الجامعة الأهلية
AHLIA UNIVERSITY
BAHRAIN

COLLEGE OF INFORMATION TECHNOLOGY
DEPARTMENT OF INFORMATION TECHNOLOGY

COURSE SYLLABUS/SPECIFICATION

CODE & TITLE:	**ITCS 530: Bioinformatics Computing: (3-0-3)**
WEIGHT:	**(3-0-3)**
PREREQUISITE:	**Computer Programming skills**
NQF Level Allocated:	**5**
NQF Notional Hours / Credits:	**120**
DESCRIPTION:	Bioinformatics is the study of the structure and function of genes and proteins through the use of computational analysis, statistics, and pattern recognition and the use of databases, search and web-based interfaces to store, annotate and retrieve gene, protein and other information. This course focuses on the computing aspects of Bioinformatics. It introduces the broad frontiers of bioinformatics topics from fundamental algorithms to practical tools. Course topics include an overview of some bioinformatics resources, pattern matching, sequence alignment, gene prediction, fragment assembly, multiple alignment, phylogeny, statistical and machine learning approaches.
OBJECTIVES:	1. To overview the biology of bioinformatics 2. To familiarize students with the principles and computational tools of contemporary bioinformatics 3. To discuss the bioinformatics techniques used in real scientific problems. 4. To learn about the algorithms and performance issues related to computational genomics.
SEMESTER:	Second **ACADEMIC YEAR:** 2018/2019
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INTENDED LEARNING OUTCOMES (ILOS)

A.	Knowledge and Understanding	NQF Descriptor/ Level
A1	Concepts and Theories: Demonstrate understanding of key concepts and theories of bioinformatics computing such as methods for storing, retrieving, organizing and analyzing biological data; and recognize how computer science algorithms and software tools are used to generate useful biological knowledge and help to discover new knowledge in genomics.	**Knowledge**: Theoretical understanding [Level 9]
A2	Contemporary Trends, Problems and Research: Demonstrate an informed and critical awareness of constraints, motivation, and challenges presented to computational scientists by contemporary biological research problems.	**Knowledge**: Theoretical Understanding [Level 9]
A3	Professional Responsibility: Demonstrate cognizance of, and adhere to the professional and legal standards of bioinformatics computing.	**Knowledge**: Theoretical Understanding. [Level 9]

B.	Subject-specific Skills	NQF Descriptor/ Level
B1	Problem Solving: Demonstrate skills in formulating adequate computational solutions to real bioinformatics problems.	**Knowledge**: Practical application [Level 9]
B2	Modeling and Design: Design, implement and verify programs to investigate biological phenomena.	**Skills**: Generic problem solving & Analytical Skills [Level 9] **Knowledge**: Practical application [Level 9]
B3	Application of Methods and Tools: Use specific computational techniques and software tools such as MATLAB or bioinformatics software (e. g, BioPython) in the analysis of biological data.	**Skills**: Communication, ICT and Numeracy [Level 9]

C.	Thinking Skills	NQF Descriptor/ Level
C1	Analytic: Analyze bioinformatics problems and propose suitable computational solutions.	**Skills**: Generic problem solving & Analytical Skills [Level 9]
C2	Synthetic: Assemble and present problem outcomes in a clear and logical manner.	**Skills**: Generic problem solving & Analytical Skills [Level 9]
C3	Creative: Identify and apply optimal computational solutions to given biological problems.	**Skills**: Informed judgements [Level 8]

D.	General and Transferable Skills (other skills relevant to employability and personal development)	NQF Descriptor/ Level
D1	Communication: Express and communicate ideas cogently, persuasively and effectively in written and oral form.	**Skills**: Communication, ICT and Numeracy [Level 9]
D2	Teamwork and Leadership: Work effectively as a member of a project team and demonstrate understanding of individual responsibility within the team.	**Competence**: Autonomy, Responsibility and Context [Level 9]
D3	Organizational and Developmental Skills: Organize ideas and allocate time efficiently in assigned tasks.	**Competence**: Autonomy, Responsibility and Context [Level 8]
D4	Ethical and Social Responsibility: Demonstrate understanding of, and adhere to, ethical and societal responsibilities in the field of bioinformatics computing.	**Knowledge**: Theoretical understanding [Level 9]

