SYLLABUSES FOR THE DEGREE OF
BACHELOR OF SCIENCE IN BIOINFORMATICS
BSC(BIOINFORMATICS)

These syllabuses are applicable to candidates admitted under the 4-year BSc(Bioinformatics) curriculum in the academic year 2022-23 and thereafter.

Curriculum Structure

1. Courses for BSc(Bioinformatics) Major (96 credits)

   Students are required to complete a total of 96 credits of courses for the Bioinformatics major, of which the 3 anchoring courses, 6 foundation courses, 1 or 2 data science laboratory course(s) and the final year project course are prescribed.

   Prescribed courses (66 credits)

   - *Anchoring Courses (18 credits)*

		Year	Credits
BIOF1001	Introduction to Biomedical Data Science	1	6
BIOF2001	Artificial Intelligence in Medicine	2/3	6
BIOF3001	Big Data Biomedical Informatics	3/4	6

   - *Foundation Courses (36 credits)*

		Year	Credits
BIOC1600	Perspectives in Biochemistry	1	6
COMP1117	Computer Programming	1	6
MATH1013	University Mathematics II	1	6
MATH2014	Multivariable Calculus and Linear Algebra	2	6
STAT2601	Probability and Statistics I	2	6
STAT2602	Probability and Statistics II	2	6

   - *Project: Capstone Experience (12 credits)*

		Year	Credits
BIOF4001	Final Year Project	4	12

   Disciplinary Elective Courses (30 credits)

   List A (Data Science Laboratory Courses) Select 1 course (6 credits) or both courses (12 credits) from the list below:

		Year	Credits
BIOF3002	Genome Sequencing and Analysis	3/4	6
BIOF3003	Digital Health	3/4	6

   List B (Disciplinary Electives) Select any 4 from the list below (24 credits) or 3 if both courses were selected from List A (18 credits):

		Year	Credits
BBMS2003	Human Genetics	2	6
BBMS2007	Essential Molecular Biology	2	6
BIOC2600	Basic Biochemistry	2	6
COMP2113	Programming Technologies	2	6
COMP2119	Introduction to Data Structures and Algorithms	2	6
BBMS3008	Essential Proteomics	3/4	6

BBMS3009	Genome Science	3/4	6
BBMS4004	Public Health Genetics	3/4	6
BIOC3605	Sequence Bioinformatics	3/4	6
BIOF3004	Bioinformatics Internship	3/4	6
BIOF3005	Structural Bioinformatics	3/4	6
BIOF3006	Biomedical Software Systems	3/4	6
BIOF4002	Global Health Informatics	3/4	6
BIOF4003	Biomedical Image Informatics	3/4	6
COMP3314	Machine Learning	3/4	6
COMP3317	Computer Vision	3/4	6
COMP3353	Bioinformatics	3/4	6
STAT3600	Linear Statistical Analysis	3/4	6
STAT3612	Statistical Machine Learning	3/4	6
STAT4602	Multivariate Data Analysis	3/4	6
STAT4609	Big Data Analytics	3/4	6

2. Common Core Courses (36 credits)

   Students are required to complete 6 Common Core courses (6-credit each) by the end of the second year, comprising at least one and not more than two courses from each Area of Inquiry with not more than 24 credits of courses being selected within one academic year except where candidates are required to make up for failed credits.

3. Language Enhancement Courses (18 credits)

   Students are required to complete 2 English Language courses (6-credit each), including 6 credits of Core University English[1] and 6 credits of English-in-the-Discipline course, and 1 Chinese Language course (6-credit)[2], within the first and second years of the curriculum in accordance with the Regulations for First Degree Curricula of the University.

4. Minors and/or Electives (90 credits)

   Apart from taking the 96 credits of courses for the Bioinformatics major as specified in paragraph 1, plus the Common Core courses (36 credits) and the Language Enhancement courses (18 credits), students can plan their study with the remaining credits (i.e. 90 credits) in various manners, subject to timetable constraints and approval of the host Faculties. Those interested in enriching and deepening their understanding on topics in the field of bioinformatics may opt to take a minor and/or electives offered within the BSc(Bioinformatics) curriculum, while those who would like to broaden their knowledge base outside the realm of bioinformatics can consider a minor and/or

[1] Candidates who have achieved Level 5 or above in English Language in the Hong Kong Diploma of Secondary Education Examination, or equivalent, are exempted from this requirement, and Core University English is optional. Those who do not take this course should take an elective course in lieu, see Regulation UG6.

[2] Students are required to successfully complete the 6-credit Faculty-specific Chinese language enhancement course, except for:

(a) Putonghua-speaking students who should take CUND9002 (Practical Chinese and Hong Kong Society) or CUND9003 (Cantonese for Non-Cantonese Speaking Students); and

(b) students who have not studied Chinese language during their secondary education or who have not attained the requisite level of competence in the Chinese language to take CEMD9008 Practical Chinese for Biomedical Sciences Students should write to the Faculty Board to apply for exemption from the Chinese language requirement, and

   (i) take a 6-credit Cantonese or Putonghua language course offered by the School of Chinese especially for international and exchange students; OR

   (ii) take an elective course in lieu.

electives offered in other curricula.

