, Third edition, World Scientific Publishing Co. Pte. Ltd.

Gareth James, Daniela Witten, Trevor Hastie, Robert Tibshirani, (2013),"Introduction to Statistical Learning", Springer.

Ian Goodfellow, Yoshua Bengio, Aaron Courville ,(2016),"Deep Learning", MIT Press . Raúl Rojas, (2013)," Neural Networks: A Systematic Introduction", Springer Science & Business Media.

Christopher M. Bishop, (2013)," Pattern Recognition and Machine Learning", Springer. David W. Pearson, Nigel C. Steele, Rudolf F. Albrecht ,(2012) "Artificial Neural Nets and Genetic Algorithms", Springer Science & Business Media

Richard O. Duda, Peter E. Hart, David G. Stork ,(2012)," Pattern Classification", John

Wiley & Sons, Second Edition.
Online Resources: 1.https://www.analyticsvidhya.com/blog/2022/01/introduction-to-neural-networks/ 2. https://www.geeksforgeeks.org/self-organising-maps-kohonen-maps/

K1-Remember	***K2-Understand***	***K3-Apply***	***K4-Analyze***	***K5-Evaluate***	***K6-Create***

Course designed by: Dr.RM.Vidhyavathi

Course Outcome VS Programme Outcomes

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S(3)	M(2)	-	-	-	L(1)	L(1)	L(1)	L(1)	L(1)
CO2	S(3)	M(2)	-	-	-	L(1)	L(1)	L(1)	L(1)	L(1)
CO3	S(3)	S(3)	-	-	-	L(1)	L(1)	L(1)	L(1)	L(1)
CO4	S(3)	S(3)	M(2)	-	L(1)	M(2)	L(1)	M(2)	L(1)	M(2)
CO5	S(3)	S(3)	M(2)	M(2)	L(1)	M(2)	M(2)	M(2)	S(3)	S(3)
W.AV	3	2.6	0.8	0.4	0.4	1.4	1.2	1.4	1.4	1.6

S –Strong (3), M-Medium (2), L- Low (1)

Course Outcome VS Programme Specific Outcomes

CO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	S(3)	-	-	-	M(2)
CO2	S(3)	-	-	-	M(2)
CO3	S(3)	-	M(2)	L(1)	S(3)
CO4	S(3)	M(2)	M(2)	M(2)	S(3)
W. AV	3	2	3	2	3

S –Strong (3), M-Medium (2), L- Low (1)

Assignment & Seminar - Introduction to Neural Networks

- Describe the relation between real brains and simple artificial neural network models.
- Explain and contrast the most common architectures and learning algorithms for Multilayer Perceptrons, Radial-Basis Function Networks, Committee Machines, and Kohonen Self-Organizing Maps.
- Discuss the main factors involved in achieving good learning and generalization performance in neural network systems.
- Describe the equations using vector expressions.

- Identify the main implementation issues for common neural network systems. Evaluate the practical considerations in applying neural networks to real classification and regression problems.

Data Warehousing and Data Mining

Program: M.Sc.,	Semester: --- (2022 Onwards)
Course Title and Code: Data Warehousing and Data Mining Subject Code: 502507	Class Time: As per Time Table
Name of the Course Teacher	Dr. RM. Vidhyavathi
Mobile: +91 9444835869	E-mail: vidhyavathirm@alagappauniversity.ac.in

Course Brief:

Data mining, *the extraction of hidden predictive information from large databases*, is a powerful new technology with great potential to help companies focus on the most important information in their data warehouses. Data mining tools predict future trends and behaviors, allowing businesses to make proactive, knowledge-driven decisions. The automated, prospective analyses offered by data mining move beyond the analyses of past events provided by retrospective tools typical of decision support systems. Data mining tools can answer business questions that traditionally too time consuming to resolve. They scour databases for hidden patterns, finding predictive information that experts may miss because it lies outside their expectations. Thus, Introduction to Database Management Systems will concentrate on the principles, design, implementation and applications of database management systems.

Teaching Methods: The mode of teaching of delivering the courses are as follows through these below mentioned methodologies:

- Lectures covering the Practical part using PowerPoint presentations.
- Delivering the lectures in the form of presentation using advanced technologies devices such as smart board.
- Case-studies and Discuss model question bank.

Attendance: Attendance and participation are vital to the student's success in this course. Students are expected to attend class every day. Minimum attendance to be eligible to take end-semester-examination is 80%. It is also essential that the students study regularly.

Punctuality: Punctuality is very important in the course, because if student are late, you not only waste your time, but other student's. You will also disturb others when you go into the lecture class or laboratory after the class begins. Therefore, please arrive at the class on time. Names of late students will be recorded by mentor and marks from Course performance will be deducted. An excuse for being absent from class shall be a medical or personal emergency acceptable at the discretion of the Head of the Dept.

Class Participation: Class participation and interaction helps to form a complete educational experience. However, class participation and interaction is to be relevant to course content and context. Deviant behavior may lead to dismissal or suspension.

Submission of Assignment: Assignments are given to students with just one motive to get more quantitative and qualitative knowledge insights into the assigned topic/chapter that will lead to preparation and completion of the assignment in a constructive manner here just the

knowledge provided is not merely counted but also completion prior to proposed deadline will also have a check on the student's serious consideration of the assignments.

Presentation of Seminar: Apart from the assignments the concerned instructors also allocate the students with a topic or based on their interests to present seminar that will aid them built their confidence levels, command over English language to communicate with precision and fluently. In addition, the fellow students are encouraged to pose questions that will instigate interest and provide update in that particular topic besides the information presented helping them to prepare for their examinations that can be taken as added advantage for the students.

Preparedness: At the end of every class, the concerned instructor tells the students what will be taken in the next class using these details the students should be aware of the topics that will be covered in the upcoming lectures which actually enhance the student's capability to grasp the knowledge and concepts provided much efficiently.

Academic Dishonesty: This is an important aspect that every student should be aware of. Thus, the respective faculty members educate the students of possible means of academic malpractices (plagiarism, violation of copyrights and stealing the patented knowledge) and the following consequences that will make them more vigilant in their academic career.

Subject to change clause: Based on the requirement of student's feasibility and meeting the competitive demands of the discipline the syllabus courses will be re-structured and updated accordingly at the discretion of the Professor(s) and Board of studies chairman.

Important dates: Please note down the important dates and stick to the schedule

CIA Test I	CIA Test II	Assignment	Seminar
As per Academic Calendar		After CIA Test-I	

Course Outline: Data Warehousing and Data Mining

- Databases to enable decision support through warehousing and mining of data.
- Areas with data mining will include justifying the need for knowledge recovery in databases, data mining methods such as clustering, classification, Bayesian networks, association rules, and visualization.
- Data warehouse including efficient data retrieval using bitmap and join indexes, reporting, ad hoc querying, and multi-dimensional operations such as slicing, dicing, pivoting, drill-down, and roll-up operation.
- Data extraction, transformation, loading techniques for data warehousing.
- Machine learning schemes in data mining.
- Database Concepts and Architecture.
- Data Modeling using Entity Relationship Diagrams.
- Referential integrity, entity integrity, and other constraints. Defining a relational schema from an ER diagram**.**
- Machine learning schemes in data mining.

More books for Reading and Referencing

ata Warehousing and Mining - 2012 ITLESL, Pearson Education India **(ISBN : 8131799050, 9788131799055)**
Data Mining Data Warehousing and Olap – 2009 Gajendra Sharma, S. K. Kataria & Sons **(ISBN: 8189757474, 9788189757472)**

Data Warehousing Olap and Data Mining –2006 S. Nagabhushana, New Age International **(ISBN: 8122417647, 9788122417647)**
Data Warehousing: Architecture and Implementation – 1999 Mark Humphries, Michael W. Hawkins, Michelle C. Dy, Prentice Hall Professional and **(ISBN:0130809020, 9780130809025)**

Major Elective					
DSE	**Course Code: 502507**	**Data Warehousing and Data Mining**	**T**	**Credits:5**	**Hours:5**
Unit-I					
Objective -1	To introduce students to the basic concepts and techniques of Datamining and Data Warehousing.				
Overview and Concepts: Need for data warehousing, Basic elements of data warehousing, Planning and Requirements: Project planning and management, Collecting the requirements. Architecture And Infrastructure: Architectural components, Infrastructure and metadata.					
Outcome -1	Understand concepts of Data warehousing, components ofdata warehousing and design schemas.				**K2**
Unit-II					
Objective -2	To develop skills of using recent data mining software for solvingpractical problems				
Data Design And Data Representation: Principles of dimensional modeling, Dimensional modeling advanced topics, data extraction, transformation and loading, data quality. Information Access and Delivery: Matching information to classes of users, OLAP in data warehouse, Data warehousing and the web. Implementation and Maintenance: Physical design process, data warehouse deployment, growth and maintenance.					
Outcome -2	Understand the concepts of OLAP and OLAP tools. To understand the clustering methods and apply algorithms to datasets.				**K2**
Unit-III					
Objective -3	To gain experience of doing independent study and research.				
Introduction: Basics of data mining, related concepts, Data mining techniques. Data Mining Algorithms: Classification, Clustering, Association rules. Knowledge Discovery: KDD Process. Web Mining: Web Content Mining, Web Structure Mining, Web Usage mining.					
Outcome -3	Recall the concepts of mining methods and classificationtypes and apply the algorithms to datasets.				**K1**
Unit-IV					
Objective-4	To study the methodology of engineering legacy databases for data warehousing and data mining to derive business rules for decision support systems.				
Advanced Topics: Spatial mining, temporal mining. Visualization : Data generalization and summarization-based characterization, Analytical characterization: analysis of attribute relevance, Mining class comparisons: Discriminating between different classes, Mining descriptive statistical measures in large databases Data Mining Primitives, Languages, and System Architectures: Data mining primitives, Query language, Designing GUI based on a data mining query language.					
Outcome -4	Build competitive advantage through proactive analysis, predictive modelling, and identifying new trends and				**K3**
	behaviour's.				

Unit-V		
Objective -5	Develop and apply enthusiasm for learning. Class participation isencouraged in this course.	
DBMS: Introduction, overview and types. Relational and transactional Database. Relational database-Introduction to relational DB, Data Definition-Manipulation-control- Objects, Views, sequences and Synonyms. Data Abstraction; Data Models; Instances & Schemes; E-R Model - Entity and entity sets; Relations and relationship sets; E-R diagrams; Reducing E-R Diagrams to tables. Network Data Model: Basic concepts; Hierarchical Data Model: Basic Concepts; Multimedia Databases - Basic Concepts and Applications; Indexing and Hashing; Text Databases; Introduction to Distributed Database Processing, Data Security. ORACLE and SQL- introduction and functions in DBMS; SYBASE		
Outcome 5	Differentiate database system from file system by enumerating the features provide by database system anddescribe each in both function and benefit.	**K5**

Suggested Readings:

Kimball, R. (2013), "The Data Warehouse Toolkit", John Wiley.

Kamber, H., Kaufmann, M. (2011), "Data Mining Concepts and Techniques".

Ian H. Witten, Eibe Frank, Mark A. Hall, Christopher J. Pal, (2016),"Data Mining", Morgan Kaufmann, Fourth Edition.

Michael W. Berry and Jacob Kogan, (2010),") Text Mining Applications and Theory", John Wiley & Sons.

Feldman, R and Sanger, J. (2007) "The Text Mining Handbook: Advanced approaches in analyzing unstructured data"; Cambridge University Press.

Xiaohua Hu and Yi Pan (2007), Knowledge Discovery in Bioinformatics, John Wiley & Sons.

William H. Inmon, (2005),"Building the Data Warehouse", John Wiley & Sons, Fourth Edition.

Dunham, M.H. (2006) "Data Mining Introductory and Advanced Topics", PearsonEducation.

Mallach, (2002)." Decision Support And Data Warehouse Systems", Tata McGraw-Hill Education**.**

Online Resources:

1. https://www.montecarlodata.com/blog-data-warehousing-guide/
2. https://www.tutorialspoint.com/dwh/dwh_olap.htm

K1-Remember	*K2-Understand*	*K3-Apply*	*K4-Analyze*	*K5-Evaluate*	*K6-Create*

Course designed by: Dr.RM.Vidhyavathi

Course Outcome VS Programme Outcomes

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S(3)	S(3)	S(3)	S(3)	-	M(2)	M(2)	M(2)	M(2)	S(3)
CO2	M(2)	S(3)	M(2)	S(3)	M(2)	M(2)	M(2)	M(2)	M(2)	M(2)
CO3	M(2)	S(3)	M(2)	S(3)	M(2)	M(2)	M(2)	S(3)	S(3)	M(2)
CO4	S(3)	S(3)	S(3)	S(3)	M(2)	M(2)	M(2)	S(3)	S(3)	M(2)
CO5	S(3)	S(3)	S(3)	S(3)	M(2)	M(2)	S(3)	S(3)	S(3)	M(2)
W.Avg	2.6	3	2.8	3	1.6	M(2)	2.4	2.6	2.6	2.6

S –Strong (3), M-Medium (2), L- Low (1)

Course Outcome VS Programme Specific Outcomes

	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	S(3)	S(3)	M(2)	S(3)	M(2)
CO2	M(2)	M(2)	M(2)	S(3)	M(2)
CO3	S(3)	S(3)	M(2)	M(2)	S(3)
CO4	M(2)	M(2)	L(1)	M(2)	L(1)
CO5	S(3)	S(3)	S(3)	L(1)	M(2)
W.Avg	2.6	2.6	2	2.2	2

S –Strong (3), M-Medium (2), L- Low (1)

Assignment & Seminar - Data Warehousing and Data Mining

- Introduction to the process of knowledge discovery in databases.
- The role of OLAP server.
- Basic concepts of data warehousing and data mining.
- Data warehouse design and implementation: multidimensional data model, casestudy using Oracle technology.
- Data mining core algorithms: statistical modeling, classification, clustering, association rules.
- Patterns of data mart development.
- Providing OLAP (On-line Analytical Processing) to User-Analysts.
- Designing GUI based on a data mining query language.
- Descriptive statistical measures in large databases Data Mining Primitives, Languages, and System Architectures.
- Database Support to Data Mining.
- Association rules and Knowledge Discovery process.
- Data Warehousing Technology.
- Prism Solutions.
- Analytical characterization.
- Discuss about Introduction to Distributed Database Processing.
- Model development, schema design for a data warehouse.
- Explain DBMS functions.
- Purpose of building a DBMS system and RDBMS system.
- Compare between File systems and database systems.
- Explain the relational model with suitable example.
- Reducing E-R Diagrams to tables.
- Define the following terms.
  a. Tuple
  b. Attribute
  c. Domain
  d. Primary Key
  e. Foreign Key

Program: M.Sc.,	Semester: III (2022 Onwards)
Course Title and Code: Programming in C and C++ Subject Code: 502508	Class Time: As per Time Table
Name of the Course Teacher	Dr. RM. Vidhyavathi
Mobile: +91 9444835869	E-mail: vidhyavathi@alagappauniversity.ac.in

Course Brief:

This course provides a fast-paced introduction to the C and C++ programming languages. To learn the required background knowledge, including memory management, pointers, preprocessor macros, object-oriented programming, and how to find bugs when inevitably use any of those incorrectly. In computing, C is a general- purpose computer programming language used along with the UNIX operating system. Although C was designed for implementing system software, it is also used for developing application software. It is widely used on different types of software platforms and computer architectures, and several popular compilers exist. C has greatly influenced many other popular programming languages.