11. Course Structure						
Week	**Hours**		**ILOs**	**Topics**	**Teaching Method**	**Assessment Method**
	Lecture	**Lab**				
1	3	-	A1, A2, A3	Introduction to Bioinformatics. Overview of Biochemistry and Molecular Biology	Lecture Discussion	Oral Enquiry* (A1)
2	3	-	A1,A2, A3,D1,D4	Introduction to the Genome, Information flow from the Genome , genes, DNA/RNA	Lecture Discussion	Oral Enquiry* (A1, D1)
3	3	-	A1, A2,A3,D1,D4	Web-based information systems Assignment of Group Project	Lecture Discussion	Oral Enquiry* (A1,D1) Assignment 1 (A1, A2,A3,D1,D4)
4	3	-	A1, B1, B2, B3, C1, D1	Bioinformatics programming and modeling Languages, Computational analysis tools Algorithms, Statistics, Hidden Markov models	Lecture Discussion Lab tutorial	Oral Enquiry* (A1,D1)
5	3	-	A1, B1,B2, B3,C1,D1	Data Mining, Pattern matching techniques	Lecture, Discussion Lab tutorial	Oral Enquiry* (A1,D1) Assignement 2 (B1,B2,B3,C1,D1)
6	3	-	A1,B1,B2, B3,C1	Databases and Data modeling, Search and Queries, Data warehouses	Lecture Lab tutorial	Oral Enquiry* (A1,D1)
7	3	-	A1,A2, A3, B1,B2, B3,C1,C2,D1	Data visualization	Lecture Lab tutorial	Oral Enquiry* (A1,D1) Assignment 3 (B1,B2,B3,C1,D1)
8-9	6	-	A1, A2, B1, B2,C1,C2,D1	Pairwise sequence Alignment BLAST and FASTA searching algorithms	Lecture	Midterm Exam (A1,B1,B2,C1,C2, D1) Oral Enquiry* (A1,D1)
10	3	-	A1, A2,B1,B2,B3,C1 ,D1	Multiple sequence alignments algorithms	Lecture Discussion Lab tutorial	Oral Enquiry* (A1,D1)
11	3	-	A1,B1,B2,B3,D1	Protein-protein interaction and networks, Hidden Markov model searches	Lecture Discussion	Oral Enquiry* (A1,D1) Assignement 4 (B1,B2,B3,D1)
12	3	-	A1, A2, A3, D1, D4	Protein comparisons, domains and protein families, Gene prediction	Lecture Discussion	Oral Enquiry* (A1,A2,A3,D1,D4)
13	3	-	A1, A2, B1, B2, B3,C1,D1	Genome sequencing and assembly Genome annotation: automated pipelines	Lecture Discussion Lab Tutorial	Oral Enquiry* (A1,D1)
14	3	-	A1, A2,B1, B2,B3, C1, C2,D1	Genome annotation: manual Genome comparison	Lecture Discussion Lab Tutorial	Oral Enquiry* (A1,D1)
15	3	-	B1,B2, B3, C1,C2,C3, D1,D2, D3,D4	Group Project Presentations by students		Evaluation of Group Project (B1,B2,B3,C1,C2, C3,D1,D2,D3,D4)
16	2			**Comprehensive Assessment**		**Final Exam**

*FORMATIVE ASSESSMENT

TEACHING MATERIAL:

TEXTBOOK(S): Miguel Rocha, Pedro G. Ferreira, Bioinformatics Algorithms: Design and Implementation in Python, 1st Edition, 1st edition, 2018, Academic Press

HANDOUT(S): Lecture slides and notes
Other resources are available on the Course website (Moodle system)

REFERENCE(S):

1. Paul M. Selzer, Richard J. Marhöfer, Oliver Koch, Applied Bioinformatics: An Introduction 2nd ed. 2018, Springer.
2. Chandra Sekhar Mukhopadhyay, Ratan Kumar Choudhary, Mir Asif Iquebal, Basic Applied Bioinformatics, 2017, Wiley Blackwell.
3. Charles Malkoff, Bioinformatics, Proteomics and Genomics, Callisto Reference, 2017.
4. David W. Mount, "Bioinformatics sequence and Genom Alanysis", Cold Spring Laboratory Press, 2016.
5. David J. Barnes, D. Chu, *Introduction to Modeling for Biosciences*, Springer, 2010
6. Larry Hunter , *The Processes of Life: An Introduction to Molecular Biology*, MIT Press, 2009
7. *Journal of Bioinformatics and Computational Biology,* Publisher: World Scientific, Imperial College Press.
8. *BMC Bioinformatics,* Publisher: Jo Appleford-Cook, BioMed Cenral
9. *BioData Mining,* Publisher: BioMed Cenral
10. *Cognitive Computation,* Publisher: Springer US
11. *Bioinformatics,* Publisher: Oxford University Press
12. More references are available in **the course website in Moodle.**

ASSESSMENTS:

Type of Assessment[1]	Description[2]	Learning Outcomes[3]	Weighting
Assignment 1 *Assignment 2* *Assignment 3* *Assignment 4*	*Each assignment consists of a set of theoretical exercises related to the material covered in class (Assignment 1), in addition to programming questions where the student is required to write a program to implement bioinformatics algorithms discussed in class.* *Assignments must be handed in electronically or uploaded on the Moodle system on the due date. The assignments will be made available on the course website on the Moodle system.*	Assignment 1: A1,A2,A3,D1 Assignment 2 : B1,B2,B3,C1,D1 Assignment 3 : B1,B2,B3,C1,D1 Assignment 4 : B1,B2,B3,D1	4 ×5%
Midterm Exam	*The Midterm Exam is close book of one hour and 30 min duration, and consists of problem solving-based and short answer questions (SAQs).*	A1,B1,B2,B3,C1,C2	20 %
Group Project evaluation	*A project is assigned in the 3rd week of the semester where the students have to write a paper about one of the topics related to what is covered in the class. Students are recommended to contact the instructor to discuss any problems they may encounter.*	B1,B2, B3, C1,C2,C3, D1,D2, D3,D4	15 % + 5% presentation

	In the final week, each student is required to make a presentation of his/her project. Presentations are evaluated according to a specific marking rubric.		
Final examination	*The final exam is of two hours duration and consists of Multiple Choice Questions (MCQs) and problem solving-based short answer questions (SAQs) .*	A1, A3, B1,B2, C1,C2	40%
Oral enquiry	*Questions are asked continuously throughout the course to assess student understanding in the different topics covered in class.*	A1,A2,A3,D1	Formative Assessment
		Overall:	**100%**

[1] *For approved types of assessment (e.g. quiz, exam, project, etc.) see the ILO-Assessment Matrix in page 9 of Assessment Manual Version 2.0*

[2] As *a minimum provide the description should provide details of type of tasks to be completed and duration (if appropriate)*

[3] *The learning outcomes should be taken from the weekly schedule. Ensure that the assessment type and the learning outcomes are aligned as per the ILO-Assessment Matrix in page 9 of Assessment Manual Version 2.0*

Ahlia University values academic integrity. Therefore, all students must understand the meaning and consequences of cheating, plagiarism and other academic offences under the Code of Student Conduct and Disciplinary Procedures (see www.ahlia.edu.bh/integrity for more information).