

# University of Information Technology and Communications

## جامعة تكنولوجيا المعلومات والاتصالات



*First Cycle – Bachelor's Degree  
(B.Sc.) - Bioinformatics*

بكالوريوس – معلوماتية احيائية



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## Overview .1

This catalog is about the courses (modules) given by the program of the Bioinformatics Department to gain the Bachelor of Science degree in bioinformatics. The program delivers (48) Modules with (6000) total student workload hours and 240 total ECTS. The module delivery is based on the Bologna Process.

نظرة عامة

يتناول هذا الدليل المواد الدراسية التي يقدمها برنامج قسم المعلوماتية الاحيائية للحصول على درجة بكالوريوس العلوم في المعلوماتية الاحيائية. يقدم البرنامج (٤٨) مادة دراسية، مع (٦٠٠٠) إجمالي ساعات حمل الطالب و ٢٤٠ إجمالي وحدات أوروبية. يعتمد تقديم المواد الدراسية على عملية بولونيا.

## 2. Undergraduate Courses 2023-2024

### Module 1

Code	Course/Module Title	ECTS	Semester
ITC320000	Biology	6.00	1
Class (hr/w)	Lect/Lab./Prac./Tutor	SSWL (hr/sem)	USWL (hr/w)
2	2	63	87
<b>Description</b>			
Biology is the scientific study of life and living organisms. Biology and bioinformatics are closely intertwined fields that complement each other. By studying biology at the beginning of the student's study, the student will explore the fundamental principles and concepts that govern life. The biology module will provide a foundation understanding of the diversity, complexity, and interconnectedness of life, and it continues to advance scientific knowledge and the betterment of human well-being. Moreover, this course will inform the students about the biodiversity, classification, and taxonomy of living kingdoms. Biology will also provide information about the cells and main differences between cells in prokaryotic and eukaryotic, cellular organelles functions, cell signaling, that may help the students for forward classes.			

### Module 2

Code	Course/Module Title	ECTS	Semester
ITC320011	Computer Programming I	6.00	1
Class (hr/w)	Lect/Lab./Prac./Tutor	SSWL (hr/sem)	USWL (hr/w)
2	2	63	87
<b>Description</b>			
<p>Computer Programming is a fundamental course that introduces students to the concepts and principles of designing algorithms using flowcharts and implementing them in programming languages. It provides a comprehensive overview, equipping learners with essential skills to understand and write code. Students learn to analyze problems, develop logical solutions, and translate them into step-by-step instructions. Practical programming skills are emphasized, covering syntax, variables, loops, conditionals, and functions.</p>			

### Module 3

Code	Course/Module Title	ECTS	Semester
ITC320021	Mathematics I	6.00	1
Class (hr/w)	Lect/Lab./Prac./Tutor	SSWL (hr/sem)	USWL (hr/w)
3	2	78	72
<b>Description</b>			
<p>This course will cover some of the key mathematical concepts needed for computer science. It assumes no prior mathematical knowledge, so is suitable for learners of all backgrounds and previous educational attainment. This course provides students with sufficient mathematical knowledge to enable them to understand the foundations of their subject for both study purposes and later career development. It seeks to bridge the gap in style and content between school level and university mathematics, and to introduce students to the language and methods of professional mathematics.</p>			

### Module 4

Code	Course/Module Title	ECTS	Semester
ITC320030	General Chemistry	6.00	1
Class (hr/w)	Lect/Lab./Prac./Tutor	SSWL (hr/sem)	USWL (hr/w)
3	2	78	72
<b>Description</b>			
<p>In the first class of general chemistry, students are introduced to the basic concepts and principles of the subject. The instructor starts by discussing the importance of chemistry in understanding the composition, structure, and behavior of matter. The class covers fundamental topics such as the classification of matter, including elements, compounds, and mixtures. The instructor also discusses the periodic table, highlighting the organization of elements based on their atomic number, electron configuration, and properties. Students gain an understanding of the periodic trends, such as atomic radius, electronegativity, and ionization energy.</p> <p>Furthermore, the class covers chemical bonding, including ionic and covalent bonds, and introduces students to Lewis structures and molecular geometry. They learn about the concepts of polarity and intermolecular forces, which play a crucial role in the physical and chemical properties of substances.</p>			

#### Module 5

Code	Course/Module Title	ECTS	Semester
ITC320040	Computer Fundamentals	4.00	1
Class (hr/w)	Lect/Lab./Prac./Tutor	SSWL (hr/sem)	USWL (hr/w)
2	2	63	37
<b>Description</b>			
<p>This course aims to help students build up an understanding of what a computer is, its software system, hardware, and peripheral devices. Its purpose is to present, as clearly and completely as possible, the nature and characteristics of modern-day computer systems, giving them the fundamental principles of how computer systems work. The course will cover the whole computer components as software, processing unit and its internal registers and buses like internal and external buses. Also study types of system lines such as control, data, and address lines. Furthermore, the course offers an in-</p>			

depth exploration of computer internal and external storage. It also highlights the significance of I/O devices in data and information transfer.