C++ Language is one of the approaches to provide object-oriented functionality with C like syntax. C++ adds greater typing strength, scoping and other tools useful in object-oriented Programming and permits generic programming via templates. It is regarded as a middle-level language, as it comprises a combination of both high-level and low-level language features. Some of its application domains include systems software, device drivers, embedded software, high-performance server and client applications, and entertainment software such as video game. The practical part of this course is covered in the lab through exercises, practical assignments, and tutorials.

Teaching Methods: The mode of teaching of delivering the courses are as follows through these below mentioned methodologies:

- Lectures covering the theoretical part using PowerPoint presentations.
- Delivering the lectures in the form of presentation using advanced technologies devices such as smart board.
- Case-studies and Review questions

Attendance: Having good attendance record marks the student's sincerity and has an overall positive impact on his/her personality trait development. The students are asked to attend the classes on a regular note and those having a minimum scale of 70-75% attendance are eligible to take up the end-semester examinations as per the University norms.

Punctuality: It is the most important attribute to be followed and maintained by the student throughout his/her life which for sure will lead to the path of success. Students who arrive late by 10 mins after the attendance will be marked absent unless there is a valid reason (medical/ personal emergency) at the discretion of the Head of the Department.

Class/Lab Participation: A student's overall growth and personality development is based on his/her involvement in the class not just by mere presence but rather being interactive through questioning that will lead to propagation of ideas, initiation of thought-provoking process and much more that will provide a wholesome enriched classroom experience. Therefore, students are advised to be more attentive so that they learn from one another and develop quality-based knowledge.

Submission of Assignment: Assignments are given to students with just one motive to get more quantitative and qualitative knowledge insights into the assigned topic/chapter that will lead to preparation and completion of the assignment in a constructive manner
here just the knowledge provided is not merely counted but also completion prior to proposed deadline will also have a check on the student's serious consideration of the assignments.

Presentation of Seminar: Apart from the assignments the concerned instructors also allocate the students with a topic or based on their interests to present seminar that will aid them built their confidence levels, command over English language to communicate with precision and fluently. In addition, the fellow students are encouraged to pose questions that will instigate interest and provide update in that particular topic besides the information presented helping them to prepare for their examinations that can be taken as added advantage for the students.

Preparedness: At the end of every class, the concerned instructor tells the students what will be taken in the next class using these details the students should be aware of the topics that will be covered in the upcoming lectures which actually enhance the student's capability to grasp the knowledge and concepts provided much efficiently.

Academic Dishonesty: This is an important aspect that every student should be aware of. Thus, the respective faculty members educate the students of possible means of academic malpractices (plagiarism, violation of copyrights and stealing the patented knowledge) and the following consequences that will make them more vigilant in their academic career.

Subject to change clause: Based on the requirement of student's feasibility and meeting the competitive demands of the discipline the syllabus courses will be re-structured and updated accordingly at the discretion of the Professor(s) and Board of studies chairman.

Important dates: Please note down the important dates and stick to the schedule

CIA Test I	CIA Test II	Assignment	Seminar
As per Academic Calendar		After CIA Test I	

Course Outline: Programming in C and C++

Introduction to compiling and software development life cycle

- Basic scalar data types, operators, variables, statements, flow control, streamed input/ output, conversions, preprocessor.
- Declaring, defining and invoking functions.
- Strings processing, exceptions handling, dealing with namespaces.
- Object-oriented approach.
- It discusses class and objects.
- Defining overloaded operators, File input and output functions.
- The above said methods are used to create a bioinformatics related programs in C and C++.

More books for Reading and Referencing

C++ Programming Today – 2011 Johnston**,** Barabara **: ISBN-10: 812-033-831-6, ISBN-13**: **978-812-033-831-9**
Practical C++ Programming – 2003 Steve Oualline**,**'O'Reilly Media, Inc and **(ISBN: 0596004192, 9780596004194**)
Advanced Graphics Programming In C & C++ - 1993 Roger T. Stevens,BPB Publications and **(ISBN: 817029228X, 9788170292289)**

Computer Programming with C++ - 2017
Kunal Pimparkhede, Cambridge University Press,
(ISBN: **1316506800, 9781316506806)**

Major Elective					
DSE	**Course Code: 502508**	**Programming in C and C++**	**T**	**Credits:5**	**Hours:5**

Unit-I		
Objective-1	To learn the fundamental programming concepts and methodologies which are essential to building good C/C++ programs.	
Basics of C: Essentials of C Programs, Data Types and names in C, Reading and Writing to Standard input and output (I/O).Statements, Expressions, Operators, Hierarchy of operators, Control statements including decision, loops and branching, Loop control structures.		
Outcome-1	Easy to implement, test, debug, and document programs in C andC++	**K2**
Unit-II		
Objective-2	To practice the fundamental programming methodologies in the C/C++ programming language via laboratory experiences.	
Arrays, Functions and Pointers: Array initialization, 1D and 2D Arrays, Functions in C, Passing elements to functions, Scope and Storage Classes in C, Introduction to Pointers, Pointer notations, Applying Pointers, Allocating Memory, More Data Types, Storage classes, C preprocessor.		
Outcome-2	Construct the programs that demonstrate effective use of C+features.	**K6**
Unit-III		
Objective-3	To code, document, test, and implement a well-structured, robust computer program using the C programming language.	
Structure & Unions: Collecting Data Items of Different Types, Unions: Another Way to Collect Dissimilar Data, File input and output operations. Standard functions in the 'C' graphics module.		
Outcome-3	Understand and use the common data structures typically found in C++ programs - namely arrays, strings, lists, trees, and hash tables.	**K2**
Unit- IV		
Objective-4	To code, document, test, and implement a well-structured, robust computer program using the C++ programming language.	
Introduction to C++- History- Features- Installation-C++ Program-C++ cout, cin, endl- Variable-Data types- Keywords- Operators- Object oriented programming concepts- inheritance, polymorphism, and encapsulation. C++ Control Statement: if-else-switch- For Loop- While Loop- Do-While Loop- Break Statement- Continue Statement- Goto Statement- Comments.		
Outcome-4	Create programs that measure or simulate performance and use them to analyse behaviour.	**K6**
Unit-V		
Objective-5	Be able to apply object oriented or non-object oriented techniques tosolve bigger computing problems	
C++ Functions: Call by value & reference- Recursion- Storage Classes- Arrays: Array to Function-Multidimensional Arrays-C++ Pointers-: Pointers-C++ Object Class- OOPs Concepts-Object Class- Constructor- Destructor- this Pointer- static-Structs- Enumeration- Friend Function- C++ Namespaces- Templates: Templates- C++ Strings: Strings-Exceptions-:Exception Handling: try/catch- User-Defined-Programs.		
Outcome-5	Apply Programming constructs to develop simple bioinformatics	**K5**

	programs and tools.	

Suggested Readings:

E. Balagurusamy (2017), "Programming in ANSI C ", Tata McGraw- Hill Education, Seventh Edition.

Herbert Scheldt (2009),"C++: The Complete Reference", Tata McGraw- Hill Education, Fourth Edition.

Jesse Liberty, (1998),"Teach Yourself C++ in 21 Days", Sams Publishing 2nd edition.Marshall A. D, (1999),"Programming in C", Nikos Drakos.

Brian W. Kernighan, Dennis Ritchie, (1988),"The C programming Language", PrenticeHall.

Michael Barr, (1999)," Programming Embedded Systems in C and C++ ", O'Reilly. Guigo, R. & Gilbert D., (2002) "Algorithms in bioinformatics", Springer- Verlag, Berlin.Dan Gookin, (2004) "C for Dummies", John Wiley & Sons, 2nd edition.

Parthasarathy, S. (2008), "Essentials of C Programming for Life Sciences", Ane's Books India, New Delhi. Y. Daniel Liang, (2011),"Introduction to Programming with C++", Pearson Education, Second Editio

Online Resources:

1. https://books.goalkicker.com/CBook/
2. https://books.goalkicker.com/CPlusPlusBook/

K1-Remember	***K2-Understand***	***K3-Apply***	***K4-Analyze***	***K5-Evaluate***	***K6-Create***

Course designed by: Dr.RM.Vidhyavathi

Course Outcome VS Programme Outcomes

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S(3)	S(3)	M(2)	M(2)	M(2)	S(3)	M(2)	M(2)	M(2)	S(2)
CO2	S(3)	M(2)	L(1)	-	L(1)	L(1)	L(1)	-	M(2)	L(1)
CO3	S(3)	S(3)	L(1)	L(1)	L(1)	M(2)	M(2)	M(2)	L(1)	L(1)
CO4	S(3)	S(3)	L(1)	M(2)	L(1)	M(2)	M(2)	M(2)	L(1)	L(1)
CO5	S(3)	S(3)	L(1)	M(2)	L(1)	M(2)	M(2)	M(2)	M(2)	L(1)
W.Avg	3	2.8	1.2	1.4	1.2	2	1.8	1.6	1.6	1.2

S –Strong (3), M-Medium (2), L- Low (1)

Course Outcome VS Programme Specific Outcomes

CO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	S(3)	M(2)	M(2)	M(2)	M(2)
CO2	M(2)	M(2)	M(2)	-	M(2)
CO3	M(2)	M(2)	L(1)	M(2)	L(1)
CO4	M(2)	L(1)	L(1)	L(1)	L(1)
CO5	M(2)	L(1)	L(1)	L(1)	-
W.Avg	2.2	1.6	1.4	1.2	1.2

S –Strong (3), M-Medium (2), L- Low (1)

Assignment & Seminar - Programming in C and C++

- To describe the advantages of a high level language like C/C++, the programming process, and the compilation process.
- To describe and use software tools in the programming process.
- Use an IDE to compile, load, save, and debug a C/C++ program.
- Create and analyze algorithms for solving simple problems.
- Analyze, explain and trace the behavior of simple programs involving the fundamental programming constructs addressed in the course.
- Write programs that use each of the following fundamental programming constructs: basic computations, simple console I/O, standard conditional and iterative structures (including pretest and posttest loops, counter-controlled loops, and conditionals).
- To demonstrate an understanding of primitive data types, values, operators and expressions in C/C++.
- Describe automatic type conversion rules, related issues of magnitude and precision, type casting, and determine the value and type of an expression involving mixed types.
- Find mismatches between two sequences of same length, Pass the value to a function using pointer.
- Convert NCBI format file to fast a sequence file, Find GC content using Structures

Cell Communication and Cell Signaling

Program: M.Sc.,	Semester: --- (2022 Onwards)
Course Title and Code: Cell Communication and Cell Signaling Subject Code: 502509	Class Time: As per Time Table
Name of the Course Teacher	Dr. M.Karthikeyan
Mobile: -	E-mail: mkbioinformatics@gmail.com-

Course Brief:

Cell communication and cell biology course deals with the molecular biology of cell signaling. The students will gain an insight into the fundamental processes of the cell to cell communication and signaling uptake of molecules by membrane receptors, including membrane-protein and protein-protein interactions, and their associated effectors. Students will learn about Morphogenesis and organogenesis. The second half of lectures will deal with cell cycle signaling system and cell death.

Teaching Methods: The mode of teaching of delivering the courses are as follows through these below mentioned methodologies:

- Delivering the lectures in the form of presentation using advanced technologies devices such as smart board.

- Video-conferencing for lectures that will be sought from experts belonging to overseas reputed institutions

Attendance: Having good attendance record marks the student's sincerity and has an overall positive impact on his/her personality trait development. The students are asked

to attend the classes on a regular note and those having a minimum scale of 70-75% attendance are eligible to take up the end-semester examinations as per the University norms.

Punctuality: It is the most important attribute to be followed and maintained by the student throughout his/her life which for sure will lead to the path of success. Students who arrive late by 10mins after the attendance has been taken will be marked absent unless there is a valid reason (medical/ personal emergency) at the discretion of the Head of the Department.

Class Participation: A student's overall growth and personality development is based on his/her involvement in the class not just by mere presence but rather being interactive through questioning that will lead to propagation of ideas, initiation of thought-provoking process and much more that will provide a wholesome enriched classroom experience. Therefore, students are advised to be more attentive so that they learn from one another and develop quality-based knowledge.

Submission of Assignment: Assignments are given to students with just one motive to get more quantitative and qualitative knowledge insights into the assigned topic/chapter that will lead to preparation and completion of the assignment in a constructive manner here just the knowledge provided is not merely counted but also completion prior to proposed deadline will also have a check on the student's serious consideration of the assignments.

