MAHATMA GANDHI UNIVERSITY

Kottayam, Kerala

Undergraduate Programmes (HONOURS)
2024 Admission Onwards

SYLLABUS						
SIGNATURE COURSE						
Name of the College	UC College, Aluva					
Faculty/ Discipline	Zoology					
Programme	BSc (Hons) Zoology					
Course Coordinator	Rima Joseph					
Contributors						
Course Name	SYSTEMS BIOLOGY, DRUG DISCOVERY TOOLS & APPLIED BIOSTATISTICS					
Type of Course	DSE					
Specialization title	This Signature Course does not have a specialization.					
Course Code	To be prepared by the University					
Course Level	300					
Course Summary	This course explores advanced applications of computational biology in systems biology, network analysis, and in silico drug discovery. Students are introduced to pathway databases, interaction platforms, and tools for drug-likeness and ADME prediction. The biostatistics component covers inferential statistics, including hypothesis testing, parametric and non-parametric tests. Through practical exposure to tools such as JASP and GraphPad Prism, students learn to analyze real-world biological datasets. The course emphasizes analytical thinking, evidence-based interpretation, and the application of computational approaches to model and solve complex biological problems.					
Semester	6	**Credits**			4	**Total Hours**
Course Details	**Learning Approach**	Lecture	Tutorial	Practical	Others	
		3		1		75
Pre-requisites, if any	Basic knowledge of molecular biology, genetics, and introductory statistics at the higher secondary or first-year undergraduate level is recommended. Familiarity with computer usage and internet-based research tools will be helpful but not mandatory.					

Course Outcomes (CO)

Number of COs		**4**	
CO No.	**Expected Course Outcome**	**Learning Domains ***	**PO No**
1	Explain the principles of systems biology, network biology and drug-likeness prediction tools in the context of drug discovery.	U, A	PO2, PO3, PO10
2	Describe the assumptions underlying statistical inference and apply hypothesis testing frameworks.	U, A	PO1, PO2, PO10
3	Select and apply appropriate statistical tests and interpret the results.	A, E	PO1, PO2, PO10
4	Apply statistical and computational tools to analyze biological data and address real-world questions.	A, S	PO1, PO2, PO3, PO10

**Remember (K), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C), Skill (S), Interest (I) and Appreciation (Ap)*

CO-PO Articulation Matrix

CO/PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10
CO 1	-	2	2	-	-	-	-	-	-	2
CO 2	2	2	-	-	-	-	-	-	-	2
CO 3	2	2	-	-	-	-	-	-	-	2
CO 4	2	2	2	-	-	-	-	-	-	2

'0' is No Correlation, '1' is Slight Correlation (Low level), '2' is Moderate Correlation (Medium level) and '3' is Substantial Correlation (High level).

Course Content

Content for Classroom transaction (Units)

Module	Units	Course Description	Hrs	CO No.
1	Systems Biology and In Silico Drug Discovery			
	1.1	Systems biology, Exploration of pathway databases: KEGG (metabolism, signal transduction) and Reactome (curated molecular interactions)	3	["1"]
	1.2	Network biology: interaction networks (gene/protein), databases like STRING	3	["1"]
	1.3	Introduction to drug design workflow	3	["1"]
	1.4	Lipinski's rule of five	2	["1"]
	1.5	SwissADME for ADMET prediction	2	["1"]
	1.6	AI-assisted tools (basic awareness): AlphaFold, SwissTargetPrediction, SwissDock	2	["1"]
2	Foundations of Statistical Inference			
	2.1	Concepts of population and sample	3	["2"]
	2.2	Sampling techniques: random, stratified	3	["2"]
	2.3	Hypothesis testing: null and alternative hypothesis	2	["2"]
	2.4	Concept of p-value and significance	3	["2"]
	2.5	Overview of statistical distributions and test assumptions (normality, variance, independence) – relevance to test selection.	4	["2"]
3	Statistical Tests & Correlation Analysis			
	3.1	Parametric tests: t-test (independent and paired), ANOVA	3	["3"]
	3.2	Non-parametric tests: Mann–Whitney U test, Kruskal–Wallis test	3	["3"]
	3.3	Chi-square test: interpretation and application	2	["3"]
	3.4	Performing parametric and non-parametric tests using GraphPad Prism/JASP	4	["3"]
	3.5	Correlation and regression: scatterplots, correlation coefficients, linear trend lines	3	["3"]