#### Module 6

Semester	ECTS	Course/Module Title	Code
1	2.00	Democracy and Human Rights	ITC000000
USWL (hr/w)	SSWL (hr/sem)	Lect/Lab./Prac./Tutor	Class (hr/w)
17	33	-	2
<b>Description</b>			
<p>من خلال هذه المادة يتعرف الطالب على الديمقراطية كشكل من أشكال الحكم، ومرجعاً أساسياً للجميع لحماية حقوق الإنسان؛ وهي توفر بيئة لحماية حقوق الإنسان. تهدف المادة أيضاً لفهم الطالب ما هي الحريات العامة والخاصة وما هي الحريات المقرة بالشرع السماوي ومن ثم المواثيق الدولية لكي يتمتع بها ويمارسها بشكلها الصحيح دون الاعتداء على حريات الآخرين. معرفة نظام بلده السياسي عبر التعرف على النظام الديمقراطي الذي تمارسه أغلب دول العالم والذي يعد كضمانة للحقوق والحراء وتمكن الطلبة بالحصول على المعرفة بالديمقراطية وهي التي تعد أحد المثل العليا المعترف بها عالمياً والقائمة على قيم مشتركة تتبادلها الشعوب في مختلف أنحاء العالم، بغض النظر عن الاختلافات الثقافية والسياسية والاجتماعية والاقتصادية. معرفة الطالب بحقوق الإنسان على المستوى الوطني والدولي ومهارة تطبيق حقوق الإنسان الحريات العامة في حياتهم.</p>			

#### Module 7

Code	Course/Module Title	ECTS	Semester
ITC000031	English I	2.00	2
Class (hr/w)	Lect/Lab./Prac./Tutor	SSWL (hr/sem)	USWL (hr/w)
2	-	33	17
<b>Description</b>			
<p>English I course specifically for bioinformatics students. It helps them improve their reading, writing, listening, and speaking skills in the context of bioinformatics. The course also focuses on improving their speaking skills through discussions and presentations. English I prepares bioinformatics students to communicate effectively.</p>			

**Module 8**

Code	Course/Module Title	ECTS	Semester
ITC320022	Mathematics II	7.00	2
Class (hr/w)	Lect/Lab./Prac./Tutor	SSWL (hr/sem)	USWL (hr/w)
3	2	78	97
<b>Description</b>			
This course introduces further mathematical concepts. This will be essential for prospective researchers and Professionals to know these concepts. Topics include inverse functions and logarithmic functions; hyperbolic functions, technic of integrations; differential equations, sequences and series. When successfully completing the module students will be able to demonstrate problem solving skills using mathematics.			

**Module 9**

Code	Course/Module Title	ECTS	Semester
ITC320012	Computer Programming II	6.00	2
Class (hr/w)	Lect/Lab./Prac./Tutor	SSWL (hr/sem)	USWL (hr/w)
2	2	63	87
<b>Description</b>			
Computer Programming II is an advanced course that focuses on basic data structures. Students learn to implement and manipulate various data structures to efficiently store and organize data. They become familiar with operations like insertion, deletion, and retrieval. The course also covers debugging techniques and code documentation. By the end of the course, students develop proficiency in algorithmic thinking, problem-solving, and understanding the software development life cycle. They gain expertise in working with data structures, honing their ability to design efficient algorithms. Overall, Computer Programming 2 enhances students' programming skills, enabling them to tackle complex problems and develop robust software solutions.			

**Module 10**

Code	Course/Module Title	ECTS	Semester
ITC320050	Introduction to Bioinformatics	7.00	2
Class (hr/w)	Lect/Lab./Prac./Tutor	SSWL (hr/sem)	USWL (hr/w)
2	2	63	112
<b>Description</b>			
This course provides a comprehensive introduction to the field of Bioinformatics and its significance in analyzing biological data. Students will learn about the scope and importance of bioinformatics, as well as the role of the internet in this field. They will gain an understanding of different methods used to characterize and manage various types of biological data. The classification of biological databases will be covered, along with topics such as sequence similarity search using tools like BLAST, sequence alignment, and analysis. Additionally, students will explore the construction of phylogenetic trees and gain insights into the structures of proteins, including primary, secondary, tertiary, and quaternary structures.			

**Module 11**

Code	Course/Module Title	ECTS	Semester
ITC320060	Biophysics	6.00	2
Class (hr/w)	Lect/Lab./Prac./Tutor	SSWL (hr/sem)	USWL (hr/w)
2	2	63	87
<b>Description</b>			
Biophysics is the field that applies the theories and methods of physics to understand how biological systems work. Biophysics has been critical to understanding the mechanics of how the molecules of life are made, how different parts of a cell move and function, and how complex systems in our bodies—the brain, circulation, immune system, and others—work. Biophysics is a vibrant scientific field where scientists from many fields including math, chemistry, physics, engineering, pharmacology, and			

materials sciences, use their skills to explore and develop new tools for understanding how biology—all life—works.

### Module 12

Semester	ECTS	Course/Module Title	Code
2	2.00	Arabic	ITC000041
USWL (hr/w)	SSWL (hr/sem)	Lect/Lab./Prac./Tutor	Class (hr/w)
17	33	-	2
<b>Description</b>			

يسعى مقرر اللغة العربية للمرحلة الأولى إلى تعليم الأسس الإملائية الأولية للطلبة غير الاختصاص ، و أن يحيطون علمًا بأقسام الكلام من حرف و اسم و فعل ، وأنواع الأفعال وأحكامها بين البناء و الإعراب ، و أن يعرفوا كيفية التفريق بين الكلمات التي تكتب بالظاء عن شبيهتها التي تكتب بالضاد و التمييز بينهما بالشكل و الدلالة ، و أن يعوا الكتابة الصحيحة الهمزة و أحكامها بحسب موقعها من الكلمة و السياق و الإعراب ، و أن يفرقوا بين الكلمات التي تكتب بالبناء الطويلة وتلك التي تكتب بالبناء المربوطة ، و تمكن الطالبة من كتابة العدد كتابةً صحيحةً بحسب التأنيث والتذكير و العدد وتمييزه ، كما تتمكن هذه المادة طلبة الأقسام العلمية من معرفة كيفية استعمال المعاجم اللغوية و استخراج معاني الكلمات منها بحسب نوع كل معجم ، وكذلك تتمكن الطالبة من معرفة الأخطاء اللغوية الشائعة ؛ حتى يتجنّبون الوقوع بالخطأ الإملائي والشكلي ، و يهتم مقرر اللغة العربية كذلك بتمكين الطالبة من معرفة كيفيات الخطاب الإداري و استراتيحياته و أساليبه حتى يفيونك من هذه المعلومات جميعاً في سوق العمل ، في أدائهم اليومي و البحثي و الوظيفي مستقبلاً.