Presentation of Seminar: Apart from the assignments the concerned instructors also allocate the students with a topic or based on their interests to present seminar that will aid them built their confidence levels, command over English language to communicate with precision and fluently. In addition, the fellow students are encouraged to pose questions that will instigate interest and provide update in that particular topic besides the information presented helping them to prepare for their examinations that can be taken as added advantage for the students.

Preparedness: At the end of every class, the concerned instructor tells the students what will be taken in the next class using these details the students should be aware of the topics that will be covered in the upcoming lectures which actually enhance the student's capability to grasp the knowledge and concepts provided much efficiently.

Academic Dishonesty: This is an important aspect that every student should be aware of. Thus, the respective faculty members educate the students of possible means of academic malpractices (plagiarism, violation of copyrights and stealing the patented knowledge) and the following consequences that will make them more vigilant in their academiccareer.

Subject to change clause: Based on the requirement of student's feasibility and meeting the competitive demands of the discipline the syllabus courses will be re-structured and updated accordingly at the discretion of the Professor(s) and Board of studies chairman.

Important dates: Please note down the important dates and stick to the schedule

CIA Test I	II CIA Test	Assignment	Seminar
As per Academic Calendar		After CIA Test-I	

Course Outline: Core: Cell Communication and Cell Signaling

Basic concepts about the Host parasitic interactions – understanding the entry processof different pathogens.

Exploring the virus-induced cell transformation and pathogen induced diseases in animals and plants.
Cell-Cell fusion method in both normal and abnormal cells.
Cell signaling mechanism in cells, hormones and their receptors.
Signaling through G-protein coupled receptor.
Principles of cellular communication and regulation of hematopoiesis.
Cell adhesion and role of different adhesion molecules.
Genetic rearrangements in progenitor cells, oncogenes, tumor suppressor genes.
Programmed cell death, aging and senescence.
Morphogenesis and organogenesis in animals and plants.

More books for Reading and Referencing

Molecular Cell Biology (Fourth Edition) by Harvey Lodish, Arnold Berk, David Baltimore; 1999, **ISBN-13: 978-0716737063, ISBN-10: 071673706X**
Handbook of Cell Signaling by Edward A. Dennis; 2009, **ISBN: 9780123741455**
Handbook of Cell Signaling (Second Edition) by Ralph A. Bradshaw and Edward A. Dennis; 2015; **ISBN: 978-0-8153- 4244**
Cell Signaling: principles and mechanisms by Wendell Lim, Bruce Mayer, Tony Pawson
Cell Communication: Understanding how Information is Stored and Used in Cells by Michael Friedman, Brett Friedman, 2005; **ISBN 10: 1404203192, ISBN 13: 9781404203198**
Cell-to-Cell Communication by Walmor C. De Mello; 2012; **ISBN 13:978-1-4612-9006-7**

Major Elective					
DSE	**Course Code: 502509**	**Cell Communication and Cell Signaling**	**T**	**Credits:5**	**Hours: 5**
Unit - I					
Objective - 1	To study the cellular morphology, function and to develop an understanding of genome organization.				
Host parasite interaction: Recognition and entry processes of different pathogens like bacteria, viruses into animal and plant host cells, alteration of host cell behavior by pathogens, virus-induced cell transformation, pathogen-induced diseases in animals and plants, cell-cell fusion in both normal and abnormal cells.					
Outcome - 1	Students will learn about Morphogenesis and organogenesis to describe how cells exploit signaling components to assemble the specific signaling pathways.				**K2**
Unit – II					
Objective - 2	To underpin the more advanced concept those are covered experimental basis of current understandings, new experimental methodologies in molecular cell biology techniques.				

Cell signaling: Hormones and their receptors, cell surface receptor, signaling through G-protein coupled receptors, signal transduction pathways, second messengers, regulation of signaling pathways, bacterial and plant two-component systems, light signaling in plants, bacterial chemo taxis and quorum sensing.		
Outcome - 2	Student will be able to learn components and properties of major cell signaling pathways in control of gene expression and cellular metabolism.	**K2**
Unit – III		
Objective - 3	To provide the student with a strong foundation for principles of cell communication	
Cellular communication: General principles of cell communication, cell adhesion and roles of different adhesion molecules, gap junctions, extracellular matrix, integrins, neurotransmission and its regulation and Regulation of hematopoiesis.		
Outcome - 3	Recognize and discuss the main types of cell communication, including the signal molecules.	**K1&K2**
Unit – IV		
Objective - 4	To make the students to understand the genetic rearrangement	
Cellular and genetic alterations: Genetic rearrangements in progenitor cells, oncogenes, tumor suppressorgenes, cancer and the cell cycle, virus-induced cancer, metastasis, interaction of cancer cells with normal cells, apoptosis, therapeutic interventions of uncontrolled cell growth. Pr med cell death, aging and senescence.		
Outcome - 4	To understand the importance of genetic alteration	**K5**
Unit -V		
Objective - 5	To find out the methods for analyzing the cell morphogenesis and organogenesis	
Morphogenesis and organogenesis in animals: Cell aggregation and differentiation in *Dictyostelium*; axes and pattern formation in *Drosophila*, amphibia and chick; organogenesis – vulva formation in *Caenorhabditis elegans*, eye lens induction, limb development and regeneration in vertebrates; differentiation of neurons, post embryonic development- larval formation, metamorphosis; environmental regulation of normal development; sex determination.**Morphogenesis and organogenesis in plants:** Organization of shoot and root apical meristem; shoot and root development; leaf development and phyllotaxy; transition to flowering, floral meristems and floral development in *Arabidopsis* and *Antirrhinum.*		
Outcome - 5	Analyze the general celluler morphogenesis and organogenesis foraminal and plant.	**K4**

Suggested Readings:

Pfeffer U (2013) Cancer Genomics; Springer.

Scott F. Gilbert (2013) Developmental Biology; Tenth Edition; Sinauer Associates, Inc., Sunderland, USA.

Henry C. Pitot (2002) Fundamentals of Oncology; Fourth Edition, Revised and Expanded; Marcel Dekker,Inc., New York, USA.

Wolfgang Arthur Schulz (2005) Molecular Biology of Human Cancers; An Advanced Student's Textbook; Springer, USA.

Raymond W. Ruddon, Daniel D. Loeb (2007) Cancer Biology; Fourth Edition; OXFORD University Press, NewYork, USA.

Bunz F (2016) Principles of Cancer Genetics; Springer.

Online Resources: 1. https://elifesciences.org/articles/55793 2. https://academic.oup.com/jb/article/159/6/553/1750854					
K1-Remember	***K2-Understand***	***K3-Apply***	***K4-Analyze***	***K5-Evaluate***	***K6-Create***
Course designed by: Dr. M. Karthikeyan					

Course Outcome VS Programme Outcomes

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	M(2)	M(2)	M(2)	M(2)	L(1)	M(2)	M(2)	M(2)	M(2)	M(2)
CO2	M(2)	M(2)	S(3)	M(2)	M(2)	M(2)	M(2)	M(2)	L(1)	M(2)
CO3	M(2)	L(1)	L(1)	L(1)	M(2)	M(2)	L(1)	L(1)	M(2)	L(1)
CO4	L(1)	L(1)	M(2)	M(2)	L(1)	M(2)	L(1)	M(2)	L(1)	L(1)
CO5	M(2)	L(1)	M(2)	L(1)	L(1)	M(2)	M(2)	L(1)	M(2)	M(2)
W.AV	1.9	1.4	2	1.4	1.4	2	1.8	1.8	1.8	1.8

S –Strong (3), M-Medium (2), L- Low (1)

Course Outcome VS Programme Specific Outcomes

CO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	M(2)	1	M(2)	1	M(2)
CO2	1	M(2)	1	1	1
CO3	1	M(2)	1	M(2)	M(2)
CO4	M(2)	M(2)	M(2)	1	1
CO5	1	M(2)	M(2)	1	M(2)
W. AV	1.4	1.8	1.6	1.2	1.6

S –Strong (3), M-Medium (2), L- Low (1)

Assignment & Seminar: Cell Communication and Cell Signaling

Describe signal transduction pathways.

1. Discuss about the cell signaling pathways.
2. What are bacterial chemotaxis and quorum sensing?
3. Describe virus-induced cell transformation
4. Write about G-protein coupled receptors
5. Explain the pathogen-induced diseases in animals and plants.
6. Define Regulation of hematopoiesis and its regulation.
7. Discuss about the neurotransmission.
8. Give an account on cell adhesion and roles of different adhesion molecules.

9. Define bacterial and plant two-component systems?

Big data analysis and Next Generation Sequencing

Program: M.Sc., Bioinformatics	Semester : --- (2022 Onwards)
Course Title: Big data analysis and Next Generation Sequencing Subject Code: 502510	Class Time: As per Time Table
Name of Course Teacher	Dr. Sanjeev Kumar Singh Dr. M. Karthikeyan
Mobile: +91 - 98944 29800 & +91 - 94869 81874	E-mail : sksingh@alagappauniversity.ac.in karthikeyanm@alagappauniversity.ac.in

Course Brief:

The course portrays the crucial ideas of Essential Packages and libraries, operators, Data structures, control loops of R-language; file operations, graphic libraries 182and plots; Overview of Statistical packages and bioconductor libraries, Data representation in R; concepts and Principles of Genomics/Epigenomics, methods of Sequencing: Sanger's dideoxy method, Microarray and RNA-seq, Next Generation Sequencing technology; Impact of transcriptomics on biology; Data analysis: NGS, Big Data, microarray; Mapping algorithms. Measuring gene, lncRNA, siRNA from RNA-seq, NGS data; Sequence assembly concepts, challenges and Algorithms for assembling short reads using graph theory, Gene prediction, annotation and gene ontology (GO); Identification genetic variants from genome sequence: SNPs, SNVs, translocation, copy number variation; Gene expression analysis, Differential expression analysis, Hidden Markov model annotating histone markers, Cloud computing.

Teaching Methods: The mode of teaching is based on the following learning activities:

- Lectures covering the theoretical part will be delivered using PowerPointpresentations.
- A set of laboratory exercises to analyze biological problems using softwares andtools to develop student's interests in scientific discovery.
- Case studies in informatics-based research.

Attendance: The students are expected to attend the classes regularly, since regular attendance is essential to gain academic achievement. As per the University norms, the students having a minimum scale of 70-75% attendance are only qualified to write their end-semester examinations.

Punctuality: Punctuality is the most important quality for the student to be followed and maintained to achieve success. Students who arrive late by 10 mins to the class without any vital reason will be marked absent in the attendance register. On the other hand, valid excuse including personal or medical emergency is acceptable, with prior consent by the Head of the Department.

Class Participation: A student's overall growth and personality development is based on his/her involvement in the class not just by mere presence but rather being interactive through questioning that will lead to propagation of ideas, initiation of thought-provoking practice and much more that will provide a wholesome enriched classroom experience. When students participate, they learn from one another and gain their knowledge better.

Submission of Assignment: Assignments are given to students in order to apply the concepts for deeper understanding of the subject. Therefore, each student will be allocated two assignments for the course, covering the entire topic. Students will be given deadline to

submit the assignment by the course instructor and good preparation of assignment will help the students for their final exams.

Presentation of Seminar: Apart from the assignments, students are supposed to give an oral presentation during the class seminar hours in their assigned topic. The concerned instructor will encourage the participants to ask valid questions during seminar presentation in order to put up their confidence levels and communication skills. In addition, students will be able to gain information and can be updated in their course.

Preparedness: At the end of every class, the concerned instructor conveys the students about the details that will be handled in the next class to increase the student's awareness related to the topics.

Academic Dishonesty: Academic dishonesty is a completely unacceptable mode of conduct and every student should be aware of this important aspect. Thus, the respective faculty members educate the students of possible means of academic malpractices (plagiarism, violation of copyrights and stealing the patented knowledge) and the following consequences that will make them more vigilant in their academic career.

Subject to change clause: Depending upon the requirement of student's possibility, the course syllabus will be re-structured and updated accordingly at the discretion of the Professor(s) and Board of studies chairperson.

Important dates: Scheduled dates for the various activities related to the course

CIA Test I	**CIA Test II**	**Assignment I**	**Assignment II**	**Seminar**
As per Academic Calendar		After CIA tests		

Course Outline: Core: Big Data Analysis and Next Generation Sequencing Essentials of R-Package, libraries, operators, control loops in biological data, statistical packages and bioconductor libraries in R, Qualitative and quantitative data types; plotting of data.