Two minor options are offered in the BSc(Bioinformatics) curriculum.

Minor in Digital Health (36 credits) – any 6 courses from the following list

		Year	Credits
Select at least two courses from this list			
BIOF1001	Introduction to Biomedical Data Science	1	6
BIOF2001	Artificial Intelligence in Medicine	2/3	6
BIOF3003	Digital Health	3/4	6
BIOF3006	Biomedical Software Systems	3/4	6
BIOF4002	Global Health Informatics	3/4	6
BIOF4003	Biomedical Image Informatics	3/4	6
Select at least two courses from this list			
BMED2500	Biomedical Signal and Linear Systems	2/3	6
COMP3314	Machine Learning	3/4	6
COMP3317	Computer Vision	3/4	6
BMED4500	Biomedical Instrumentation and Systems	4	6
BMED4504	Biomedical Signals Processing and Modeling in Biomedical Applications	4	6

Minor in Biomedical Data Science (36 credits) – any 6 courses from the following list

		Year	Credits
Select at least two courses from this list			
BIOF1001	Introduction to Biomedical Data Science	1	6
COMP1117	Computer Programming	1	6
STAT1005	Essential Skills for Undergraduates: Foundations of Data Science	1	6
STAT1600	Statistics: Ideas and Concepts	1	6
BIOF2001	Artificial Intelligence in Medicine	2/3	6
STAT2604	Introduction to R Programming and Elementary Data Analysis	2/3	6
BIOF3001	Big Data Biomedical Informatics	3/4	6
BIOF3002	Genome Sequencing and Analysis	3/4	6
BIOF3005	Structural Bioinformatics	3/4	6
BIOF3006	Biomedical Software Systems	3/4	6
BIOF4002	Global Health Informatics	3/4	6
BIOF4003	Biomedical Image Informatics	3/4	6
Select at least two courses from this list			
BIOC1600	Perspectives in Biochemistry	1	6
BBMS2003	Human Genetics	2	6
BBMS2007	Essential Molecular Biology	2	6
BBMS3002	Molecular Biology of the Cell	3/4	6
BBMS3008	Essential Proteomics	3/4	6
BBMS3009	Genome Science	3/4	6
BBMS4003	Developmental Genetics	3/4	6
BBMS4004	Public Health Genetics	3/4	6
BIOC3605	Sequence Bioinformatics	3/4	6
BIOC4612	Molecular Biology of the Gene	3/4	6

Note:

(1) Students who have taken the course(s) for the major will not be allowed to claim credits awarded for the same courses to fulfill the requirements of the minor option.

(2) All elective courses may only be offered in alternate years; students should check on course availability and course prerequisites.

COURSE DESCRIPTIONS

Prescribed Courses: Anchoring Courses

BIOF1001 Introduction to Biomedical Data Science **Year 1 (6 credits)**

This course aims to introduce students to a variety of common biomedical data and practical skills to perform exploratory data analysis on these data. Data analysis skills such as data preprocessing, data quality assessment, data visualisation and clustering will be introduced. The role of modern data analytics in the scientific process and medical applications will be examined. The ethical issues related to collection, sharing and integration of big data will also be discussed.
Assessment: 70% continuous assessment; 30% examination.

BIOF2001 Artificial Intelligence in Medicine **Year 2 or 3 (6 credits)**

This course aims to introduce students to key concepts in artificial intelligence (AI) and practical machine learning techniques that are applicable to biomedical research and healthcare applications. Using a problem-oriented approach, students will learn how to frame biomedical problems using a machine learning framework, collect relevant data, perform model training and evaluation, and deploy an AI system in the real-world. The course will also explore the social and ethical impact of digital health and AI technology in medicine and the scientific process.
Prerequisite: Eligible for students who have successfully completed one of the following courses: BIOF1001, STAT1005, COMP1117 or STAT2604, or are enrolled in STAT2604.
Assessment: 80% continuous assessment; 20% examination.

BIOF3001 Big Data Biomedical Informatics **Year 3 or 4 (6 credits)**

This course uses a problem-based approach to introduce analytical skills to tackle practical biomedical problems via integration of diverse biomedical big data. Students will be given structured scenarios in groups to solve a variety of biomedical problems using diverse data types. These may include data from genome sequencing and non-sequencing-based omics, electronic medical records, wearable/IoT technology, medical imaging, and social media. In the course, the students will learn the theory (algorithm, statistics), and hands-on skills (data collection, programming, data analysis, visusalisation) to support integrative data analysis tasks.
Prerequisite: Eligible for students who have successfully completed or are enrolled in BIOF2001.
Assessment: 100% continuous assessment including reports, presentation, and projects.

Prescribed Courses: Foundation Courses

BIOC1600 Perspectives in Biochemistry **Year 1 (6 credits)**

This course aims to teach students a biochemical perspective on each of the Basic Sciences focusing on concepts fundamental to the learning of Biochemistry and promote deep learning of course material through an integrated programme of practical and collaborative tasks. Students will be inspired with a view of the great discoveries and future challenges for Biochemistry and helped to make the transition from school to university by developing their teamwork, independent study skills and confidence to communicate within a Biochemistry learning environment.