### Module 13

Code	Course/Module Title	ECTS	Semester
ITC320070	Object Oriented Programming	6.00	3
Class (hr/w)	Lect/Lab./Prac./Tutor	SSWL (hr/sem)	USWL (hr/w)
2	2	63	87
<b>Description</b>			

The Object-Oriented Programming course teaches students the principles and techniques of object-oriented programming. Through lectures, labs, and practical

exercises, students learn to design and implement software systems using objects, classes, and their relationships. They gain proficiency in encapsulation, inheritance, and polymorphism, enabling them to create modular and reusable code. By the end of the course, students are equipped with a strong foundation in object-oriented programming and ready to develop efficient and scalable software solutions.

#### Module 14

Code	Course/Module Title	ECTS	Semester
ITC320080	Applied Bioinformatics	5.00	3
Class (hr/w)	Lect/Lab./Prac./Tutor	SSWL (hr/sem)	USWL (hr/w)
2	2	63	62
<b>Description</b>			

Applied bioinformatics refers to the practical application of bioinformatics tools, methods, and techniques to solve specific biological problems. It involves the utilization of computational approaches to analyze and interpret biological data in real-world scenarios. One of the key applications of bioinformatics is in genome analysis. By employing various computational tools, bioinformaticians can analyze DNA sequences and identify genes, regulatory elements, and other functional regions within a genome. This information is crucial for understanding the structure and function of genomes, as well as for studying genetic variations and their implications in diseases. Further Protein sequence analysis is a fundamental aspect of bioinformatics that provides valuable insights into protein structure, function, and evolution. By analyzing protein sequences, students can gain knowledge about the preferences and distributions of amino acid residues, which in turn contribute to understanding the secondary and tertiary structures of proteins.

#### Module 15

Code	Course/Module Title	ECTS	Semester
ITC320090	Data Structures	6.00	3
Class (hr/w)	Lect/Lab./Prac./Tutor	SSWL (hr/sem)	USWL (hr/w)
2	2	63	87
<b>Description</b>			

The Data Structures course teaches the students the principles of data structures. This course will focus on data structures and algorithms for manipulating them. Basic algorithms for creating, manipulating and using these structures will also be discussed. In the Theoretical and Practical parts, students will understand the primitive, non-primitive data structures. The aim is to introduce the method of writing and analyzing algorithms. Students will learn how to implement linear data structures like stack, queue, linked list with its types and non-linear data structures like trees. Different types of searching and sorting techniques will also be introduced and will be compared. Students will carry out a number of programming assignments, which will emphasize various aspects of data organization and manipulation process. Also it contains subjects about file organization concepts.

#### Module 16

Code	Course/Module Title	ECTS	Semester
ITC320100	Fundamental of Organic Chemistry	4.00	3
Class (hr/w)	Lect/Lab./Prac./Tutor	SSWL (hr/sem)	USWL (hr/w)
2	2	63	37
<b>Description</b>			
<p>The fundamentals of organic chemistry class introduces students to the fascinating world of carbon-based compounds. This branch of chemistry focuses on the study of the structure, properties, composition, reactions, and synthesis of organic molecules. Students learn about various topics such as bonding, functional groups, isomerism, nomenclature, and stereochemistry. They explore different types of reactions, including substitution, addition, elimination, and oxidation-reduction. The class also covers important organic compounds like alkanes, alkenes, alkynes, alcohols, ethers, aldehydes, ketones, carboxylic acids, and amines. Through theoretical concepts and laboratory experiments, students develop a solid foundation in understanding the behavior and properties of organic compounds, which are the building blocks of life.</p>			

#### Module 17

Code	Course/Module Title	ECTS	Semester
ITC320110	Microbiology	4.00	3
Class (hr/w)	Lect/Lab./Prac./Tutor	SSWL (hr/sem)	USWL (hr/w)
2	2	63	37
<b>Description</b>			

Introducing the fundamentals of microbiology through the study of the characteristics of microorganisms, multiplication, and growth in different media, metabolic pathways, and effects of microbes. Knowledge of these principles will enable students to understand how they react under different conditions and how they cause different diseases and their control. Microbiology is the branch of biology that studies microorganisms, which are organisms that are too small to be seen with the naked eye. Microbiology explores the structure, function, classification, and interactions of these organisms.

Microbiologists investigate various aspects of microorganisms, including their genetics, metabolism, growth, and reproduction. They also study how microorganisms interact with their environments and the impact they have on other living organisms, including humans. In addition to its practical applications, microbiology also contributes to our understanding of evolutionary processes, cell biology, and the intricate ecosystems that exist at the microbial level. Through techniques such as culturing, microscopy, molecular biology, and genomics, microbiologists unravel the mysteries of the microscopic world and its profound implications for life on Earth.