- Concepts of genomics and epigenomics, methodology and principle of sequencing, Genome projects of model organisms, ChIP-chip ChIP-seq- techniques, Methylation of DNA and genetics; volume of data produced and important repositories.
- Analysis of data: gene expression analysis, statistical methods, Mapping algorithms such as Burro-Wheeler; Measuring gene, lncRNA, siRNA from RNA- seq NGS data; Gene prediction and annotation; gene ontology (GO); Genome-wide annotation methods; Algorithms for assembling short reads using graph theory such as Hamiltonian cycle and de Brjin;
- Genetic variants identification from genome sequence; preface to various applications. Concepts and algorithms to measure transcriptional regulation, small RNA analysis, validation of whole-genome database.
- Finding of differential Gene and Allele-specific expression, Organizing genetic, Non-synonyms (SIFT, Polyphen), Regulatory and Synonyms variants, , Hidden Markov model annotating histone markers,

More books for Reading and Referencing

The R Book-**Michael J Crawley** Publisher: John Wiley & Sons, January 1, 2007. (**ISBN**: 978-0-470-97392-9)
Data Analysis and Graphics: Using R - **J. H. Maindonald and John Braun** Publisher: Cambridge University Press, 06-May-2010. (**ISBN**: 978-0-521-76293-9)
Epigenetics: Current Research and Emerging Trends - **Brian P. Chadwick** Publisher Caister Academic Press, July 2015. (**ISBN: 978-1-910190-07-4**)
Non-coding RNAs and Epigenetic Regulation of Gene Expression: Drivers of Natural Selection - **Kevin V. Morris** Publisher: Caister Academic Press, February 2012. (**ISBN: 978-1-904455-94-3**)
Computational Methods for Next Generation Sequencing Data Analysis- **Ion Mandoiu, Alexander Zelikovsky** Publisher: John Wiley & Sons, October 2016. (**ISBN: 978-1-118-16948-3**)
Next-Generation Sequencing Data Analysis- **Xinkun Wang** Publisher: CRC Press , February 24, 2016 (**ISBN: 978-1-482-21788-9**)

Major Elective					
DSE	**Course Code: 502510**	**Big Data Analysis and Next Generation Sequencing**	**T**	**Credits:5**	**Hours: 5**
Unit - I					
Objective - 1	To make students understand the use of R in Data representation, File Input/Output operations; Big Data Analysis and Next Generation Sequencing;				
R statistical package: Essentials of R-Package and libraries, mathematical operations, string operations, Data structures: vectors, data frames, lists, matrices, Control loops: if, else, while for loops. File Input/Output operations. R plots and the graphics library. Overview of Statistical packages and bioconductor libraries in R. Data representation: Qualitative and quantitative data types, Tabulation and visual display of data, plotting line plot, scatter plot, frequency histograms, pie-chart, heat map and 3D plots.					
Outcome - 1	The student should be able to understand basic use of R statistical package in biological data				**K1**
Unit – II					
Objective - 2	To provide the student with a strong foundation for principles, methods and concepts of sequencing, Impact of transcriptomics on biology				
Concepts of Genomics/Epigenomics: History of genomics; Genome projects of model organisms; Principle of Sanger's dideoxy method, Microarray and RNA-seq, Next Generation Sequencing technology, Different platforms of NGS, Overview of metagenomics principles, Methylation of DNA and genetics; histone modifications, ChIP-chip ChIP-seq- techniques. Impact of transcriptomics on biology, volume of data produced and important repositories.					
Outcome - 2	The student will have the capacity to comprehend the ideas of Genome projects of model organisms, Next Generation Sequencingtechnology.				**K1**
Unit – III					
Objective - 3	To create students opportUNITy to analyze the Big Data, NGS, Microarray, RNA-Seq of gene, lncRNA, siRNA				

Transcriptome NGS/Big Data analysis: Microarray data analysis: gene expression analysis, statistical methods; relative merits of various platforms. Mapping algorithms such as Burro-Wheeler. Measuring gene, lncRNA, siRNA from RNA-seq NGS data. Sequence assembly concepts and challenges in assembling short reads; Algorithms for assembling short reads using graph theory such as Hamiltonian cycle and de Brjin; Writing code for assembling reads. Gene prediction and annotation; gene ontology (GO); Genome-wide annotation methods; identification of synteny between various genomes and challenges.

Outcome - 3	The students will be able to demonstrate Microarray data analysis, Genome-wide annotation methods; identification of synteny between various genomes and challenges	**K3**

Unit – IV

Objective - 4	To make the students look the Identification genetic variants from genome sequence; small RNA analysis, validation of whole-genome database.

Variant Analysis and computational Epigenomics: Identification genetic variants from genome sequence: SNPs, SNVs, translocation, copy number variation. Concepts behind genome-wide association studies. Introduction to various applications. Concepts and algorithms to measure transcriptional regulation;methylation and alternative splicing; relative merits of various approaches; small RNA analysis, validation of whole-genome database.

Outcome - 4	The students will be able to analyze SNPs, SNVs, translocation, copy number variation, Concepts and algorithms to measure transcriptional regulation	**K4**

Unit -V

Objective - 5	To find out the methods for analyzing the Gene expression, Differential expression, Allele-specific expression and Statisitcal considerations.

Data Analysis Interpretation: Gene expression analysis, Differential expression analysis, Allele-specific expression, Prioritizing genetic variants, Non-synonyms variants (SIFT, Polyphen), Synonyms variants, Regulatory variants, Statistical methods on rare variants, Statisitcal considerations, Hidden Markov model annotating histone markers, Cloud computing.

Outcome - 5	The student should understand the Differential expression analysis of gene, the Statistical methods on rare variants	**K2**

Suggested Readings:

Momiao Xiong ”Big Data in Omics and Imaging: Association Analysis” (2017), CRC Press, **ISBN:** 978-1-4987-2578-1

Peter Dalgaard “Introductory Statistics with R” (2015) Second Edition, Springer Science & BusinessMedia. **ISBN:** 978-0-387-79053-4

Laurens Holmes “Applied Epidemiologic Principles and Concepts” (2017), CRC, **ISBN:** 978-1-4987-3378-6 Greg J. Hunt, Juergen R. Gadau "Advances in Genomics and Epigenomics of Social Insects” 1st Ed, (2017). Frontiers

Ka-Chun Wong “Big Data Analytics Genomics” (2016), Springer, **ISBN:** 978-3-319-41279-5

Ion Mandoiu, Alexander Zelikovsky "Computational Methods for Next Generation Sequencing DataAnalysis" (2016) John Wiley & Sons.

Shui Qing Ye “Big Data Analysis for Bioinformatics and Biomedical Discoveries” (2016), CRC, **ISBN :** 978-1-4987-2454-8

Ion Mandoiu, Alexander Zelikovsky “Computational Methods for Next Generation Sequencing DataAnalysis” (2016), John Wiley & Sons, **ISBN:** 9781119272175

Hyunjoung Lee, Il Sohn “Fundamentals of Big Data Network Analysis for Research and Industry” (2016),John Wiley & Sons, **ISBN:** 978-1-1190-1558-1

Andrew E. Teschendorff “Computational and Statistical Epigenomics” (2015), Springer, **ISBN:** 978-94-017-9929-

Online Resources:

1. https://books.google.co.in/books?id=8bMj8m4RDQC&printsec=frontcover&dq=inauthor:%22John+Maindonald%22&hl=en&newbks=1&newbks_redir=0&source=gb_mobile_search&ovdme=1&sa=X&redir_esc=y
2. https://www.google.co.in/books/edition/Epigenetics/lm_0oQEACAAJ?hl=en

K1-Remember	*K2-Understand*	*K3-Apply*	*K4-Analyze*	*K5-Evaluate*	*K6-Create*

Course designed by: **Dr. Sanjeev Kumar Singh & Dr. M. Karthikeyan**

Course Outcome VS Programme Outcomes

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	L(1)	L(1)	M(2)	L(1)	-	-	L(1)	L(1)	M(2)	L(1)
CO2	L(1)	L(1)	L(1)	L(1)	-	L(1)	L(1)	L(1)	L(1)	L(1)
CO3	L(1)	L(1)	L(1)	L(1)	-	-	L(1)	L(1)	L(1)	L(1)
CO4	M(2)	L(1)	M(2)	M(2)	L(1)	L(1)	L(1)	L(1)	L(1)	L(1)
CO5	-	L(1)	-	L(1)	L(1)	-	L(1)	-	L(1)	L(1)
W.AV	1	1	1.2	1.2	0.2	0.2	1	0.6	1.2	1

S –Strong (3), M-Medium (2), L- Low (1)

Course Outcome VS Programme Specific Outcomes

CO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	M(2)	M(2)	M(2)	M(2)	M(2)
CO2	M(2)	M(2)	M(2)	L(1)	L(1)
CO3	L(1)	-	L(1)	L(1)	L(1)
CO4	L(1)	-	L(1)	L(1)	L(1)
CO5	L(1)	L(1)	L(1)	-	L(1)
W.AV	1.4	1.2	1.4	1	1.2

S –Strong (3), M-Medium (2), L- Low (1)

Assignment & Seminar - Big Data Analysis and Next Generation Sequencing

1. Microarray data analysis.
2. Differential expressed gene finding.
3. Next Generation Sequencing technology.
4. Line plot, scatter plot, frequency histograms, pie-chart, heat map and 3D plots using R.
5. NGS data analysis.

6. Genome-wide annotation methods.
7. Identification SNPs.
8. Hidden Markov model.
9. Use bioconductor for analysis of microarray data using R.

General Microbiology

Program: M. Sc	Semester : --- (2022 Onwards)
Course Title: General Microbiology Subject Code: 502511	Class Time: As per Time Table
Name of Course Teacher	Dr.J.Joseph Sahayarayan
Mobile: -	E-mail :jjsrbioinformatics2016@gmail.com-

Course Brief:

This course explain the contributions of various scientist to the field of Microbiology, different system classification, basic structure and morphology of bacteria, reserve food materials, functions of different cell organelles, morphology of cyanobacteria and archaebacteria, classification of algae and fungi and their lifecycle, properties of viruses, various assay and life cycle of bacteriophages and virus related agents, Principle and applications of bright and dark field microscope, electron microscope, polarized and confocal microscope.

Attendance: Having good attendance record marks the student's sincerity and has an overall positive impact on his/her personality trait development. The students are asked to attend the classes on a regular note and those having a minimum scale of 70- 75% attendance are eligible to take up the end-semester examinations as per the University norms.

Punctuality: It is the most important attribute to be followed and maintained by the student throughout his/her life which for sure will lead to the path of success. Students who arrive late by 10mins after the attendance will be marked absent unless there is a valid reason (medical/ personal emergency) at the discretion of the Head of the Department.

Class Participation: A student's overall growth and personality development is based on his/her involvement in the class not just by mere presence but rather being interactive through questioning that will lead to propagation of ideas, initiation of thought-provoking process and much more that will provide a wholesome enriched classroom experience. Therefore, students are advised to be more attentive so that they learn from one another and develop quality-based knowledge.

Submission of Assignment: Assignments are given to students with just one motive to get more quantitative and qualitative knowledge insights into the assigned topic/chapter that will lead to preparation and completion of the assignment in a constructive manner here just the knowledge provided is not merely counted but also completion prior to proposed deadline will also have a check on the student's serious consideration of the assignments.

Presentation of Seminar: Apart from the assignments the concerned instructors also allocate the students with a topic or based on their interests to present seminar that will aid them built their confidence levels, command over English language to communicate with precision and fluently. In addition, the fellow students are encouraged to pose questions that will instigate interest and provide update in that particular topic besides the information presented helping them to prepare for their examinations that can be taken as added advantage for the students.

Preparedness: At the end of every class, the concerned instructor tells the students what will

be taken in the next class using these details the students should be aware of the topics that will be covered in the upcoming lectures which actually enhance the student's capability to grasp the knowledge and concepts provided much efficiently.

Academic Dishonesty: This is an important aspect that every student should be aware of. Thus, the respective faculty members educate the students of possible means of academic malpractices (plagiarism, violation of copyrights and stealing the patented knowledge) and the following consequences that will make them more vigilant in their academiccareer.

Subject to change clause: Based on the requirement of student's feasibility and meeting the competitive demands of the discipline the syllabus courses will be re-structured and updated accordingly at the discretion of the Professor(s) and Board of studies chairman.

Components of Internal Assessment (Max. Marks 25)

CIA Test I	CIA Test II	Assignment	Seminar
As per Academic Calendar		After CIA Test-I	

Course Outline: General Microbiology (502511)

1. History of Microbiology
2. Various classification accepted
3. Internal and external structure of bacteria
4. Characteristics and life cycle of algae
5. Characteristics and life cycle of fungi
6. Characteristics, structural organization and life cycle of viruses
7. Principle and applications of different types of Microscope

Major Elective					
DSE	**Course Code: 502511**	**General Microbiology**	**T**	**Credits:5**	**Hours: 5**
Unit – I					
Objective -1	To describe the history and scope of microbiology and explain theclassification of microorganisms.				
Overview of History of Microbiology: History and Scope of Microbiology – Generation theory – Contribution of Leuwenhoek, Louis Pasteur, Robert Koch, Edward Jenner, Joseph Lister, Winogradsky, Waksman and John Tyndall. Classification of microorganisms - Haeckel's three kingdom concept, Whittaker's five kingdom concept, Carl Woes three domain system, Bacterial classification according to Bergey's manual of systemic Bacteriology.					
Outcome -1	Explain the history and scope of microbiology, including the contributions of key scientists and classification systems.				**K2**
Unit – II					
Objective -2	To find out the methods for analyzing the morphology, cell structure andsubcellular structures of bacteria.				
Morphology and Sub-cellular structures: Morphological types, Cell wall of Gram negative, Gram positive bacteria and halophiles. Cell wall synthesis. Capsule composition and function. Cell membranes in Eubacteria, archaebacteria and cyanobacteria, Cell membrane functions. Periplasmic space. Structure and function of flagella, cilia and pili, gas vesicles, chlorosomes, carboxysomes, magnetosomes and phycobilisomes. Reserve food materials – polyhydroxy butyrate, polyphosphates, cyanophycin and Sulphur inclusions. General account onmycoplasma.					

Outcome -2	Understand the morphology and sub-cellular structures of various microorganisms, including bacteria, algae, fungi, and protozoa.	**K2**
Unit – III		
Objective -3	To explain the general characteristics, classification, structure, andreproduction of eukaryotic microbes including algae and fungi.	
Basic concepts of eukaryotic microbes: General characteristics, Classification, Structure and Reproduction of Algae: Chlorophyta (Green algae), Diatoms, Rhodophyta (Red algae), Fungi: Cell wall – chemical composition and functions, membranes and their functions, nutritional strategies of fungi. Structure and life cycle of fungi Ascomycetes (*Aspergillus*), Zygomycetes (*Mucor*), Basidiomycetes (*Agaricus*) and Protozoa.		
Outcome -3	Analyze the general characteristics, classification, structure, and reproduction of eukaryotic microbes, such as algae and fungi.	**K4**
Unit – IV		
Objective -4	To describe the distinctive properties, morphology, classification, cultivation, and purification of viruses. To understand bacteriophages and viral-related agents.	
Basic concepts of virology: Discovery, distinctive properties, morphology and ultra-structure of Virus, Classification, Cultivation and Purification assay of virus. Bacteriophages- structural organization and life cycle - lytic, lysogenic. Viral related agents - viroid and prion.		
Outcome -4	Know the basic concepts of virology, including the structure, classification, and life cycles of viruses andbacteriophages.	**K3**
Unit -V		
Objective -5	To explain the principles and applications of various microscopictechniques used to study microorganisms.	
Microscopic Techniques: Principle and application of bright field, dark field, phase contrast, fluorescence, electron microscope- TEM and SEM, Polarized Microscope and Confocal Microscopy.		
Outcome -5	Application of various microscopic techniques, such as bright field, dark field, phase contrast, fluorescence, and electron microscopy, to study microorganisms.	**K4**

Suggested Readings:

Willey., J.M, Sherwood., L.M, & Woolverton., C.J. (2014).Prescott's Microbiology.McGraw Hill Education, Ninth Edition.