Prerequisite: Eligible for students who have attained Level 3 or above in HKDSE Biology, Chemistry, or Combined Science with Biology or Chemistry component, or equivalent.
Assessment: 50% continuous assessment; 50% examination.

COMP1117 Computer Programming **Year 1 (6 credits)**

This is an introductory course in computer programming. Students will acquire basic Python programming skills, including syntax, identifiers, control statements, functions, recursions, strings, lists, dictionaries, tuples and files. Searching and sorting algorithms, such as sequential search, binary search, bubble sort, insertion sort and selection sort, will also be covered.
Mutually exclusive with: ENGG1111 or ENGG1330
Assessment: 70% continuous assessment; 30% examination.

MATH1013 University Mathematics II **Year 1 (6 credits)**

This course aims at students with Core Mathematics plus Module 1 or Core Mathematics plus Module 2 background and provides them with basic knowledge of calculus and some linear algebra that can be applied in various disciplines.
Prerequisite: Eligible for students who have attained Level 2 or above in Module 1, or Module 2 of HKDSE Mathematics or equivalent, or successfully completed MATH1009 or MATH1011.
Assessment: 50% continuous assessment; 50% examination.
Remark: Not eligible for students who have successfully completed MATH1821, or MATH1851 and MATH1853, or are enrolled in one of the following courses: MATH1821, MATH1851 or MATH1853.

MATH2014 Multivariable Calculus and Linear Algebra **Year 2 (6 credits)**

This course aims to provide students with a solid foundation in calculus of several variables and linear algebra, which they will need in the study of mathematics related subjects.
Prerequisite: Eligible for students who have successfully completed MATH1013.
Assessment: 50% test; 50% examination.

STAT2601 Probability and Statistics I **Year 2 (6 credits)**

The discipline of statistics is concerned with situations in which uncertainty and variability play an essential role and forms an important descriptive and analytical tool in many practical problems. Against a background of motivating problems this course develops relevant probability models for the description of such uncertainty and variability.
Prerequisite: Eligible for students who have successfully completed or are enrolled in MATH2014.
Assessment: 30% continuous assessment; 70% examination.
Remark: Not eligible for students who have successfully completed or are enrolled in STAT1603 or STAT2901.

STAT2602 Probability and Statistics II **Year 2 (6 credits)**

This course builds on STAT2601, introducing further the concepts and methods of statistics. Emphasis is on the two major areas of statistical analysis: estimation and hypothesis testing. Through the disciplines of statistical modelling, inference and decision making, students will be equipped with both quantitative skills and qualitative perceptions essential for making rigorous statistical analysis of real-life data.

Prerequisite: Eligible for students who have successfully completed STAT2601.
Assessment: 25% continuous assessment; 75% examination.

Prescribed Course: Project

BIOF4001 Final Year Project **Year 4 (12 credits)**

The course involves around 300 students' learning hours spreading over 2 semesters. Each student is required to carry out an in-depth study of a specialist field of bioinformatics under the guidance of a supervisor who will provide continuous assessment on the student's performance (15%). The project entails about 100 hours to write up a dissertation (10,000 words) and to give a professional presentation (20 minutes), which accounts for 60% and 25% of the final assessment, respectively. The research project also constitutes the capstone experience for the student.
Prerequisite: Eligible for students who have successfully completed or are enrolled in BIOF3001.
Assessment: 15% continuous assessment; 25% oral presentation; 60% dissertation.

Language Courses

CAES1000 Core University English **Year 1 (6 credits)**

The Core University English (CUE) course aims to enhance first-year students' academic English language proficiency in the university context. CUE focuses on developing students' academic English language skills for the Common Core Curriculum. These include the language skills needed to understand and produce spoken and written academic texts, express academic ideas and concepts clearly and in a well-structured manner and search for and use academic sources of information in their writing and speaking. Four online-learning modules through the Moodle platform on academic speaking, academic grammar, academic vocabulary, citation and referencing skills and avoiding plagiarism will be offered to students to support their English learning. This course will help students to participate more effectively in their first-year university studies in English, thereby enriching their first-year experience.
Assessment: 100% continuous assessment.

CEMD9008 Practical Chinese for Biomedical Sciences Students **Year 1 (6 credits)**

This course is designed specifically to raise the students' level of proficiency in the use of the Chinese language in the field of biomedical sciences. It aims at sharpening the students' skills both of writing documents (such as letters, brochures, leaflets, reports and proposals) and of effectively interacting with professional practitioners and members of the public in Chinese. There are also drilling practices to familiarize the students with the simplified forms of some basic Chinese biomedical terms.
Assessment: 50% continuous assessment; 50% examination.

CAES9722 Academic English for Biomedical Sciences Students **Year 2 (6 credits)**

This six credit English-in-the-Discipline course is offered to second year students studying Biomedical Sciences. It helps students develop the necessary skills to use both written and spoken English within their studies and beyond. Students will learn to better communicate and discuss scientific concepts with other biomedical scientists as well as to a wider audience. In the writing component, students will learn how to disseminate recent scientific research in the form of a popular science article as well

as a wiki article for a novice scientist audience. In the speaking component, students will present information from their research in an oral presentation format.
Assessment: 100% continuous assessment.