### Module 18

Code	Course/Module Title	ECTS	Semester
ITC320120	Discrete Mathematics	3.00	3
Class (hr/w)	Lect/Lab./Prac./Tutor	SSWL (hr/sem)	USWL (hr/w)
2		33	42
<b>Description</b>			
<p>The purpose of this course is to understand and use (abstract) discrete structures that are backbones of computer science. In particular, this class is meant to introduce logic, proofs, sets, relations, functions, counting, and probability, with an emphasis on applications in computer science. The goal of this course is to build the mathematical foundation for computer science courses such as data structures, algorithms, relational and database theory.</p>			

### Module 19

Code	Course/Module Title	ECTS	Semester
ITC000010	Crimes of the baath regime in Iraq	2.00	3
Class (hr/w)	Lect/Lab./Prac./Tutor	SSWL (hr/sem)	USWL (hr/w)
2		33	17
<b>Description</b>			

لقد شهدت فترة حكم حزب البعث على ارتكاب العديد من الجرائم منذ تولي الحزب السلطة عام ١٩٦٨ ولغاية ٢٠٠٣ وقد تنوّعت الانتهاكات التي مارسها النظام بين القتل والقمع وانتهاك الحريات العامة واسقاط الجنسية وادخال العراق في حروب وأزمات إقليمية والتي انعكست اثارها على الشعب وقد لجأ حزب البعث إلى سلوكيات قمعية وافتعل جملة من الظواهر والآليات بهدف احداث تغييرات في بنية المجتمع العراقي ومنذ ان استولى حزب البعث على السلطة عبأ امكاناته لضرب الحركة الاسلامية في العراق وقام بقتل العلماء ورجال الدين وحضر الاحزاب الاسلامية وان الانتهاكات لم تنتهي عند هذا الحد بل تجاوز ايضا على البيئة مسببا في ارتفاع نسبة التلوث وما صاحبه من اختلال كبير في التوازن البيئي وذلك من خلال استعماله الاسلحة المحرمة دوليا في قصف عدة مدن ومنها حلبجة واتباعه احدى الطرق البشعة في تدمير البيئة وهي سياسة الأرض المحروقة لتدمير بيئه العراق بحرق ابار النفط وتجفيف الاهوار بالإضافة الى قصف المدن العراقية وتم اسقاط النظام في سنة ٢٠٠٣ مما الزم على الحكومة العراقية على ايجاد معالجات ل تلك الانتهاكات الخطيرة التي عانى منها الشعب وانصاف الضحايا وذويهم وضمان حقوقهم عن طريق انظمة العدالة الانتقالية.

#### Module 20

Code	Course/Module Title	ECTS	Semester
ITC000032	English II	2.00	4
Class (hr/w)	Lect/Lab./Prac./Tutor	SSWL (hr/sem)	USWL (hr/w)
2	-	33	17
<b>Description</b>			
<p>The English II course aims to enhance students' skills in the English language by providing further practice in speaking, listening, reading, and writing. It focuses on developing technical vocabulary to improve academic writing skills, enabling students</p>			

to produce clear and coherent reports. Moreover, the course emphasizes practicing clear presentations and effective communication, ensuring students possess a solid command of bioinformatics vocabulary. This proficiency facilitates effective communication within the bioinformatics field and enhances their research capabilities. By acquiring these language skills, students are empowered to contribute meaningfully to bioinformatics research.

### Module 21

Code	Course/Module Title	ECTS	Semester
ITC320130	Bioinformatics Programming	5.00	4
Class (hr/w)	Lect/Lab./Prac./Tutor	SSWL (hr/sem)	USWL (hr/w)
2	2	63	62
<b>Description</b>			
<p>Recently, the new sequencing technologies have allowed new discoveries for Life Sciences. However, computer skills became highly necessary to deal with big biological data. Hence, knowing how to build computer programs is essential to Bioinformatics. Python is the main programming language used for bioinformaticians.</p> <p>This module will survey current areas where computer science approaches have been applied to genomics research. Chiefly, the course focuses on DNA sequencing data analysis, including sequence alignment, de novo assembly, error correction, and DNA data compression, Counting DNA Nucleotides, Translating RNA into Protein, Counting Point Mutations using Python. In this module, you will learn to develop computer programs for the application of Bioinformatics and the analysis of biological databases.</p>			

### Module 22

Code	Course/Module Title	ECTS	Semester
ITC320140	Fundamentals of Biochemistry	5.00	4
Class (hr/w)	Lect/Lab./Prac./Tutor	SSWL (hr/sem)	USWL (hr/w)
2	2	63	62

Description			
<p>The fundamentals of biochemistry, students are introduced to the basic principles and concepts of the field. The instructor begins by discussing the importance of biochemistry in understanding the chemical basis of life processes. They provide an overview of the major biomolecules, including proteins, nucleic acids, carbohydrates, and lipids, emphasizing their structures, functions, and roles in biological systems. Students learn about the basics of enzyme kinetics, including enzyme-substrate interactions and the factors that affect enzymatic activity. The class may also touch upon metabolism and the concept of energy transformation in living organisms. Throughout the students are encouraged to ask questions, participate in discussions, and begin building a solid foundation in biochemistry.</p>			

#### Module 23

Code	Course/Module Title	ECTS	Semester
ITC320150	Biostatistics	5.00	4
Class (hr/w)	Lect/Lab./Prac./Tutor	SSWL (hr/sem)	USWL (hr/w)
2	2	63	62

#### Description

This course focuses on developing the knowledge and skills necessary to effectively analyze medical and biological information. It covers both the theoretical foundations and practical applications of biostatistics in the field of biology. Upon completion of this course, students will have the ability to apply their knowledge to work with bioinformatics and its various applications. They will gain practical experience in handling biological and medical data, as well as utilizing biostatistical tools and techniques.