Wessner., D,tioiKD ., C,searanC ., T,dnifnaN ., J. (2013). Microbiology. Wiley, First edition.

Willey., J.M, Sherwood., L.M, & Woolverton., C.J. (2011).Prescott's Microbiology.McGraw HillEducation, Eighth Edition.

Prescott, L.M., Harley, J.P. and Helin, D.A. (2008). "Microbiology";, McGraw Hill, New York, 5th Edition.

Tortora G.J., Funke, B.R. and Case, C.L (2016). Microbiology-An introduction, Pearson Education India, 11th Edition.

Tyagi., R. (2015). Advanced Applied Microbiology. D.P.S. Publishing House

Sharma., P.D. (2014).Microbiology. Rastogi Publications.

Dubey, R.C. and Maheswari, D.K. (2013). A text book of Microbiology; S. Chand and Company Ltd, NewDelhi, 3rd Edition.

Kreig, N.R. Whitman, W. et al, (2012) "Bergeys Manual of Systematic Bacteriology";Springer, Volume 5.

Khuntia., B. K. (2011). Basic Microbiology-An Illustrated Laboratory Manual. Daya Publishing House.

Alcamo, I.E. (2010). "Fundamentals of Microbiology"; Addison wesley Longman, Inc.California, 9th Edition.

Pelczar, M.J., Chan, E.C.S and Kreig, N.R. (2009). Microbiology – An application based approach, Tata McGraw Hill Publishing Company Limited, New Delhi, 5th Edition.

Madigan, M.T., Martinko, J. M., Dunlap, P.V. and Clark, D.P. (2009). Brock Biology of Microorganisms, Prentice Hall, New Jerry, 12th Edition.

Geeta Sumbali and Merhrotra R.S. (2009).Principles of Microbiology. Tata McGraw Hill

Education Private Limited.
Glazer., A.N, Nikaido., H. (2008). Microbial biotechnology – Fundamentals of Applied Microbiology, Cambridge University Press, Second edition.
Wheelis, M. (2008). Principles of Modern Microbiology, Jones & Bartlett India Pvt. Ltd., New Delhi.
Alexopoulus, E.J., Mims, C.W. and Blackwell, M. (2007). Introductory Mycology; John Wiley and Sons, New York, 4th Edition.
Salle, A.J. (2007). Fundamental Principles of Bacteriology, Tata McGraw Hill Publishing Company, New Delhi, 7th Edition.
Clarke, A.R. and Eberhardt, C.N. (2002). Microscopy Techniques For Microscopy, CRC press.
Davis, B.D., Duelcco, R., Fisen, H.N. and Ginsberg, H.S. (1990). Microbiology; Harper & Row Publishers, Singapore, 4th Edition.
Atlas, R.M., (1987). "Microbiology Fundamentals and Applications"; MacMillan Pub. Co.,New York.
Stainer., R.Y., Ingraham, J.L., Wheelis, M.L. and Painter, P.H. (1987). The Microbial World; MacMillan Press Ltd., London, 5th Edition.
Chapman, V.J. and Chapman, D.J. (1980). Sea Weeds; Chapman & Hall, London, 3rd Edition.

Online Resources:

1. https://www.google.com/search?q=MicrobiologyAn+introduction
2. https://www.google.com/search?q=general+microbiology

K1-Remember	*K2-Understand*	*K3-Apply*	*K4-Analyze*	*K5-Evaluate*	*K6-Create*

Course designed by:Dr. J. Joseph Sahayarayan

Course Outcome VS Programme Outcomes

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S(3)	M(2)	S(3)	L(1)	L(1)	S(3)	M(2)	S(3)	S(3)	S(3)
CO2	S(3)	M(2)	S(3)	L(1)	L(1)	S(3)	M(2)	S(3)	S(3)	S(3)
CO3	S(3)	M(2)	S(3)	L(1)	L(1)	S(3)	M(2)	S(3)	S(3)	S(3)
CO4	S(3)	M(2)	S(3)	L(1)	L(1)	S(3)	M(2)	S(3)	S(3)	S(3)
CO5	S(3)	M(2)	S(3)	L(1)	L(1)	S(3)	M(2)	S(3)	S(3)	S(3)
W.AV	3	2	3	1	1	3	2	3	3	3

S –Strong (3), M-Medium (2), L- Low (1)

Course Outcome VS Programme Specific Outcomes

CO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	L(1)	M(2)	L(1)	S(3)	S(3)
CO2	L(1)	M(2)	L(1)	S(3)	S(3)
CO3	L(1)	M(2)	L(1)	S(3)	S(3)
CO4	L(1)	M(2)	L(1)	S(3)	S(3)
CO5	L(1)	M(2)	L(1)	S(3)	S(3)
W.AV	1	2	1	3	3

S –Strong (3), M-Medium (2), L- Low (1)

Assignment I Morphology of Bacterial cell

1. Explain the internal structure.
2. Explain the external structure.
3. Draw the neat diagram of typical bacterial cell.
4. Differentiate the cell wall nature of gram positive and gram negative bacteria.
5. Differentiate archaebacteria and Eubacteria.

Assignment II Life cycle of viruses

1. Define viruses.
2. Differentiate viruses from bacteria.
3. Account on viral assay methods.
4. Explain the lytic life cycle.
5. Explain the lysogenic life cycle.

Open Source in Bioinformatics

Program: M.Sc., Bioinformatics	Semester : --- (2022 Onwards)
Course Title: Open Source in Bioinformatics Subject Code: 502512	Class Time: As per Time Table
Name of Course Teacher	Dr. Sanjeev Kumar Singh, Dr. M. Karthikeyan & Dr. J. Joseph Sahayarayan
Mobile: +91 - 9653003854 +91 - 94869 81874 +91 - 90475 64087	E-mail:sksingh@alagappauniversity.ac.in karthikeyanm@alagappauniversity.ac.in josephj@alagappauniversity.ac.in

Course Brief:

The course will explore students about the Bioinformatics tools and data resources that are available for the understanding and development of biomacromolecular structures, focusing on how best to use structural information to expand the most from it in definite research backgrounds. More and more genomes are being sequenced and many new types of datasets are being generated in large-scale projects. This course will cover the use of publicly available resources to manage, share, analyze and interpret data and also deals with software programs that are intended for mining out the meaningful information from the mass of molecular biology or biological databases in order to carry out sequence or structural analysis. The impact of genetic variation on structure, predicting protein structure and function and exploring interactions with other macromolecules as well as with low molecular weight compounds were easily carried out by learning the applications of various tools and softwares. The course depicts the usage of Bioinformatics resources that are easily accessible and also allows students to discover interaction networks and pathways in which specific gene(s) participate. Students will gain hands-on experience using a range of data resources and tools, combined with lectures. Furthermore, there will be the prospect to discuss the challenges facing towards research works in the bioinformatics field.

Teaching Methods: The mode of teaching of delivering the courses are as follows through these below mentioned methodologies:

- Delivering the lectures in the form of presentation using advanced technologies devices such as smart board.
- Video-conferencing for lectures that will be sought from experts belonging to overseas reputed institutions.
- Case-studies and Review questions

Attendance: Having good attendance record marks the student's sincerity and has an overall positive impact on his/her personality trait development. The students are asked to attend the classes on a regular note and those having a minimum scale of 70-75% attendance are eligible to take up the end-semester examinations as per the University norms.

Punctuality: It is the most important attribute to be followed and maintained by the student throughout his/her life which for sure will lead to the path of success. Students who arrive late by 10mins after the attendance will be marked absent unless there is a valid reason (medical/ personal emergency) at the discretion of the Head of the Department.

Class Participation: A student's overall growth and personality development is based on his/her involvement in the class not just by mere presence but rather being interactive through questioning that will lead to propagation of ideas, initiation of thought-provoking process and much more that will provide a wholesome enriched classroom experience. Therefore, students are advised to be more attentive so that they learn from one another and develop quality-based knowledge.

Submission of Assignment: Assignments are given to students with just one motive to get more quantitative and qualitative knowledge insights into the assigned topic/chapter that will lead to preparation and completion of the assignment in a constructive manner here just the knowledge provided is not merely counted but also completion prior to proposed deadline will also have a check on the student's serious consideration of the assignments.

Presentation of Seminar: Apart from the assignments the concerned instructors also allocate the students with a topic or based on their interests to present seminar that will aid them built their confidence levels, command over English language to communicate with precision and fluently. In addition, the fellow students are encouraged to pose questions that will instigate interest and provide update in that particular topic besides the information presented helping them to prepare for their examinations that can be taken as added advantage for the students.

Preparedness: At the end of every class, the concerned instructor tells the students what will be taken in the next class using these details the students should be aware of the topics that will be covered in the upcoming lectures which actually enhance the student's capability to grasp the knowledge and concepts provided much efficiently.

Academic Dishonesty: This is an important aspect that every student should be aware of. Thus, the respective faculty members educate the students of possible means of academic malpractices (plagiarism, violation of copyrights and stealing the patented knowledge)

and the following consequences that will make them more vigilant in their academic career.

Subject to change clause: Based on the requirement of student's feasibility and meeting the competitive demands of the discipline the syllabus courses will be re-structured and updated accordingly at the discretion of the Professor(s) and Board of studies chairman.

Important dates: Scheduled dates for the various activities related to the course

CIA Test I	CIA Test II	Assignment	Seminar
As per Academic Calendar		After CIA Test-I	

Course Outline: Elective: Open source in Bioinformatics

- Web based servers and softwares for genome analysis: Entrez- GenBank- GenScan-Vienna RNA Package-Biological network analysis.
- Access to protein sequence and functional information- Includes data from Swiss-Prot and TrEMBL-Database providing extensive structural and functional information for proteins-SOPMA-Predictprotein.
- Tools and resources for drug discovery: ChEMBL- drug-gene interactions, drug-protein interactions-docking-Structural visualization-RasMol- cluster genes with similar microarray expression profiles-Neural network.
- Process of primer design -standard PCR, bisulphite PCR, real-time PCR (QPCR) and sequencing. Multiple sequence alignment-TCoffee-PHYLIP-evolutionary analysis-Sequence manipulation.

- ACD Chemsketch-Drawing package-draw chemical structures including organics, organometallics, polymers, and Markush structures. Calculation of molecular properties, 2D and 3D structure cleaning and viewing-prediction of *logP*.
- Cytoscape - open source software platform for visualizing complex networks and integrating these with any type of attribute data.
- Introduction to the analysis of gene expression data obtained using microarray experiments-Basic principles.

More books for Reading and Referencing:

R Programming for Bioinformatics (Chapman & Hall/CRC Computer Science & Data Analysis) - Robert Gentleman; 2008 **(ISBN: 978-14-200-6367-7)**
Bioinformatics Research and Applications - Zhipengcai, Oliver Eulenstein, Daniel Janies and David Schwartz **(ISBN: 978-36-423-8035-8)**
Python Programming for Biology: Bioinformatics and Beyond - Tim J. Stevens and Wayne
Boucher;2015 **(ISBN: 978-05-217-2009-0)**
Practical Bioinformatics (Nucleic Acids and Molecular Biology) - Janusz M. Businicki; 2007**(ISBN: 978-81-812-8522-5)**
Bioinformatics Algorithms: An Active Learning Approach (Vol. 1) - Phillip Compeau and Pavel Pevzner; 2015(**ISBN: 978-09-903-7460-2)**
Bioinformatics Algorithms: An Active Learning Approach (Vol. 2) - Phillip Compeau and Pavel Pevzner; 2014 (**ISBN: 978-09-903-7462-6)**

Major Elective					
DSE	**Course code: 502512**	**Open source in Bioinformatics**	**T**	**Credit:5**	**Hours: 5**

Unit - I		
Objective -1	To analyze DNA and RNA sequences using tools like Entrez, GenBank, EMBOSS, Artemis, Sequencher and Vienna RNA Package.	
DNA and RNA sequence analysis: Entrez, GenBank, EMBOSS, Artemis R11, Sequencher, DNA user, Jambw, GENSCAN, Glimmer, MUMmer, AUGUSTUS, RNA draw, RNA structure, Vienna RNA Package, RNA Family, CLC RNA Workbench.		
Outcome -1	Gain proficiency in using open-source tools for DNA and RNA sequence analysis**.**	**K2**
Unit – II		
Objective -2	To analyze protein sequences using tools like ExPASy, PSAAM, Predict Protein and CLC Protein Workbench.	
Protein sequence analysis: ExPASy Proteomics tools, AnthePro, PSAAM, Osprey, CLC Protein Workbench, WinPep, SubMito, ProteinVis, PIVOT, SOPMA, SIPMA, PSIPRED, PSORTb, BiologicalNetworks, Predict Protein, SCRATCH, and Introduction to Bioubuntu		
Outcome -2	Develop skills in protein sequence analysis using various bioinformatics tools.	**K3**
Unit – III		
Objective -3	To briefly explain sequence alignment and phylogenetic analysis using tools like NetPrimer, BioEdit, PAUP, Phylip and MEGA.	
Molecular biology, Sequence alignment and Phylogeny: NetPrimer, PerlPrimer, SimVector, CGView, BioEdit, BioCococa, Readseq, PAUP, Phylip, TreeView, Sequence Manipulation Suite, MEGA, NJplot, TCoffee, PHYML.		
Outcome -3	Understand and apply molecular biology, sequence alignment, and phylogenetic analysis tools.	**K3**
Unit – IV		
Objective -4	To know molecular modeling and docking studies using tools like Hex, AutoDock, RasMol, VMD, MODELLER and Gromacs.	
Molecular modeling: Docking study: Hex, Auto dock, Argus lab. RasMol, VMD, MolMol, CN3D, DTMM, Swiss-PdbViewer, gopenmol, StrukEd, JMVC, OscailX, ICM Browser, Gromacs, BioInfo3D, MODELLER, Chimera.		
Outcome -4	Learn molecular modeling techniques and perform docking studies using appropriate software.	**K4**
Unit -V		
Objective -5	To perform chemical drawing and microarray analysis using tools like ChemSketch, ScanAnalyze, Cluster, Cytoscape, dchip, and Bioconductor.	
Chemical drawing and Microarray analysis: ChemSketch, ChemDraw, BKChem, ScanAnalyze, Cluster, Cytoscape, dchip, SAM, DAVID Bioinformatics EASE, TM4, Pathway Explorer, Bioconductor.		
Outcome -5	Gain skills in chemical drawing and microarray data analysis using open-source tools.	**K5**

Suggested Readings:

Mandoiu, I., Zelikovsky, A. (2016). Computational Methods for Next Generation Sequencing Data Analysis. Wiley Publications.