Disciplinary Elective Courses (List A: Data Science Laboratory Courses)

BIOF3002 Genome Sequencing and Analysis **Year 3 or 4 (6 credits)**

This course aims to give students end-to-end experience in high throughput genome sequencing from sample preparation, sequencing to data analysis using a portable DNA sequencing device. Students will gain hands-on knowledge of how portable DNA sequencers generate genomics data. Using these datasets, the students will then apply bioinformatics analyses to answer specific biological questions. This course will also provide students with knowledge of current publicly available genomic resources.
Prerequisite: Eligible for students who have successfully completed BIOF1001 plus completed or are enrolled in BBMS3009.
Assessment: 100% continuous assessment including project reports and presentation.

BIOF3003 Digital Health **Year 3 or 4 (6 credits)**

This course aims to give students practical experience in collecting, analysing, and evaluating data generated from modern digital health technology, such as wearable devices, mobile smartphones, images, text, as well as structured data from electronic medical record. In this project-oriented course, student experiences how to develop a data collection strategy, process sensor data, images, and text, as well as performing evaluation. Students will learn how to develop a mobile application to solve specific biomedical problems.
Prerequisite: Eligible for students who have successfully completed one of the following courses: BIOF2001, STAT2602 or COMP2119, or are enrolled in BIOF2001.
Assessment: 100% continuous assessment including project reports and presentation.

Disciplinary Elective Courses: List B

BBMS2003 Human Genetics **Year 2 (6 credits)**

To present an extensive introduction to the principles of genetics, illustrate how they operate in humans with examples, and discuss the applications of these in medical and clinical genetics. Topics include the Mendel's laws of genetics, the basic patterns of Mendelian inheritance in humans, the construction and the analysis of a pedigree, single gene and polygenic inheritance, multifactorial traits and heritability, cytogenetics, karyotypes, structural changes in chromosomes, and non-Mendelian inheritance. Concepts of genetic variations in human populations and Hardy-Weinberg equilibrium will also be presented.
Prerequisite: Eligible for students who have successfully completed BBMS1001 or BIOC1600.
Assessment: 30% continuous assessment; 70% examination.

BBMS2007 Essential Molecular Biology **Year 2 (6 credits)**

This course aims to enable the students to understand the basics in molecular biology including the process and machineries involving in the storage, utilization and maintenance of the genetic information and the corresponding genomes.
Prerequisite: Eligible for students who have successfully completed BIOC1600.

Assessment: 40% continuous assessment; 60% examination.

BIOC2600 Basic Biochemistry **Year 2 (6 credits)**

This course is designed to present an overview of biochemistry of fundamental importance to the life process. We aim to develop appreciation of the basics in biochemistry as a common ground for science and non-science students to progress into their areas of specialization. Students intending to pursue further studies in Biochemistry and Molecular Biology will find this course particularly helpful.
Prerequisite: Eligible for students who have successfully completed BIOC1600.
Assessment: 40% coursework; 60% examination.
Remark: Not eligible for students who have successfully completed or are enrolled in one of the following courses: BIOL2220, MEDE2301 or BMED2301.

COMP2113 Programming Technologies **Year 2 (6 credits)**

This course covers intermediate to advanced computer programming topics on various technologies and tools that are useful for software development. Topics include Linux shell commands, shell scripts, C/C++ programming, and separate compilation techniques and version control. This is a self-learning course; there will be no lecture and students will be provided with self-study materials. Students are required to complete milestone-based self-assessment tasks during the course.
This course is designed for students who are interested in Computer Science / Computer Engineering.
Prerequisite: Eligible for students who have successfully completed COMP1117.
Assessment: 30% written examination; 70% continuous assessment.

COMP2119 Introduction to Data Structures and Algorithms **Year 2 (6 credits)**

Arrays, linked lists, trees and graphs; stacks and queues; symbol tables; priority queues, balanced trees; sorting algorithms; complexity analysis.
Prerequisite: Eligible for students who have successfully completed COMP2113 or COMP2123.
Assessment: 40% continuous assessment; 60% examination.

BBMS3008 Essential Proteomics **Year 3 or 4 (6 credits)**

This course will introduce protein structure and contemporary proteomics relevant to biomedical sciences. Protein structure will include protein structure classification and identification, protein modelling, and structure determination by X-ray crystallography and cryo-EM. Proteomics will include protein mass spectrometry, isotope labelling, and protein-protein interaction techniques.
Prerequisite: Eligible for students who have successfully completed one of the following courses: BBMS2007, BIOC2600, BIOL2220 or BIOL3401.
Assessment: 50% continuous assessment; 50% examination.