Module	Units	Course Description	Hrs	CO No.
4	Practical			
	4.1	Using SwissADME for drug-likeness and ADME prediction	4	["4"]
	4.2	Introduction to ligand structure input via SMILES	2	["4"]
	4.3	Exploring pathway database and network database	10	["4"]
	4.4	Using BLAST and Clustal Omega for sequence comparison	2	["4"]
	4.5	Using GraphPad Prism/JASP for parametric tests, non-parametric tests, and correlation	10	["4"]
	4.6	Protein structure viewing using RCSB and PyMOL/Chimera	2	["4"]

Teaching and Learning Approach	**Classroom Procedure (Mode of transaction)** Classroom instruction will be delivered using a combination of lectures, demonstrations, active learning, and problem-based discussions. Practical sessions will emphasize experiential learning through mini-projects, simulations, and self-paced exploration of in silico tools.

Assessment Types	**MODE OF ASSESSMENT** Mode of Assessment: Both **A. Continuous Comprehensive Assessment (CCA)** **• Theory – 25 Marks** Assignment – 10 marks, Quiz / Class Test – 10 marks, Tool-based Micro-Presentation – 5 marks **• Practical – 15 Marks** Mini Project and Report – 5 marks, Viva Voce – 5 marks, Lab Involvement – 5 marks **B. End Semester Evaluation (ESE)** **• Theory – 50 Marks** Assessment Methods – MCQ, Short answer, Short Essays Duration of Examination – 1.50 Hrs Pattern of examination for Theory – Non-MCQ Different parts of written examination – Part - A , B , C Answer Type: ◦ PART - A ◦ MCQ - (10 out of 10) – 10 × 1 = 10 ◦ PART - B ◦ Short answer - (10 out of 15) – 10 × 2 = 20 ◦ PART - C ◦ Short Essays - (5 out of 10) – 5 × 4 = 20 **• Practical – 35 Marks** Assessment Methods – Mini Project Report, Viva, Spotters, Demonstration Duration of Examination – 2.00 Hrs

References

- Rastogi, S. C., Mendiratta, N., & Rastogi, P. (2004). Bioinformatics: Methods and applications: Genomics, proteomics and drug discovery. Prentice-Hall of India Private Limited.
- Xiong, J. (2006). Essential bioinformatics (South Asian ed.). Cambridge University Press.
- Lesk, A. M. (2020). Introduction to bioinformatics (2nd international ed.). Oxford University Press.
- Rastogi, V. B. (2008). Fundamentals of biostatistics (2nd ed.). Ane Books Pvt. Ltd.
- Le, C. T., & Eberly, L. E. (2016). Introductory biostatistics (2nd ed.). John Wiley & Sons.

Suggested Readings

- Lesk, A. M. (2012). Introduction to genomics (2nd ed., South Asia ed.). Oxford University Press.
- Motulsky, H. (2018). Intuitive biostatistics: A nonmathematical guide to statistical thinking (4th ed.). Oxford University Press.
- Daniel, W. W., & Cross, C. L. (2013). Biostatistics: A foundation for analysis in the health sciences (9th ed.). Wiley.
- Montgomery, D. C. (2017). Design and analysis of experiments (9th ed.). John Wiley & Sons.
- SwissADME online documentation: https://www.swissadme.ch/
- GraphPad Prism and JASP user manuals.

Affidavit

- We, UC College, Aluva and Rima Joseph, retain the copyright of this syllabus and expressly prohibit its distribution in complete form to any institution outside our own.
- We, UC College, Aluva, agree to appoint a new course coordinator for the proposed SYSTEMS BIOLOGY, DRUG DISCOVERY TOOLS & APPLIED BIOSTATISTICS in the event of the unavailability of the currently nominated coordinator. This appointment will ensure the continued coordination of course delivery, assessments, and all related academic responsibilities necessary for the successful implementation of the signature course, for as long as the college offers this programme.
- We, UC College, Aluva and Rima Joseph, declare that no part of this signature course submitted here for approval has been taken from the course content developed by, or from any of the course titles prepared by, the BoS/expert committee in the same discipline under our University.