#### Module 24

Code	Course/Module Title	ECTS	Semester
ITC320160	Immunoinformatics	5.00	4
Class (hr/w)	Lect/Lab./Prac./Tutor	SSWL (hr/sem)	USWL (hr/w)
2	2	63	62

#### Description

Immunoinformatics is a field that combines immunology and bioinformatics to study the immune system using computational tools and techniques. Immunoinformatics uses computational methods to study various aspects of immunology, including the prediction of antigenic epitopes, which are regions on pathogens or other foreign

substances that are recognized by the immune system.

Furthermore, immunoinformatics helps in understanding the complex interactions between antigens and the immune system. It can aid in predicting the binding affinity between antigens and antibodies, studying the diversity of immune repertoires, and analyzing patterns in immune responses to different diseases.

The field of immunoinformatics has applications in vaccine design, immunotherapy development, allergy research, autoimmune disease studies, and understanding host-pathogen interactions. By integrating computational methods with immunological knowledge, immunoinformatics contributes to advancing our understanding of the immune system and its role in health and disease.

#### Module 25

Code	Course/Module Title	ECTS	Semester
ITC000042	Arabic II	2.00	4
Class (hr/w)	Lect/Lab./Prac./Tutor	SSWL (hr/sem)	USWL (hr/w)
2		32	18
<b>Description</b>			

#### Module 25

Code	Course/Module Title	ECTS	Semester
ITC320170	Data Analysis and Visualization	6.00	4
Class (hr/w)	Lect/Lab./Prac./Tutor	SSWL (hr/sem)	USWL (hr/w)
2	2	63	87
<b>Description</b>			

This course on data analysis and data science provides a comprehensive introduction to key concepts, techniques, and practical applications in the field. Students will learn about data types, structures, profiling, cleaning, transformation, scaling, statistical analysis, and data visualization. Through a combination of theory and hands-on exercises, students will develop essential skills for effective data analysis and interpretation.

**Module 26**

Code	Course/Module Title	ECTS	Semester
BID311	Bioinformatics Algorithms	5.00	5
Class (hr/w)	Lect/Lab./Prac./Tutor	SSWL (hr/sem)	USWL (hr/w)
2	2	64	61
<b>Description</b>			
Bioinformatics algorithms are computational methods designed to analyze biological data, such as DNA sequences, protein structures, and gene expression patterns. These algorithms play a crucial role in deciphering complex biological information and uncovering meaningful insights. They encompass a wide range of techniques, including sequence alignment, gene prediction, phylogenetic analysis, protein structure prediction, and data mining. Bioinformatics algorithms utilize statistical, mathematical, and computational approaches to process large datasets, identify patterns, and infer biological functions. They are vital tools for understanding the intricacies of genomics, proteomics, and other molecular biology domains, facilitating advancements in drug discovery, personalized medicine, and evolutionary biology research.			

**Module 27**

Code	Course/Module Title	ECTS	Semester
BID312	Numerical Methods for Bioinformatics	5.00	5
Class (hr/w)	Lect/Lab./Prac./Tutor	SSWL (hr/sem)	USWL (hr/w)
2	2	64	61
<b>Description</b>			

A numerical methods course for medical informatics students aims to enhance their ability to understand and analyze numerical data in the medical field. The course will teach students various numerical techniques and algorithms that are commonly used in medical informatics research. The objectives of the course include providing students with an understanding of the underlying principles and concepts of numerical methods, as well as the ability to use software tools to solve complex problems in medical informatics. The outputs of the course include students who are capable of accurately and efficiently analyzing medical data using numerical tools and techniques. Students will also have gained the ability to develop and implement numerical methods to solve real-world problems in the field of medical informatics.

### Module 28

Code	Course/Module Title	ECTS	Semester
BID313	Genetics	5.00	5
Class (hr/w)	Lect/Lab./Prac./Tutor	SSWL (hr/sem)	USWL (hr/w)
2	2	64	61
<b>Description</b>			

Genetics is fundamental to understanding life sciences. In this course the students will gain an understanding of how information is stored and inherited in living organisms. They will also consider genetics from the perspectives of DNA structure, gene expression, genome replication, heredity, genes in populations, and evolution. Modern techniques in DNA sequencing and the exploration of gene diversity will be introduced, with examples from humans and other organisms. In laboratory practicals the students will prepare and analyse DNA, and examine how traits are passed down from parents to offspring and explore the underlying mechanisms that govern inheritance.

Advances in genetics have led to significant breakthroughs, such as the mapping and sequencing of the human genome. This has deepened their understanding of the genetic basis of diseases, allowed for the development of personalized medicine, and opened up new avenues for genetic engineering and biotechnology.

### Module 29

Code	Course/Module Title	ECTS	Semester
BID314	Database Management Systems	5.00	5
Class (hr/w)	Lect/Lab./Prac./Tutor	SSWL (hr/sem)	USWL (hr/w)
2	2	64	61

Description			
<p>The Database Management Systems course introduces students to the fundamentals of managing databases. They learn about data models, including the Entity-Relationship (ER) model, entity types, key attributes, and relationship constraints. The course also covers relational model concepts, integrity constraints, and Structured Query Language (SQL) for data definition and retrieval. Students gain proficiency in constructing SQL queries, particularly the SELECT-FROM-WHERE structure, and apply them to medical and biological data for specific information retrieval. By the end of the course, students acquire a solid understanding of data modeling, relational databases, and SQL querying, equipping them to work effectively with databases in various domains.</p>			

### Module 30

Code	Course/Module Title	ECTS	Semester
BMI311	Artificial Intelligence	5.00	5
Class (hr/w)	Lect/Lab./Prac./Tutor	SSWL (hr/sem)	USWL (hr/w)
2	2	64	61

### Description

The course on AI and Machine Learning introduces the fundamental concepts and techniques in the field. It explores the difference between traditional programming and machine learning, focusing on supervised learning. The course focuses on supervised learning, delving into regression and classification algorithms. Students learn to build machine learning pipelines, perform data preprocessing, and troubleshoot models. Evaluating model performance and understanding metrics are emphasized.