BBMS3009 Genome Science **Year 3 or 4 (6 credits)**

This course will present topics applicable to human genetics and genomic biology in the "post-genome" era. Main topics include The Human Genome Project; technologies for genomic analysis such as microarrays and high-throughput sequencing; and bioinformatics for handling, analysing and interpreting genomic data, making use of standard analysis programs and public genomic resources such as the HapMap, 1000 Genome, ENCODE and Epigenetic Roadmap. We also show how the

application of genome science to human diseases has led to improved understanding of disease aetiology and mechanisms. Students will gain knowledge and understanding in genomics that will be useful in their future career, be it in science or industry.
Prerequisite: Eligible for students who have successfully completed BIOL2102 and one of the following courses: BBMS2003, BBMS2007, BIOL3401 or BIOL3408.
Assessment: 40% coursework; 60% examination.

BBMS4004 Public Health Genetics **Year 3 or 4 (6 credits)**

Public health genetics is the study of variation in the genome, its inheritance, and its contribution to health and disease. The main features of public health genetics research will be highlighted including how genetic and environmental factors play a role in disease susceptibility; emergence of biobanks; cancer genomics; precision medicine; and Mendelian randomisation. This course will also discuss the use of genetic epidemiology in the study of human diseases, the use of genetic testing in the diagnosis and screening of diseases as well as the use of genetic information in the treatment of diseases. It will also explore the ethical, legal and policy questions raised when applying genomics to health care.
Prerequisite: Eligible for students who have successfully completed STAT2601 and BBMS2003.
Assessment: 100% continuous assessment.

BIOC3605 Sequence Bioinformatics **Year 3 or 4 (6 credits)**

This course will examine existing bioinformatics tools for DNA and protein sequence analysis. The underlying principles of these analysis programs and services will be presented. Students will learn how to retrieve, analyze, and compare protein and DNA sequences using bioinformatics tools available on the internet. A basic introduction to the principles and tools for the analysis of next generation sequencing data will also be presented.
Prerequisite: Eligible for students who have successfully completed one of the following courses: BIOC2600, BIOL2220, BBMS2003 or BBMS2007.
Assessment: 30% coursework; 70% examination.

BIOF3004 Bioinformatics Internship **Year 3 or 4 (6 credits)**

This course will offer students the opportunity to gain work experience in the industry relating to bioinformatics and health data science. The workplace learning experience will enable students to apply knowledge gained during their studies in real work environments. Students have to take on approximately 160 hours of internship work either within the University or outside the University with the approval of the course coordinator.
Prerequisite: Eligible for students who have successfully completed BIOF2001.
Assessment: 100% continuous assessment including written report and oral presentation.

BIOF3005 Structural Bioinformatics **Year 3 or 4 (6 credits)**

This course will introduce theory and computational methods for determining, analysing, comparing and predicting the structure of DNA, chromatin, RNA, and proteins. It covers the biophysical basis of structural determination and prediction, as well as modern machine learning methods for molecular structure prediction and analysis.
Prerequisite: Eligible for students who have successfully completed BIOF2001 and BIOC1600.
Assessment: 70% continuous assessment; 30% examination.

BIOF3006 Biomedical Software Systems **Year 3 or 4 (6 credits)**

There are many software systems in modern biomedical data sciences – from standalone bioinformatics software, molecular sequence databases, web services, electronic health record system, telehealth system, mobile app, cloud-based systems, and embedded software in wearable devices. This course introduces design principles and practical hands-on experience in designing and evaluating various biomedical software systems. It will also discuss the impact of biomedical software in the healthcare system and scientific process.
Prerequisite: Eligible for students who have successfully completed COMP2119.
Assessment: 100% continuous assessment and project.

BIOF4002 Global Health Informatics **Year 3 or 4 (6 credits)**

This course aims to present key biostatistical, computational, and epidemiology concepts and techniques that are useful for monitoring, modelling, predicting, and managing infectious and non-communicable diseases. This course will introduce practical techniques for data collection, data analysis, and predictive modelling for global health applications. This course will also discuss issues related to communication of public health information, and formulation of public health policy.
Prerequisite: Eligible for students who have successfully completed BIOF3001.
Assessment: 70% continuous assessment; 30% examination.

BIOF4003 Biomedical Image Informatics **Year 3 or 4 (6 credits)**

This course aims to introduce common medically relevant images data, and computational techniques to process them. Image processing and computer vision techniques will be introduced.
Prerequisite: Eligible for students who have successfully completed BIOF2001.
Assessment: 70% continuous assessment; 30% examination.

COMP3314 Machine Learning **Year 3 or 4 (6 credits)**

This course introduces algorithms, tools, practices, and applications of machine learning. Topics include core methods such as supervised learning (classification and regression), unsupervised learning (clustering, principal component analysis), Bayesian estimation, neural networks; common practices in data pre-processing, hyper-parameter tuning, and model evaluation; tools/libraries/APIs such as scikit-learn, Theano/Keras, and multi/many-core CPU/GPU programming.
Prerequisite: Eligible for students who have successfully completed MATH1853 or MATH2101, and COMP2119 or ELEC2543.
Assessment: 50% continuous assessment; 50% examination.

COMP3317 Computer Vision **Year 3 or 4 (6 credits)**

This course introduces the principles, mathematical models and applications of computer vision. Topics include: image processing techniques, feature extraction techniques, imaging models and camera calibration techniques, stereo vision, and motion analysis.
Prerequisite: Eligible for students who have successfully completed COMP2119, and MATH1853 or MATH2101.
Assessment: 50% continuous assessment; 50% examination.