Pazos, F., Monica, C. (2015). Practical Protein Bioinformatics. Springer.

Korpelainen, E., Tuimala, J., Somervuo, P., Huss, M., Wong, G. (2014). RNA-seq Data Analysis: A Practical Approach, CRC press, Taylor and Francis group.

Edwards, D., Stajich J., Hansen, D. (2009). Bioinformatics: Tools and Applications, Springer Shui Qing Ye. (2008). Bioinformatics: A Practical Approach, Chapman & Hall/CRC.

Xiong, J. (2006). Essential Bioinformatics, Cambridge University Press.

Baxevanis, A. D., Francis Ouellette, B. F. (2005). Bioinformatics: A Practical Guide to the Analysis of Gene and Protein (3rd Ed). John Wiley & Sons.

Bujnicki, J. M. (2004). Practical Bioinformatics, Springer.

Wong, L. (2004). The Practical Bioinformatician, World Scientific Publishing Co. Pre. Ltd. Mount, D. W. (2004). Bioinformatics: Sequence and Genome Analysis, CBS publisher, Second Edition.

Online Resources:

1. https://onlinelibrary.wiley.com/doi/book/10.1002/9781119272182
2. https://link.springer.com/book/10.1007/978-3-319-12727-9
3. https://link.springer.com/book/10.1007/978-0-387-92738-1

K1-Remember	*K2-Understand*	*K3-Apply*	*K4-Analyze*	*K5-Evaluate*	*K6-Create*

Course designed by**: Dr. Sanjeev Kumar Singh, Dr. M. Karthikeyan & Dr. J. Joseph Sahayarayan**

Course Outcome VS Programme Outcomes

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S(3)	S(3)	S(3)	S(3)	S(3)	S(3)	S(3)	S(3)	S(3)	S(3)
CO2	S(3)	S(3)	S(3)	S(3)	S(3)	S(3)	S(3)	S(3)	S(3)	S(3)
CO3	S(3)	S(3)	S(3)	S(3)	S(3)	S(3)	S(3)	S(3)	S(3)	S(3)
CO4	S(3)	S(3)	S(3)	S(3)	S(3)	S(3)	S(3)	S(3)	S(3)	S(3)
CO5	S(3)	S(3)	S(3)	S(3)	S(3)	S(3)	S(3)	S(3)	S(3)	S(3)
W.AV	3	3	3	3	3	3	3	3	3	3

S –Strong (3), M-Medium (2), L- Low (1)

Course Outcome VS Programme Specific Outcomes

CO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	S(3)	S(3)	S(3)	S(3)	S(3)
CO2	S(3)	S(3)	S(3)	S(3)	S(3)
CO3	S(3)	S(3)	S(3)	S(3)	S(3)
CO4	S(3)	S(3)	S(3)	S(3)	S(3)
CO5	S(3)	S(3)	S(3)	S(3)	S(3)
W.AV	3	3	3	3	3

S –Strong (3), M-Medium (2), L- Low (1)

Assignment & Seminar: Open source in Bioinformatics

1. DNA user.
2. RNA structure.
3. Biological Networks
4. Bio Edit.
5. Introduction to Bioubuntu.
6. Sequence Manipulation Suite.
7. Ras Mol.
8. ICM Browser.
9. Net Primer.
10. Swiss-Pdb Viewer.
11. BioInfo3D.
12. Chem Sketch.
13. Pathway Explorer.

Biodiversity, Agriculture, Ecosystem, Environment and Medicine

Program: M.Sc	Semester : ---- (2022 Onwards)
Course Title: Biodiversity, Agriculture, Ecosystem, Environment and Medicine Subject Code: 502513	Class Time: As per Time Table
Name of Course Teacher	Dr. J. Joseph Sahayarayan
Mobile: +91 9047564087	E-mail : josephj@alagappauniversity.ac.in

Course Brief

This course introduces the evolution, biodiversity, and ecology of organisms. The origin and diversity of life, from prokaryotes, through simple eukaryotes to multicellular organisms are introduced. Natural selection, speciation, and phylogeny, stressing evolutionary relationships in conjunction with changing conditions on earth, are presented. The course introduces major concepts in ecology: the physical and chemical environment, population structure, life histories, species interactions, commUNITies, and ecosystems. The course also introduces motivations for food and agricultural policies and presents the policy tools that can be used to meet policy goals. We will also spend time reviewing the economic theory, and introducing some new tools, that are required to analyze the effects of policy interventions. The course provides details on specific polices, with emphasis on food and agricultural policies. In addition the course illustrates major ways in which the environment and human health. Also it portrays ways that scientific studies determine the quantitative relationship between environmental parameters and health. It depicts ways that the health impact from major environmental hazards can be effectively controlled.

Teaching methods

The teaching includes lectures, discussions, demonstrations, concept maps and

models, self-study and question times and an integrating project work. The project work is in-depth studies in groups with an emphasis on own work and literature studies. The course is completed with a written final examination.

Attendance: Having good attendance record marks the student's sincerity and has an overall positive impact on his/her personality trait development. The students are asked to attend the classes on a regular note and those having a minimum scale of 70-75% attendance are eligible to take up the end-semester examinations as per the University norms.

Punctuality: It is the most important attribute to be followed and maintained by the student throughout his/her life which for sure will lead to the path of success. Students who arrive late by 10mins after the attendance has been taken will be marked absent unless there is a valid reason (medical/ personal emergency) at the discretion of the Head of the Department.

Class Participation: A student's overall growth and personality development is based on his/her involvement in the class not just by mere presence but rather being interactive through questioning that will lead to propagation of ideas, initiation of thought-provoking process and much more that will provide a wholesome enriched classroom experience. Therefore, students are advised to be more attentive so that they learn from one another and develop quality-based knowledge.

Submission of Assignment: Assignments are given to students with just one motive to get more quantitative and qualitative knowledge insights into the assigned topic/chapter that will lead to preparation and completion of the assignment in a constructive manner here just the knowledge provided is not merely counted but also completion prior to proposed deadline will also have a check on the student's serious consideration of the assignments.

Presentation of Seminar: Apart from the assignments the concerned instructors also allocate the students with a topic or based on their interests to present seminar that will aid them built their confidence levels, command over English language to communicate with precision and fluently. In addition, the fellow students are encouraged to pose questions that will instigate interest and provide update in that particular topic besides the information presented helping them to prepare for their examinations that can be taken as added advantage for the students.

Preparedness: At the end of every class, the concerned instructor tells the students what will be taken in the next class using these details the students should be aware of the topics that will be covered in the upcoming lectures which actually enhance the student's capability to grasp the knowledge and concepts provided much efficiently.

Academic Dishonesty: This is an important aspect that every student should be aware of. Thus, the respective faculty members educate the students of possible means of academic malpractices (plagiarism, violation of copyrights and stealing the patented knowledge) and the following consequences that will make them more vigilant in their academic career.

Subject to change clause: Based on the requirement of student's feasibility and meeting the competitive demands of the discipline the syllabus courses will be re-structured and updated accordingly at the discretion of the Professor(s) and Board of studies chairman.

Important dates: Please note down the important dates and stick to the schedule

CIA Test I	CIA Test II	Assignment	Seminar
As per Academic Calendar		After CIA Test I	

Course Outline: Elective: Biodiversity, Agriculture, Ecosystem, Environment and Medicine

- On completion of this course students will be able to acquire knowledge about

- Biodiversity status, scope, types, monitoring and documentation. Also major drivers of biodiversity change and biodiversity management approaches.
- Information about management and communication, libraries, bibliographies, periodicals, databases and distribution of biodiversity.
- Proportional genomes of plant and model plants, insect resistance, improve nutritional quality; grow drought resistant crops in poorer soils, biodiversity of Indian medicinal plants.
- Ecosystem structure, ecosystem function, energy flow and mineral cycling. Also they acquire knowledge about primary production and decomposition; structure and function of some Indian ecosystems: terrestrial and aquatic.
- Principles of conservation, major approaches to management, Indian case studies on conservation/management strategy.
- Biotechnological applications of microbes, antibiotic resistance, forensic analysis of microbes, the reality of bioweapon and Metagenomics.
- Fundamentals of gene therapy, Gene therapy present and future, clinical trials.
- Applications of Bioinformatics in cancer detection, Drug targets, Human genome diversity.

More books for Reading and Referencing

Occupational & Environmental Medicine: Fourth Edition (Lange Medical Books) 4th Edition 2006 Joseph LaDou; **ISBN-13: 978-0071443135**
Environment and Ecology - (UPTU) 2011 Pandey S.N; **ISBN-13: 978-9380618593**
Ecology And Environment 2005 Sharma P.D; **ISBN-13: 978-8171339051**
Agriculture at a Glance: Enchanced Competition Explorer 2012 Sharma R.K; **ISBN-13: 978-8170357643**

Major Elective					
DSE	**Course Code: 502513**	**Biodiversity, Agriculture,Ecosystem, Environment and Medicine**	**T**	**Credits:5**	**Hours : 5**
Unit - I					
Objective -1	To describe the current status, types, drivers and management of biodiversity and understand how biodiversity information is managed and communicated.				
Biodiversity: Status, scope, types, monitoring and documentation; major drivers of biodiversity change; biodiversity management approaches. Uses of Biodiversity, Loss of biodiversity, Biotechnology information: Management and Communication, Libraries, Bibliographies, Periodicals, Databases, Distribution of biodiversity information, Meta databases, Virtual libraries, Special interest networks, Biodiversity Application Software – CD-ROMs and Diskettes.					
Outcome -1	Understand the status, scope, and types of biodiversity, and learn about biodiversity management approaches.			**K2**	
Unit – II					
Objective -2	To explain the role of biodiversity in agriculture, including crop improvement and medicinal plants and understand the structure and function of ecosystems.				
Agriculture: Crops: Comparative genomes of plant and model plants, Insect resistance, improve nutritional quality, Grow drought resistant crops in poorer soils, Biodiversity of Indian medicinal plants. **Ecosystem:** Ecosystem structure; ecosystem function; energy flow and mineral cycling (C, N,					

P); primary production and decomposition; structure and function of some Indian ecosystems: terrestrial (forest, grassland) and aquatic (fresh water, marine, eustarine).		
Outcome -2	Gain knowledge of the applications of biotechnology in agriculture, including crop improvement and medicinal plant biodiversity.	**K2**
Unit – III		
Objective -3	To describe principles and approaches to conservation biology and discuss Indian case studies of conservation strategies.	
Ecosystem: Ecosystem structure; ecosystem function; energy flow and mineral cycling (C, N, P); primary production and decomposition; structure and function of some Indian ecosystems: terrestrial (forest, grassland) and aquatic (fresh water, marine, eustarine).**Conservation Biology:** Principles of conservation, major approaches to management, Indian case studies on conservation/management strategy (Project Tiger, Biosphere reserves).		
Outcome -3	Learn about ecosystem structure and function, energy flow, mineral cycling and conservation biology principles.	**K2**
Unit – IV		
Objective -4	To explain biotechnological applications of microbes in areas like waste cleanup, climate change and alternative energy and understand issues like antibiotic resistance and bioweapons.	
Environment: Waste cleanup: Superbugs and their concept, Microbes and Climate change, Alternative energy sources and Fuel cells. Biotechnological applications of microbes, Antibiotic resistance, Forensic analysis of microbes, the reality of bioweapon, Metagenomics.		
Outcome -4	Know the role of biotechnology in environmental management, including waste cleanup, alternative energy sources, and microbial applications.	**K3**
Unit -V		
Objective -5	To describe the fundamentals and applications of gene therapy and cell therapy and understand how bioinformatics is used in areas like cancer detection and drug target identification.	
Medicine: Cell Therapyand Gene therapy Fundamentals of gene therapy, Cell Therapy and Gene therapy present and future, clinical trials. Applications of Bioinformatics in cancer detection, Drug targets, Human genome diversity.		
Outcome -5	Describe about the cell therapy, gene therapy, and the applications of bioinformatics in medicine, including cancer detection and drug targets.	**K3**

Suggested Readings:

Tandon, P., Abrol, Y.P. and Kumaria, S. (2007). Biodiversity and its Significance. I. K. International Publishing House Pvt. Ltd, New Delhi.

Singh, J.S., Singh, S.P. and Gupta, S.R. (2006). Ecology, Environment and Resource Conservation. Anamaya Publishers, New Delhi.

Saha., T.K. (2013). Ecology and Environmental Biology. Books & Allied (P) Ltd.

Dahiya., P, Ahlawat, M. (2013). Environmental Science: A New Approach. Alpha Science. Raven, P.H., Berg, .cKI ,miKC &nieK Wiano .tKeiriKSnKD .)2012(.M.t ,aKN kaCCnKzaea .R.L .tigeD tNiDiiK

Harke., S, Pande., B.N. and Diwan., A.D. (2010). Environmental Biotechnology and Sustainable Biodiversity. Narendra Publishing House, First edition.