### Module 31

Code	Course/Module Title	ECTS	Semester
BMI312	Image Processing	5.00	5
Class (hr/w)	Lect/Lab./Prac./Tutor	SSWL (hr/sem)	USWL (hr/w)
2	2	64	61

### Description

Image processing is the process of transforming an image into a digital form and performing certain operations to get some useful information from it. The image processing system usually treats all images as 2D signals. digital image processing

techniques including representation, sampling and quantization, image acquisition, imaging geometry, image transforms, image enhancement, image smoothing and sharpening, and image restoration. More advanced topics include degradation models, image filtering, color image processing, and image segmentation. Modern and different technologies and algorithms in image processing and their applications will be introduced.

### Module 32

Code	Course/Module Title	ECTS	Semester
BMI321	Web Development	5.00	6
Class (hr/w)	Lect/Lab./Prac./Tutor	SSWL (hr/sem)	USWL (hr/w)
2	2	64	61
<b>Description</b>			
In the web development course, students will introduce to HTML5, JavaScript, and CSS3, learning how to create both static and dynamic websites. They will explore the creation of web pages that incorporate various media types and gain knowledge on building web forms to collect user data. Additionally, students will learn to effectively present and organize data by displaying results as tables within meticulously formatted pages, harnessing the power of CSS3.			

### Module 33

Code	Course/Module Title	ECTS	Semester
DSE101	Data Science Ethics	4.00	6
Class (hr/w)	Lect/Lab./Prac./Tutor	SSWL (hr/sem)	USWL (hr/w)
2	-	32	68
<b>Description</b>			
The course on Data Science Ethics covers a wide range of topics related to ethical considerations in the field of data science. Students will gain a deep understanding of the concept of ethics and its significance in data science practices. The course explores the history and concept of informed consent, emphasizing the importance of respecting individuals' autonomy and privacy when collecting and analyzing data. Students will also examine data ownership issues, the protection of privacy and anonymity, and ensuring data validity. The course delves into the ethical implications of algorithmic decision-making and the importance of fairness in algorithmic outcomes. Moreover, students will explore the societal consequences of data science applications and learn about professional codes of ethics.			

### Module 34

Code	Course/Module Title	ECTS	Semester
BID321	Pattern Discovery in Bioinformatics	6.00	6
Class (hr/w)	Lect/Lab./Prac./Tutor	SSWL (hr/sem)	USWL (hr/w)
2	2	64	86
<b>Description</b>			
<p>Pattern discovery in bioinformatics involves the exploration and analysis of biological data to identify recurring patterns and meaningful relationships. Bioinformatics researchers employ computational techniques and algorithms to extract patterns from diverse biological datasets, such as DNA sequences, protein structures, gene expression data, and metabolic pathways. The goal is to uncover hidden patterns that can provide insights into biological processes, gene functions, disease mechanisms, and evolutionary relationships. Pattern discovery methods may involve data mining, machine learning, statistical analysis, and pattern recognition approaches. By deciphering patterns in bioinformatics data, scientists can make significant discoveries and advance our understanding of complex biological systems.</p>			

### Module 35

Code	Course/Module Title	ECTS	Semester
BID322	Molecular Biology and Genomics	5.00	6
Class (hr/w)	Lect/Lab./Prac./Tutor	SSWL (hr/sem)	USWL (hr/w)
2	2	64	61
<b>Description</b>			
<p>Molecular biology is a branch of biology that focuses on the study of the structure, function, and interactions of biological molecules, particularly at the molecular level. It investigates the fundamental processes that occur within cells, including DNA replication, transcription, translation, and protein synthesis. Genomics, on the other hand, is the study of genomes, which refers to the complete set of genetic material (DNA or RNA) in an organism. Genomics aims to understand the structure, function, evolution, and interactions of genes within genomes. It involves sequencing and analyzing entire genomes to decipher the genetic information encoded within them. Advances in genomics, particularly the development of high-throughput DNA sequencing technologies, have revolutionized the field of molecular biology. Genomic data provides comprehensive information about an organism's genetic makeup and enables researchers to explore gene expression patterns, identify disease-causing mutations, understand evolutionary relationships, and investigate the role of genes in health and disease. Molecular biology and genomics are closely interconnected, as genomics relies on the principles and techniques of molecular biology to decode and interpret genomic</p>			

information. Together, these fields have transformed our understanding of genetics, gene expression, and the complex molecular mechanisms that govern living organisms.

### Module 36

Code	Course/Module Title	ECTS	Semester
BMI322	machine learning	5.00	6
Class (hr/w)	Lect/Lab./Prac./Tutor	SSWL (hr/sem)	USWL (hr/w)
2	2	64	61
<b>Description</b>			

Machine Learning is a branch of Artificial Intelligence which focuses on the design of intelligent algorithms that enable a computer to learn concepts and make decisions without being explicitly programmed. These algorithms are capable of recognizing and extracting key patterns and structures in data to enable reasoning and making data-driven decisions without human involvement. Machine Learning is extensively used in our day-to-day life without even being aware of it. Few such Machine Learning driven systems include Google Search refining and customizing results, friends and products recommendation on social media, fare prediction when booking a taxi, virtual assistants such as Alexa, Siri and Google Now that learn our personal information and provide us customized service. Machine Learning has been a crucial component of our modern world which is helping a number of engineering and other industries such as manufacturing, robotics and automation, self-driving vehicle technology, healthcare, financial services, retail etc.