COMP3353 Bioinformatics **Year 3 or 4 (6 credits)**

The goal of the course is for students to be grounded in basic bioinformatics, concepts, algorithms, tools, and databases. Students will be leaving the course with hands-on bioinformatics analysis experience and empowered to conduct independent bioinformatics analyses. We will study: 1) algorithms, especially those for sequence alignment and assembly, which comprise the foundation of the rapid development of bioinformatics and DNA sequencing; 2) the leading bioinformatics tools for comparing and analyzing genomes starting from raw sequencing data; 3) the functions and organization of a few essential bioinformatics databases and learn how they support various types of bioinformatics analysis.
Prerequisite: Eligible for students who have successfully completed COMP1117 or ENGG1330.
Assessment: 70% continuous assessment; 30% examination.

STAT3600 Linear Statistical Analysis **Year 3 or 4 (6 credits)**

The analysis of variability is mainly concerned with locating the sources of the variability. Many statistical techniques investigate these sources through the use of 'linear' models. This course presents the theory and practice of these models.
Prerequisite: Eligible for students who have successfully completed STAT2602.
Assessment: 25% coursework; 75% examination
Remark: Not eligible for students who have successfully completed or are enrolled in STAT3907.

STAT3612 Statistical Machine Learning **Year 3 or 4 (6 credits)**

Machine learning is the study of computer algorithms that build models of observed data in order to make predictions or decisions. Statistical machine learning emphasizes the importance of statistical theory and methodology in the algorithmic development. This course provides a comprehensive and practical coverage of essential machine learning concepts and a variety of learning algorithms under supervised and unsupervised settings. The course materials are presented with lots of examples and reproducible codes.
Prerequisite: Eligible for students who have successfully completed one of the following courses: STAT2602, STAT3902, or STAT1603 and any University level 2 course; plus completed or are enrolled in STAT3600 or STAT3907.
Assessment: 100% coursework.
Remark: Not eligible for students who have successfully completed or are enrolled in STAT4904.

STAT4602 Multivariate Data Analysis **Year 3 or 4 (6 credits)**

In many designed experiments or observational studies, the researchers are dealing with multivariate data, where each observation is a set of measurements taken on the same individual. These measurements are often correlated. The correlation prevents the use of univariate statistics to draw inferences. This course develops the statistical methods for analysing multivariate data through examples in various fields of application and hands-on experience with the statistical software SAS.
Prerequisite: Eligible for students who have successfully completed STAT3600 or STAT3907.
Assessment: 40% coursework; 60% examination.

STAT4609 Big Data Analytics **Year 3 or 4 (6 credits)**

In the past decade, huge volume of data with highly complicated structure has appeared in every aspect, such as social web logs, e-mails, video, speech recordings, photographs, tweets and others. The efficient extraction of valuable information from these data sources becomes a challenging task.

This course focuses on the practical knowledge and skills of some advanced analytics and statistical modeling for solving big data problems.
Prerequisite: Eligible for students who have successfully completed STAT3612 or STAT4904.
Assessment: 100% coursework.

Courses for Minor in Digital Health

BIOF1001 Introduction to Biomedical Data Science **Year 1 (6 credits)**

This course aims to introduce students to a variety of common biomedical data and practical skills to perform exploratory data analysis on these data. Data analysis skills such as data preprocessing, data quality assessment, data visualisation and clustering will be introduced. The role of modern data analytics in the scientific process and medical applications will be examined. The ethical issues related to collection, sharing and integration of big data will also be discussed.
Assessment: 70% continuous assessment; 30% examination.

BIOF2001 Artificial Intelligence in Medicine **Year 2 or 3 (6 credits)**

This course aims to introduce students to key concepts in artificial intelligence (AI) and practical machine learning techniques that are applicable to biomedical research and healthcare applications. Using a problem-oriented approach, students will learn how to frame biomedical problems using a machine learning framework, collect relevant data, perform model training and evaluation, and deploy an AI system in the real-world. The course will also explore the social and ethical impact of digital health and AI technology in medicine and the scientific process.
Prerequisite: Eligible for students who have successfully completed one of the following courses: BIOF1001, STAT1005, COMP1117 or STAT2604, or are enrolled in STAT2604.
Assessment: 80% continuous assessment; 20% examination.

BMED2500 Biomedical Signals and Linear Systems **Year 2 or 3 (6 credits)**

Signals and linear system theory is fundamental to all engineering discipline, especially in the field of electrical, computer and medical engineering. This is a first course in signals and linear systems for engineering students without any pre-requisite knowledge in signal theory or signal processing other than some knowledge in fundamental calculus and use of complex numbers. The course uses simple real life examples of signals and systems to illustrate how signal theory can be used in practical application.
Assessment: 40% coursework; 60% examination.

BIOF3003 Digital Health **Year 3 or 4 (6 credits)**

This course aims to give students practical experience in collecting, analysing, and evaluating data generated from modern digital health technology, such as wearable devices, mobile smartphones, images, text, as well as structured data from electronic medical record. In this project-oriented course, student experiences how to develop a data collection strategy, process sensor data, images, and text, as well as performing evaluation. Students will learn how to develop a mobile application to solve specific biomedical problems.
Prerequisite: Eligible for students who have successfully completed one of the following courses: BIOF2001, STAT2602 or COMP2119, or are enrolled in BIOF2001.
Assessment: 100% continuous assessment including project reports and presentation.