Fulekar, M. (2009). Bioinformatics: applications in life and environmental sciences. Springer Science & Business Media, Berlin.

Sanyal., K., Kundu., M. and Rana., S. (2009). Ecology and Environment. Books & Allied (P) Ltd.

Buehler, L.K., Rashidi, H.H. (2005). Bioinformatics Basics: Applications in Biological Science and Medicine. CRC Press, Second Edition.

Arvind., K. (2004). Environment and Health. APH Publishing Corporation. First Edition. Gaston., K.J. & Spicer., J.I. (2004). Biodiversity: An Introduction. Blackwell Science Ltd, Second

edition
Krishnamurthy, K.V. (2003). An advanced Textbook on Biodiversity – principle andpractice. Oxford & IBH publishing Co. Pvt. Ltd. First Edition.
Evans., G.M & Furlong., J.C. (2003). Environmental Biotechnology: Theory andApplications. John Wiley & Sons, Inc.
Yu., M.H. (2001). Environmental toxicology: impacts of environmental toxicants onliving systems. Lewis Publishers, London.

Kresina., T.F. (2001). An Introduction to Molecular Medicine and Gene Therapy. JohnWiley & Sons, Inc.

Online Resources:

1. https://www.google.com/search?q=Biodiversity
2. https://byjus.com/biology/ecosystem/

K1-Remember	*K2-Understand*	*K3-Apply*	*K4-Analyze*	*K5-Evaluate*	*K6-Create*

Course designed by: Dr. J. Joseph Sahayarayan

Course Outcome VS Programme Outcomes

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S(3)	S(3)	S(3)	M(2)	M(2)	S(3)	M(2)	S(3)	S(3)	S(3)
CO2	S(3)	S(3)	S(3)	M(2)	M(2)	S(3)	M(2)	S(3)	S(3)	S(3)
CO3	S(3)	S(3)	S(3)	M(2)	M(2)	S(3)	M(2)	S(3)	S(3)	S(3)
CO4	S(3)	S(3)	S(3)	M(2)	M(2)	S(3)	M(2)	S(3)	S(3)	S(3)
CO5	S(3)	S(3)	S(3)	M(2)	S(3)	S(3)	S(3)	S(3)	S(3)	S(3)
W.AV	3	3	3	2	2.2	3	2.2	3	3	3

S –Strong (3), M-Medium (2), L- Low (1)

Course Outcome VS Programme Specific Outcomes

CO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	M(2)	M(2)	M(2)	S(3)	S(3)
CO2	M(2)	M(2)	M(2)	S(3)	S(3)
CO3	M(2)	M(2)	M(2)	S(3)	S(3)
CO4	M(2)	M(2)	S(3)	S(3)	S(3)
CO5	S(3)	S(3)	S(3)	S(3)	S(3)
W.A.V	2.2	2.2	2.4	3	3

S –Strong (3), M-Medium (2), L- Low (1)

Assignment & Seminar - Biodiversity, Agriculture, Ecosystem, Environment and Medicine

i. Explain biodiversity management approaches.

ii. Fundamentals of gene therapy – Explain.

iii. Applications of Bioinformatics in cancer detection – Discuss.

iv. Write a note on biodiversity application software.

v. Illustrate ecosystem structure, function, energy flow and mineral cycling.

vi. Give an account on comparative genomes of plant and model plants.

vii. Elaborate primary production and decomposition; structure and function of some Indian ecosystems.

ix. Discuss Superbugs and their concept.

x. Give detailed note biotechnological applications of microbes.

Nanotechnology and Advanced drug delivery system

Program: M.Sc.,	Semester: --- (2022 Onwards)
Course Title: Nanotechnology and Advanced drug delivery system Subject Code: 502514	Class Time: As per Time Table
Name of the Course Teacher	Dr. P. Boomi
Mobile: +91 – 9486031423	Email: boomip@alagappauniversity.ac.in

Course Brief:

Nanomedicine deals with the development and application of materials and devices to study biological processes and to treat disease at the level of single molecules and atoms. This exciting new field of nanotechnology and medicine is offering unique capabilities in disease diagnosis and management. This course also offers a survey of timely concepts in the rapidly emerging nanomedicine. The vision of combining diagnostics and therapeutics, now being referred to as theranostics is the area of recent research. Currently, the main use of nanoparticle medicinal products (NMP) is their conjugation or/and encapsulation with several active biomolecules for therapeutic or/and diagnostic purposes, since they can be used as drug carriers for chemotherapeutics to deliver medication directly to the tumor while sparing healthy tissue. This course will emphasize emerging nanotechnologies and biomedical applications including nanomaterials, nanoengineering and nanotechnology based drug delivery systems, nano-based imaging and diagnostic systems, nanotoxicology and translating nanomedicines into clinical investigation.

Teaching Methods: The course will be based on the following teaching and learning activities:

- Lectures covering the theoretical part using PowerPoint presentations
- Case studies
- Review questions

Attendance: Regular attendance is necessary for gaining academic success; hence the students are expected to attend all the classes. As per University norms, the students are qualified to write their end-semester examinations only if they have a minimum attendance of 75% in all the courses.

Punctuality: Punctuality is an important quality for the students to achieve success. Students arriving late to the class by 10 minutes without any valid reason will be marked absent in the attendance record. Excuse will be provided for personal or medical emergency with prior approval by the Head of the Department

Class Participation: Classroom participation is important because learning is not just between the student and the teacher, but part of the whole classroom experience which involves questioning, inquiring and exchanging ideas. When students participate, they learn from each other and internalize the knowledge better.

Submission of Assignment: Assignments will help the students to apply the concepts which results in deeper understanding of the subject. Hence each student will be allocated two

assignments for the course, covering the entire topic. Students will be provided deadline by the course instructor to submit the assignment. Proper preparation of assignment will help the students for final exams

Presentation of Seminar: Students are supposed to give an oral presentation during the class seminar hours in their assigned topic. Students will discuss on recent research finding related to the topic and participants are encouraged to ask valid questions. Seminars help the students to be updated in their course. In addition students will be able to learn their mistakes and can improve their communication skills during seminar presentation

Preparedness: Prior to attending the class the **s**tudents are expected to collect information regarding the topic given in advance, so that they will be able to discuss during the lecture.

Academic Dishonesty: Since the students are not aware of academic integrity, students must be clearly explained about plagiarism and the consequences of violation of copyright laws, so that academic dishonesty may be avoided.

Subject to change clause: Depending upon the requirement of student, the course syllabus and course schedule are subjective to minor changes, which will be informed to students

Important dates: Scheduled dates for the various activities related to the course

CIA Test I	**CIA Test II**	**Assignment**	**Seminar**
As per Academic Calendar		After CIA Test-I	

Course Outline: Nanotechnology and Advanced drug delivery system

1. Properties and technological advantages of nanomaterials.
2. Top down and Bottom up approaches for the synthesis of nanomaterials.
3. Characterization of the synthesized nanomaterials by spectroscopic analysis and microscopic observations.
4. Types of nanocarriers used in drug delivery and its physicochemical properties.
5. Targeted and Non-targeted drug delivery using nanocarriers.
6. Various strategies of surface modification of Nanoparticles to enhance biocompatibility.
7. Role of Nanoparticles in diagnosis and imaging.
8. Fabrication of DNA and Protein based biosensor and its diagnostic application.
9. Theranostics nanomedicine for the treatment of cancer.
10. Nanotechnology application in the treatment of neurology, cardiology and opthamology.

More books for Reading and Referencing

Kewal K. Jain, "The Handbook of Nanomedicine", (2008), Publisher-Springer Science & Business Media, **ISBN: 1603273190, 9781603273190**

V. P. Torchilin, "Nano Particulates As Drugcarriers", (2006), Publisher-Imperial College Press, **ISBN: 186094907X, 9781860949074**
Ram B. Gupta and Uday B. Kompella "Nanoparticle Technology for Drug Delivery", (2006), Publisher-CRC Press, **ISBN: 0849374553, 9780849374555**
R. Khare, "Nanomedicine and Future drugs", (2015), **ISBN:9384568643, 9789384568641**
Mark Slevin, "Current Advances in the medical application of nanotechnology"(2012), Publisher- Bentham Science Publishers, **ISBN: 1608051315, 9781608051311**
T. Pradeep, "A Textbook of Nanoscience and Nanotechnology", (2003), Publisher-Tata McGraw-Hill Education, **ISBN: 1259007324, 9781259007323**
Mansoor M. Amiji, "Nanotechnology for cancer therapy", (2006), Pubisher-CRC Press, **ISBN: 1420006630, 9781420006636**
Jeff W.M. Bulte and Michel M.J. Modo, "Nanoparticles in Biomedical Imaging Emerging Technologies and Applications", (2007), Publisher- Springer Science & Business Media, **ISBN: 0387720278, 9780387720272**

Major Elective					
DSE	**Course Code: 502514**	**Nanotechnology and dvanced drug delivery system**	**T**	**Credits:5**	**Hours:5**
Unit – I					
Objective - 1	Provide students broad overview of the application of nanotechnology to medicine				
Basic concepts of Nano-science and technology: Properties and technological advantages of Nanomaterials -Quantum wire, Quantum well, Quantum dots and Carbon nanotubes: Synthesis – Top down and bottom up approaches; Characterization - Spectroscopic techniques and Microscopic observations.					
Outcome - 1	Comprehend the principles behind nanomedicine.				**K1**
Unit – II					
Objective - 2	Impart knowledge on the role of biological and synthetic nanocarriers in drugdelivery.				
Fundamentals and types of Nanocarriers: Types - Viral nanocarrriers, Polymeric nanocarrier, lipid nanocarrier, carbon nanostructures, dendrimers, silica nanoparticles, Microbes and antibody based nanocarriers; Physicochemical properties - Size, Surface, Magnetic and Optical Properties.					
Outcome - 2	Gain a broad understanding of concepts and applications of nanomedicine.				**K2**
Unit – III					

Objective - 3	Understand the regulatory and ethical aspects on use of nanotechnology in clinicalpractice	
Nanotechnology for Drug Targeting Drug targeting – Targeted (Microneedles, Micropumps, microvalves, Implantable microchips), non-targeted delivery, controlled drug release; Nanoparticle surface modification – bioconjugation, peglyation, antibodies cell- surface targeting; nanostructures for use as antibiotics, diseased tissue destruction using nanoparticles, drug encapsulation strategies.		
Outcome - 3	Impart the knowledge to apply these nano-drug delivery systems for the diagnosis and therapy	**K2&K3**
Unit – IV		
Objective - 4	Convey knowledge about drug delivery systems.	
Nanotechnology for Imaging and Detection Fluorophores and Quantum dots - Labeling and functionalization, Image analysis, Imaging facilitating surgical approaches; Nanoparticles for bioanalytical applications – Biosensors - DNA and Protein based biosensors – materials for biosensor applications- fabrication of biosensors, BioMEMs; Use of nanoparticles for MRI, X Ray, Ultrasonography Drug Delivery; Nano devices.		
Outcome - 4	Understand the concepts of nanomedicine to a focused clinical area of their choice	**K2**
Unit -V		
Objective - 5	To acquire basic understanding of nanoparticles in Cancer Therapy	
Nanomedicine: Nanotechnology in Cancer Therapy - Passive and Active Targeting Strategies in Cancer with a Focus on Nanotechnology Applications, Multifunctional Nanoparticles for Cancer Therapy - Neutron Capture Therapy of Cancer, nanoparticles and High Molecular Weight Boron Delivery Agents; Nanoneurology – Nanocardiology - Nano-Orthopedics - Nano-Ophthalmology.		
Outcome - 5	Understand the applications of nanosystems as platforms foradvanced Cancer Therapy	**K2**

Suggested Readings:

Vo-Dinh Tuan (2015) "Nanotechnology in biology and medicine methods, devices and Applications"Second edition, CRC press, San Fransico.

V. Mishra, P. Kesharwani, M.C.I.M. Amin, A. Iyer (2017) "Nanotechnology-Based Approaches for Targetingand Delivery of Drugs and Genes" Academic Press, London.

D.P. Nikolelis, G.P. Nikoleli (2018) "Nanotechnology and Biosensors" Elseiver, Amsterdam.

S.S. Mohapatra, S. Ranjan, N. Dasgupta, R.K. Mishra (2019) "Nanocarriers for drug delivery, Nanoscienceand Nanotechnology in drug delivery", Elseiver, Amsterdam.

M. Slevin, (2012) "Current Advances in the medical application of nanotechnology", Manchester metropolitan university, Manchester, UK.

T. Varghese and K.M. Balakrishna, (2012) "Nanotechnology: An Introduction to Synthesis, Properties and
Applications of Nanomaterials", Atlantic Publishers & Distributors

W.M. Jeff Bulte, and Michel M.J. Modo, (2016) "Design and Applications of Nanoparticles in Biomedical Imaging", Springer.

P. Kumar, R. Srivastava, (2016) "Nanomedicine for Cancer Therapy: From Chemotherapeutic to Hyperthermia-Based Therapy", Springer.