### Module 37

Code	Course/Module Title	ECTS	Semester
BMI323	Computer Vision	5.00	6
Class (hr/w)	Lect/Lab./Prac./Tutor	SSWL (hr/sem)	USWL (hr/w)
2	2	64	61
<b>Description</b>			

Computer Vision is one of the most exciting fields in Machine Learning and AI. It has applications in many industries, such as self-driving cars, robotics, augmented reality, and much more. In this beginner-friendly course, you will understand computer vision and learn about its various applications across many industries. As part of this course, you will utilize Python and Matlab for basic image processing and perform image classification and object detection. This is a hands-on course and involves several labs

and exercises. Labs will combine Jupyter Labs and Computer Vision Learning Studio (CV Studio), a free learning tool for computer vision. At the end of the course, you will create your own computer vision web app and deploy it to the Cloud.

### Module 38

Code	Course/Module Title	ECTS	Semester
BID411	Software Engineering	5.00	7
Class (hr/w)	Lect/Lab./Prac./Tutor	SSWL (hr/sem)	USWL (hr/w)
2	2	64	61
<b>Description</b>			
<p>Software engineering is a discipline that encompasses the systematic design, development, testing, and maintenance of software systems. It involves applying engineering principles and practices to create high-quality software that meets user requirements and solves complex problems. Software engineers utilize various methodologies, such as Agile or Waterfall, to manage the software development lifecycle. They collaborate with stakeholders to gather requirements, analyze system specifications, and design robust software architectures. Programming languages, tools, and frameworks are employed to implement and test software solutions. Software engineers also employ version control systems and follow best practices to ensure code quality, scalability, and maintainability. Continuous learning and adaptation are integral to the field, as software engineering evolves rapidly to address emerging technologies and industry demands.</p>			

### Module 39

Code	Course/Module Title	ECTS	Semester
BID412	Artificial Neural Networks	5.00	7
Class (hr/w)	Lect/Lab./Prac./Tutor	SSWL (hr/sem)	USWL (hr/w)
2	2	64	61
<b>Description</b>			
<p>Artificial Neural Networks (ANNs) are a type of computational model inspired by the structure and function of the human brain. ANNs consist of interconnected artificial neurons or nodes organized in layers. Each neuron takes input signals, applies weights to them, performs mathematical operations, and passes the result to the next layer. Through a process called training, ANNs can learn from data by adjusting the weights between neurons, enabling them to make predictions or classify new inputs. ANNs are widely used in various fields, including image and speech recognition, natural language processing, pattern recognition, and machine learning. Their ability to learn and generalize from data makes them powerful tools for solving complex problems and</p>			

making intelligent decisions.

#### Module 40

Code	Course/Module Title	ECTS	Semester
BID413	Human Diseases	5.00	7
Class (hr/w)	Lect/Lab./Prac./Tutor	SSWL (hr/sem)	USWL (hr/w)
2	2	64	61
<b>Description</b>			
<p>Disease or a disorder is the result of an abnormal change or disturbance in the structure or function of an organ or organ systems. This can be something as minor as a cold or something as serious as cancer. Diseases can either be acute or chronic. Acute diseases are temporary, and the affected person is expected to recover from them. Chronic diseases continue for a long period of time and can sometimes last for the person's entire lifetime. Depending on their causes, diseases can be divided into certain categories including infectious diseases, degenerative diseases, nutritional diseases, metabolic or endocrine diseases, immune diseases, neoplastic diseases, and psychiatric diseases. Early diagnosis and treatment is essential for the best possible outcome in most cases of disease.</p>			

#### Module 41

Code	Course/Module Title	ECTS	Semester
BMI412	Data Mining	5.00	7
Class (hr/w)	Lect/Lab./Prac./Tutor	SSWL (hr/sem)	USWL (hr/w)
2	2	64	61
<b>Description</b>			
<p>Data mining is a process of extracting, from a large amount of data, interesting patterns that are non-trivial, hidden, new and potentially useful. This course provides a comprehensive exploration of various data mining techniques and hands-on experience with a state-of-the-art data-mining tool. Students will learn the fundamentals of data mining and the knowledge discovery process. The course covers topics such as data description, data pre-processing, attribute selection, market basket analysis, association rules, classification, clustering, outlier detection, post-processing, and the social impact and trends of data mining. Through practical exercises, students will gain the skills to use data-mining tools effectively and evaluate the quality of the knowledge</p>			

discovered. By the end of the course, students will be equipped with the knowledge and expertise to apply data mining techniques in real-world scenarios and uncover valuable insights from large datasets.

#### Module 42

Code	Course/Module Title	ECTS	Semester
BMI411	Cloud Computing	5.00	7
Class (hr/w)	Lect/Lab./Prac./Tutor	SSWL (hr/sem)	USWL (hr/w)
2	2	64	61
<b>Description</b>			
<p>The Cloud Computing course explores essential concepts and technologies related to cloud platforms. Students delve into clustering, which ensures built-in redundancy and failover mechanisms in cloud environments. Grid computing is covered, focusing on organizing computing resources into logical pools to create a high-performance distributed grid. Virtualization is introduced as a technology for creating virtual instances of IT resources, enabling resource sharing among multiple users. The course also provides an understanding of clouds as distinct IT environments designed for remote provisioning of scalable and measured resources. By studying these topics, students gain the knowledge and skills needed to effectively utilize cloud platforms and harness the benefits of scalability, reliability, and flexibility in modern computing environments.</p>			