BIOF3006 Biomedical Software Systems **Year 3 or 4 (6 credits)**

There are many software systems in modern biomedical data sciences – from standalone bioinformatics software, molecular sequence databases, web services, electronic health record system, telehealth system, mobile app, cloud-based systems, and embedded software in wearable devices. This course introduces design principles and practical hands-on experience in designing and evaluating various biomedical software systems. It will also discuss the impact of biomedical software in the healthcare system and scientific process.
Prerequisite: Eligible for students who have successfully completed COMP2119.
Assessment: 100% continuous assessment and project.

BIOF4002 Global Health Informatics **Year 3 or 4 (6 credits)**

This course aims to present key biostatistical, computational, and epidemiology concepts and techniques that are useful for monitoring, modelling, predicting, and managing infectious and non-communicable diseases. This course will introduce practical techniques for data collection, data analysis, and predictive modelling for global health applications. This course will also discuss issues related to communication of public health information, and formulation of public health policy.
Prerequisite: Eligible for students who have successfully completed BIOF3001.
Assessment: 70% continuous assessment; 30% examination.

BIOF4003 Biomedical Image Informatics **Year 3 or 4 (6 credits)**

This course aims to introduces common medically relevant images data, and computational techniques to process them. Image processing and computer vision techniques will be introduced.
Prerequisite: Eligible for students who have successfully completed BIOF2001.
Assessment: 70% continuous assessment; 30% examination.

COMP3314 Machine Learning **Year 3 or 4 (6 credits)**

This course introduces algorithms, tools, practices, and applications of machine learning. Topics include core methods such as supervised learning (classification and regression), unsupervised learning (clustering, principal component analysis), Bayesian estimation, neural networks; common practices in data pre-processing, hyper-parameter tuning, and model evaluation; tools/libraries/APIs such as scikit-learn, Theano/Keras, and multi/many-core CPU/GPU programming.
Prerequisite: Eligible for students who have successfully completed MATH1853 or MATH2101. and COMP2119 or ELEC2543.
Assessment: 50% continuous assessment; 50% examination.

COMP3317 Computer Vision **Year 3 or 4 (6 credits)**

This course introduces the principles, mathematical models and applications of computer vision. Topics include: image processing techniques, feature extraction techniques, imaging models and camera calibration techniques, stereo vision, and motion analysis.
Prerequisite: Eligible for students who have successfully completed COMP2119, and MATH1853 or MATH2101.
Assessment: 50% continuous assessment; 50% examination.

BMED4500 Biomedical Instrumentation and Systems **Year 4 (6 credits)**

This course aims to learn basic principles, design and implementation of different key biomedical diagnostic and therapeutic technologies; understand the scope of bio-instrumentation and systems in the field of basic life science research and clinical applications and understand the updated trends in the technological developments in bio-instrumentation.
Prerequisite: Eligible for students who have successfully completed BMED2500.
Assessment: 60% coursework; 40% examination.

BMED4504 Biomedical Signals Processing and Modeling in Biomedical Applications **Year 4 (6 credits)**

This course aims to provide students with fundamentals of the common and important biomedical signals (mainly, neural signals); to furnish students with essential signal processing and modelling techniques for practical and clinical biomedical applications; to offer students with practical guidance on how to choose appropriate processing methods for solving specific problems of biomedical research; to let students gain first-hand experience in operating biomedical signal (EEG and EMG) acquisition systems and analysing biomedical signals; to introduce students to the most recent developments and the state-of-the-art of biomedical signals and systems, such as brain-computer interface and brain connectome.
Prerequisite: Eligible for students who have successfully completed BMED2500.
Assessment: 60% coursework; 40% examination.

Courses for Minor in Biomedical Data Science

BIOC1600 Perspectives in Biochemistry **Year 1 (6 credits)**

This course aims to teach students a biochemical perspective on each of the Basic Sciences focusing on concepts fundamental to the learning of Biochemistry and promote deep learning of course material through an integrated programme of practical and collaborative tasks. Students will be inspired with a view of the great discoveries and future challenges for Biochemistry and helped to make the transition from school to university by developing their teamwork, independent study skills and confidence to communicate within a Biochemistry learning environment.
Prerequisite: Eligible for students who have attained Level 3 or above in HKDSE Biology, Chemistry, or Combined Science with Biology or Chemistry component, or equivalent.
Assessment: 50% continuous assessment; 50% examination.

BIOF1001 Introduction to Biomedical Data Science **Year 1 (6 credits)**

This course aims to introduce students to a variety of common biomedical data and practical skills to perform exploratory data analysis on these data. Data analysis skills such as data preprocessing, data quality assessment, data visualisation and clustering will be introduced. The role of modern data analytics in the scientific process and medical applications will be examined. The ethical issues related to collection, sharing and integration of big data will also be discussed.
Assessment: 70% continuous assessment; 30% examination.