B. Malhotra, Md. A. Ali, (2017), "Nanomaterials for Biosensors- Fundamentals and Applications", 1st Edition, Elsevier.

Online Recourse

1. http://www.nanomedicinecenter.com
2. https://nptel.ac.in/courses/118107015/module4/lecture7/lecture7.pdf
3. https://nptel.ac.in/courses/102107058/

K1-Remember	*K2-Understand*	*K3-Apply*	*K4-Analyze*	*K5-Evaluate*	*K6-Create*

Course designed by: Dr.P. Boomi

Course Outcome VS Programme Outcomes

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	M(2)	-	L(1)	L(1)	-	L(1)	-	L(1)	L(1)	L(1)
CO2	L(1)	-	L(1)	L(1)	-	M(2)	L(1)	L(1)	L(1)	L(1)
CO3	L(1)	L(1)	L(1)	L(1)	L(1)	L(1)	L(1)	L(1)	L(1)	L(1)
CO4	L(1)	L(1)	-	L(1)	-	L(1)	-	L(1)	L(1)	L(1)
CO5	L(1)	L(1)	-	L(1)	-	L(1)	L(1)	L(1)	L(1)	L(1)
W.AV	1.2	0.6	0.6	1	0.2	1.2	0.6	1	1	1

S –Strong (3), M-Medium (2), L- Low (1)

Course Outcome VS Programme Specific Outcomes

CO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	L(1)	-	M(2)	M(2)	L(1)
CO2	L(1)	L(1)	M(2)	L(1)	L(1)
CO3	L(1)	L(1)	L(1)	L(1)	L(1)
CO4	L(1)	-	M(2)	L(1)	L(1)
CO5	M(2)	-	L(1)	L(1)	L(1)
W.AV	1.2	0.2	1.6	1.2	1

S –Strong (3), M-Medium (2), L- Low (1)

Assignment I Nanotechnology and Advanced drug delivery system

1. Discuss in detail the top down and Bottom up approach of synthesis of Nanomaterials.
2. Give an account on synthesis, properties and biomedical application of quantumdots.
3. Explain in detail the various spectroscopic techniques used for the characterization of metal nanoparticles with suitable example.
4. Elaborate in detail the sample preparation and working principle behind the characterization of nanoparticles using TEM with a neat sketch.
5. Describe in detail principle and instrumentation of XRD technique and its application in the characterization of metal and metal oxide nanoparticles.
6. Elaborate in detail the types and application of polymeric nanocarriers in targeted drug delivery.
7. Explain in detail about viral nanocarriers and its application.
8. Discuss in detail the about functionalization and pharmacological application of

carbon nanotubes.

9. Give an account on microbial nanocarriers and its application in the treatment of cancer.
10. Discuss in detail the various methods of surface modification of mesoporous silica nanoparticles for cancer therapy.

Assignment II Nanotechnology and Advanced drug delivery system

1. Discuss in detail about physiochemical properties of drug molecule influencingthe design and performance of sustained release drug delivery system.
2. Explain with examples biodegradable and non biodegradable polymers used for controlled drug delivery system.
3. Give an account of approaches and applications of implantable drug delivery systems.
4. Describe in detail the active and passive targeting in drug delivery.
5. Elaborate in detail the surface modification techniques to enhance the biocompatibility of drug.
6. Discuss in detail about liposomal drug delivery system in drug targeting to a specific site.
7. Discuss in detail the role of Quantum dots in live cell imaging and diagnostics.
8. Describe in detail the principle and application of DNA and Protein based biosensors.
9. Discuss about the theranostic application and targeted drug delivery of nanoparticle for the treatment of cancer.
10. Elaborate in detail the role of nanomaterials in the field of orthopedics as bone implants and for the treatment of joint injuries involving cartilage.

Immunology and Immunotechnology

Program: M.Sc Bioinformatics	Semester : --- (2022 Onwards)
Course Title: Core- Immunology and Immunotechnology Subject Code: 502515	Class Time: As per Time Table
Name of Course Teacher	Dr.J. Joseph Sahayarayan
Mobile:	

Course Brief:

This course provides an introduction to the basic immunological principles common to man and other vertebrate animals. It provides information related to immUNITy, development of resistance against infection, mechanisms of antigen and antibody reaction, antigen processing and presentation to macrophages cells. This course also provides basic techniques in immunology such as ELISA, RIA, immunofluorescence microscopy, immunoelectrophoresis, immunodiffusion and hybridoma technology. The laboratory component of the course is designed in such a way to strengthen the technical knowledge of the students and to physically train them with state of art technology. This course would definitely assist the students to gain more knowledge on immunotechniques.

Attendance: Attendance and participation are vital to the student's success in this course. Students are expected to attend class every day. Minimum attendance to be eligible to take end-semester-examination is 80%. It is also essential that the students study regularly.

Punctuality: Punctuality is very important in the course, because if student are late, you not

only waste your time, but other student's. You will also disturb others when you go into the lecture class or laboratory after the class begins. Therefore, please arrive at the class on time. Names of late students will be recorded by mentor and marks from Course performance will be deducted. An excuse for being absent from class shall be a medical or personal emergency acceptable at the discretion of the Head of the Dept.

Class Participation: Class participation and interaction helps to form a complete educational experience. However, class participation and interaction is to be relevant to course content and context. Deviant behavior may lead to dismissal or suspension.

Submission of Assignment: Short writing assignments that address the various topics covered will be given at various times throughout the course. These writing assignments may consist of worksheets, short handwritten problems/questions, or short written assignments. The purpose of these short assignments are double they will help determine which concepts students may be having trouble with and it will help keep actively engaged in the material as we cover it.

Preparedness: Students are expected to have read and be able to discuss the assigned chapter before attending the lecture. In addition, students should be prepared to discuss homework problems.

Academic Dishonesty: Academic dishonesty includes giving, receiving, or using unconstitutional support on any academic work. This includes a person who has taken a test discussing what was on a test with a person who has not taken the test. A clear indication of academic dishonesty will result in a grade of "F" being assigned to that particular piece of work.

Subject to change clause: This syllabus, the course schedule and reading assignments are subject to change at the discretion of the Professor to accommodate instructional and/or student needs.

Components of Internal Assessment (Max. Marks 25)

Assignment/Seminar- I	CIA Test-I	Assignment/Seminar-II	II CIA Test	Attendance
During the course of hours	As per Calendar	During the course of hours	As per Calendar	As per the University Norms

Course Outline: Elective-II: Immunology and Immunotechnology

1. Introduction and scope of immunology.
2. Innate and adaptive immUNITy.
3. Elements of immune system.
4. Immune response, immunoprophylaxsis.
5. Vaccination and immunization schedule.
6. Hypersensitivity, immunodeficiency diseases.
7. Major histocompatibility complex and immunotherapy.
8. Immunocytochemistry, Imunoflourescence, Immunoelectrophoresis, Immunodiffusion.
9. ELISA, RIA, flowcytometry, AIDS, hybridoma technolog.
10. Glossary.

Major Elective					
DSE	**Course Code: 502515**	**Immunology and Immunotechnology**	**T**	**Credits:5**	**Hours: 5**

Unit - I

Objective - 1	Learn the basic principles of defense mechanism against infections.

Overview of the Immune System: Early revealing Humoral and Cellular Components of the Immune System- Innate immUNITy: types of defensive barriers: anatomic, physiologic, phagocytic and inflammatory- Adaptive ImmUNITy: Overview of humoral and cell-mediated branches of the immune system- Cells of the Immune System: Hematopoiesis. Lymphoid Cells, Mononuclear Phagocytes, Granulocytic Cells and Dendritic cells- Organs of the Immune System: Primary Lymphoid Organs (Thymus, Bone marrow), Lymphatic system, Secondary Lymphoid Organs: Lymph node, spleen, MALT.

Outcome - 1	Obtain knowledge on the basic concepts of immune system, mechanisms of immUNITy and the development and maturation process of immune competent cells	**K2**

Unit – II

Objective - 2	Understand the structure and function of the molecules, cells, and organs involved in ImmUNITy.

Antigens: Immunogenicity Versus Antigenicity, Factors That Influence Immunogenicity, Nature of Immunogen Contributing to Immunogenicity, The Biological System Contributing to Immunogenicity, Properties of B-Cell Epitopes Determined by the Nature of the Antigen-Binding Site.Antigen-Derived Peptides for T-Cell Epitopes. Haptens and its Antigenicity. tibodies:Basic Structure of Antibodies, Antibody-Mediated Effector Functions, Antibody Classes and Biological Activities, Antigenic Determinants on Immunoglobulins, B-cell receptor, Overview of T-cell receptors, Monoclonal Antibodies and its applications. Overview of sequential events in T- cell and B-cell generation, activation and differentiation. Cytokines: Properties, Cytokine Secretion by TH1 and TH2 Subset.

Outcome - 2	Recognize the structures and functions of immunoglobulin molecules	**K1**

Unit – III

Objective - 3	learn the mechanism of how the immune system recognizes foreign antigen and thesignificance of self/non-self-discrimination

Major Histocompatibility Complex: General Organization and Inheritance of the MHC, Role of Antigen- Presenting Cells, Overview of cytosolic and endocytic pathways for processing antigen: The Cytosolic Pathway for Endogenous Antigens, Endocytic Pathway for Exogenous Antigens. The Complement system: Functions of Complement, Complement Components, Complement Activation pathways, Biological Consequences of Complement Activation. Cell-Mediated Effector Responses: General Properties of Effector T Cells, Cytotoxic T Cells, Natural Killer Cells, Antibody-Dependent Cell-Mediated Cytotoxicity. Inflammation. General overview of hypersensitivity and its types. Immunologic Basis of Graft Rejection.

Outcome - 3	Understand the mechanism of immunodeficiency diseases and autoimmUNITy against infection.	**K2**

Unit – IV

Objective - 4	Analyze how cell mediated and antibody-mediated immUNITy works to protect a host from pathogenic organisms and harmful substances.

Immune Response to Infectious Diseases: (Viral Infections- HIV, Flu and SARS-Cov-2.Bacterial Infections, Protozoan Diseases. Diseases Caused by Parasitic Worms (Helminths)). Overview of Organ-Specific and Systemic Autoimmune Diseases.

Cancer and the Immune System: Cancer: Origin and Terminology, Malignant Transformation of

Cells, Tumors of the Immune System, Tumor Antigens, Immune Response to Tumors, Tumor Evasion of the Immune System and Cancer Immunotherapy.

Outcome - 4	Realize the methods for the treatment of immune related diseases	**K3**

Unit -V

Objective - 5	Understand the informatics-based approaches for prediction of epitopes, design ofvaccines and immuno-diagnostic tools.

Vaccine: Active and Passive Immunization, Designing Vaccines for Active Immunization, Whole-Organism Vaccines, Purified Macromolecules as Vaccines, Recombinant-Vector Vaccines, DNA Vaccines and Multivalent SubUNIT Vaccines. Immunoinformatics: databases and tools for Reverse Vaccinology: pipeline and workflow. Multi-epitope based vaccine design. B-cell epitope prediction algorithms using sequence-based approaches and structure-based approaches, T-cell epitope prediction methods, Prediction of Antigenicity, Immunogenicity, Allergenicity. in silico cloning of designed vaccines. Immune simulation analysis. Conformational stability analysis of the designed vaccines.

Outcome - 5	Understand the computational aspects of immunology	**K2 & K4**

Suggested Readings:

Kannan I., (2012) "Immunology"; MJP Publishers, 5th Edition.

B. Annadurai., (2017) A Textbook of Immunology & Immunotechnology, S Chand & Company, ASIN: B00QUZMCI2.

Judy Owen, Jenni Punt, Sharon Stanford (2018). Kuby Immunology. 8th Edition. WH Freemanpublication.

Seamus J. Martin , Dennis R. Burton, Ivan M. Roitt, Peter J. Delves (2017). Roitt's Essential Immunology. 13th Edition. Wiley-Blackwell Publication.

Jeffrey Actor (2014). Introductory Immunology: Basic Concepts for Interdisciplinary Applications. Academic Press.

Joseph, A. Bellanti. (2016). Immunology IV: Clinical Applications in Health and Disease. Washington, DC: Georgetown University School of Medicine.

Day, M. J., & Schultz, R. D. (2014). Veterinary immunology: principles and practice. CRC Press.

Geha, R., &Notarangelo, L. (2012). Case studies in immunology: a clinical companion. Garland Science. Rao, C. V. (2013). Immunology (2nd ed). New Delhi: Narosa Publishing House.

Coico, R., & Sunshine, G. (2015). Immunology: a short course. John Wiley & Sons.

Online Resources:

1. https://www.roswellpark.org/sites/default/files/thanavala_9-4-14_innate_immUNITy_part_1.pdf
2. https://www.wiley.com/en-in/Roitt%27s+Essential+Immunology%2C+13th+Edition-p-9781118415771
3. https://www.mea.elsevierhealth.com/basic-immunology-9780443105197.html

K1-Remember	*K2-Understand*	*K3-Apply*	*K4-Analyze*	*K5-Evaluate*	*K6-Create*

Course designed by: **Dr.J. Joseph Sahayarayan**

Course Outcome VS Programme Outcomes

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	L(1)	L(1)	L(1)	L(1)	L(1)	L(1)	L(1)	L(1)	L(1)	L(1)
CO2	L(1)	L(1)	L(1)	L(1)	L(1)	L(1)	L(1)	L(1)	L(1)	L(1)
CO3	L(1)	L(1)	L(1)	L(1)	L(1)	L(1)	L(1)	L(1)	L(1)	L(1)
CO4	L(1)	L(1)	L(1)	L(1)	L(1)	L(1)	L(1)	L(1)	L(1)	L(1)
CO5	L(1)	L(1)	L(1)	L(1)	L(1)	L(1)	L(1)	L(1)	L(1)	L(1)
W.AV	1	1	1	1	1	1	1	1	1	1

S –Strong (3), M-Medium (2), L- Low (1)

Course Outcome VS Programme Specific Outcomes

CO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	-	-	L(1)	L(1)	L(1)
CO2	L(1)	-	L(1)	L(1)	L(1)
CO3	L(1)	L(1)	L(1)	L(1)	L(1)
CO4	L(1)	-	L(1)	L(1)	L(1)
CO5	L(1)	L(1)	L(1)	L(1)	L(1)
W.AV	0.8	0.4	1	1	1

S –Strong (3), M-Medium (2), L- Low (1)

Assignment I Lymphoid organs

1. Lymphiod organs and its types
2. Types of immUNITy
3. Immunodeficiency diseases
4. Major histocompatibility complex
5. Immunocytochemistry

Assignment II Immune system

1. Types and functions of antibodies
2. Cytotoxicity
3. Immunoprophylaxis
4. Autoimmune disorder

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