#### Module 43

Code	Course/Module Title	ECTS	Semester
BMI410	Project I	5.00	7
Class (hr/w)	Lect/Lab./Prac./Tutor	SSWL (hr/sem)	USWL (hr/w)
2	-	32	93
<b>Description</b>			
<p>The Project I course, conducted during the seventh semester, allows students to choose a research project title and supervisor. Under the guidance of their supervisors, students receive support in understanding the project's direction and fulfilling the necessary tasks for progress. Through Project I, students develop crucial skills in project planning, research methodology, critical thinking, and problem-solving. They learn to manage time, resources, and data collection effectively. This course serves as a significant milestone, fostering intellectual growth and preparing students for more advanced research in Project II.</p>			

**Module 44**

Code	Course/Module Title	ECTS	Semester
BID421	Computer-Aided Drug Design	5.00	8
Class (hr/w)	Lect/Lab./Prac./Tutor	SSWL (hr/sem)	USWL (hr/w)
2	2	64	61
<b>Description</b>			
Computer-aided drug design (CADD) includes finding, developing, and analyzing medicines and related biological active compounds by computer methodologies. The use of CADD methodologies speeds up the early stages of chemical development while guiding and speeding up drug discovery. Virtual screening, virtual library design, lead optimization, de novo design and other computational approaches are all covered in CADD. It is a reasonable and methodical technique that concentrates scientists' attention on the most promising chemicals, eliminating the effort needed to test their potency in synthetic and biological laboratories. This chapter contains in-depth information on retrieving data from databases such as PubChem, DrugBank, Zinc DB, RCSB-PDB and ModBase.alos laboratory study of making drugs such as aspirin and paracetamol in the laboratory.			

**Module 45**

Code	Course/Module Title	ECTS	Semester
BID422	Convolutional Neural Network	6.00	8
Class (hr/w)	Lect/Lab./Prac./Tutor	SSWL (hr/sem)	USWL (hr/w)
2	2	64	61
<b>Description</b>			
The Convolutional Neural Networks course provides a comprehensive introduction to deep learning, focusing on the core concepts and practical implementation using TensorFlow. Students will learn about neural networks, TensorFlow basics, and delve into Convolutional Neural Networks (CNNs) for feature extraction. Through hands-on lab sessions, they will gain experience in building, training, and evaluating CNN models on various datasets. By the end of the course, students will have the skills to effectively utilize TensorFlow and develop CNN models for tasks like image classification and object detection. This course serves as a solid foundation for further exploration of advanced deep learning architectures and their real-world applications.			

**Module 46**

Code	Course/Module Title	ECTS	Semester
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BMI422	Information Security	5.00	8
<b>Class (hr/w)</b>	<b>Lect/Lab./Prac./Tutor</b>	<b>SSWL (hr/sem)</b>	<b>USWL (hr/w)</b>
2	2	64	61
<b>Description</b>			
<p>This course covers information security principles, an area of study that engages in protecting the confidentiality, integrity, and availability of information. Information security continues to grow with advancements in technology – as technology advances, so do threats, attacks, and our efforts to mitigate them. In this course, we discuss the modes of threats and attacks on information systems. We also discuss an important area of threat mitigation that saw rapid development in the twentieth century: cryptography. Information security is concerned with user identification and authentication and access control based on individual or group privileges. The basic access control models and the fundamentals of identification and authentication methods are included in this course..</p>			

#### Module 47

Code	Course/Module Title	ECTS	Semester
BID423	Computational Biology	5.00	8
<b>Class (hr/w)</b>	<b>Lect/Lab./Prac./Tutor</b>	<b>SSWL (hr/sem)</b>	<b>USWL (hr/w)</b>
2	2	64	61
<b>Description</b>			
<p>Computational biology plays a crucial role in advancing our understanding of biological systems, unraveling the complexities of life, and addressing important scientific questions. It enables the integration of diverse biological data types, the development of predictive models, and the generation of hypotheses for experimental validation. Molecular docking and molecular dynamics simulation are two computational techniques used in the field of bioinformatics and computational biology to study the interactions and dynamics of molecules, particularly proteins and small molecules (ligands). They provide a detailed understanding of molecular structures, energetics, and dynamics, which can help guide experimental studies and rationalize the design of novel therapeutics.</p>			

#### Module 48

Code	Course/Module Title	ECTS	Semester
BMI421	Big Data Analytics	5.00	8
<b>Class (hr/w)</b>	<b>Lect/Lab./Prac./Tutor</b>	<b>SSWL (hr/sem)</b>	<b>USWL (hr/w)</b>
2	2	64	61

Description			
<p>Big data in biology involves the application of large-scale data analysis techniques to study biological systems. It encompasses the collection, storage, and analysis of vast amounts of biological data, including genomic sequences, gene expression patterns, protein structures, and clinical information. This field has emerged due to advancements in high-throughput technologies that generate massive datasets. Big data analysis in biology enables researchers to uncover patterns, identify genetic variations, understand molecular mechanisms, and gain insights into disease processes. By harnessing the power of big data, scientists can make significant strides in understanding complex biological systems and improving human health.</p>			

#### Module 49

Code	Course/Module Title	ECTS	Semester
BMI420	Project II	5.00	8
Class (hr/w)	Lect/Lab./Prac./Tutor	SSWL (hr/sem)	USWL (hr/w)
2	-	32	93

Description			
<p>Project II, offered in the final semester, focuses on students building the practical component of their research project while receiving support from their supervisor. They work closely with their supervisor to execute experiments, develop software, perform data analysis, and implement the practical aspects of their project. Simultaneously, students finalize and complete the research report with the guidance of their supervisor, who provides feedback and ensures adherence to academic standards. Project II allows students to showcase their research skills, project management abilities, critical thinking, and written communication. It serves as a platform to demonstrate their research capabilities and prepares them for their future academic or professional pursuits.</p>			

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