COMP1117 Computer Programming **Year 1 (6 credits)**

This is an introductory course in computer programming. Students will acquire basic Python programming skills, including syntax, identifiers, control statements, functions, recursions, strings, lists, dictionaries, tuples and files. Searching and sorting algorithms, such as sequential search, binary search, bubble sort, insertion sort and selection sort, will also be covered.
Mutually exclusive with: ENGG1111 or ENGG1330
Assessment: 70% continuous assessment; 30% examination.

STAT1005 Essential Skills for Undergraduates: Foundations of Data Science **Year 1 (6 credits)**

The course introduces basic concepts and methodology of data science to junior undergraduate students. The teaching is designed at a level appropriate for all undergraduate students with various backgrounds and without pre-requisites.
Students will engage in a full data work-flow including collaborative data science projects. They will study a full spectrum of data science topics, from initial investigation and data acquisition to the communication of final results.
Specifically, the course provides exposure to different data types and sources, and the process of data curation for the purpose of transforming them to a format suitable for analysis. It introduces elementary notions in estimation, prediction and inference. Case studies involving less-manicured data are discussed to enhance the computational and analytical abilities of the students.
Assessment: 100% coursework.
Remark: Not eligible for the following: students who have successfully completed or are enrolled in COMP2501 or STAT1015; or students in Year 2 studies or above majoring Computer Science, Decision Analytics, Risk Management or Statistics; or students in Year 4 studies or above.

STAT1600 Statistics: Ideas and Concepts **Year 1 (6 credits)**

The course aims at providing a broad overview of statistics for students who aspire to major in Statistics or Risk Management. It focuses on the roles of statistics as a scientific tool with applications to a wide spectrum of disciplines, and as a science of reasoning which has revolutionized modern intellectual endeavours. It lays a panoramic foundation for a formal study of statistics at the university level.
Assessment: 60% continuous assessment; 40% examination.
Remark: Not eligible for students who have successfully completed one of the following courses: STAT1602, STAT1603 or STAT3902.

BBMS2003 Human Genetics **Year 2 (6 credits)**

To present an extensive introduction to the principles of genetics, illustrate how they operate in humans with examples, and discuss the applications of these in medical and clinical genetics. Topics include the Mendel's laws of genetics, the basic patterns of Mendelian inheritance in humans, the construction and the analysis of a pedigree, single gene and polygenic inheritance, multifactorial traits and heritability, cytogenetics, karyotypes, structural changes in chromosomes, and non-Mendelian inheritance. Concepts of genetic variations in human populations and Hardy-Weinberg equilibrium will also be presented.
Prerequisite: Eligible for students who have successfully completed BBMS1001 or BIOC1600.
Assessment: 30% continuous assessment; 70% examination.

BBMS2007 Essential Molecular Biology **Year 2 (6 credits)**

This course aims to enable the students to understand the basics in molecular biology including the process and machineries involving in the storage, utilization and maintenance of the genetic information and the corresponding genomes.
Prerequisite: Eligible for students who have successfully completed BIOC1600.
Assessment: 40% continuous assessment; 60% examination.

BIOF2001 Artificial Intelligence in Medicine **Year 2 or 3 (6 credits)**

This course aims to introduce students to key concepts in artificial intelligence (AI) and practical machine learning techniques that are applicable to biomedical research and healthcare applications. Using a problem-oriented approach, students will learn how to frame biomedical problems using a machine learning framework, collect relevant data, perform model training and evaluation, and deploy an AI system in the real-world. The course will also explore the social and ethical impact of digital health and AI technology in medicine and the scientific process.
Prerequisite: Eligible for students who have successfully completed one of the following courses: BIOF1001, STAT1005, COMP1117 or STAT2604, or are enrolled in STAT2604.
Assessment: 80% continuous assessment; 20% examination.

STAT2604 Introduction to R Programming and Elementary Data Analysis **Year 2 or 3 (6 credits)**

This course is designed to provide a first-level introduction to the popular and powerful statistical programming language R. This course focuses on learning the basic programming skills in R with examples and applications in elementary statistical analysis. The programming skills involved can be applied to input and output of data sets, work with different data types, manipulation and transformation of data, random sampling, descriptive data analysis, and production of professional summary reports with high-quality graphs.
Prerequisite: Eligible for students who have successfully completed or are enrolled in STAT1600 or MATH1821.
Assessment: 100% coursework.

BBMS3002 Molecular Biology of the Cell **Year 3 or 4 (6 credits)**

The course will cover current topics of cell biology and will provide an overview of the fundamentals of biological processes that contribute to cell growth and survival. Four major areas will be covered: Nucleus and Epigenetics; Signal Transduction; Cytoskeleton and Cell Adhesion; and Cell Proliferation and Differentiation. Students will also be introduced to current methodologies for molecular and cell biology research, and will be exposed to emerging systems and synthetic biology approaches in the study of cellular processes. The course also aims to provoke appreciation of how knowledge in basic science aids in the detection, rationalisation and treatment of genetic diseases, including cancer and other metabolic disorders. Students are expected to research into how good understanding of the basic principles of molecular and cell biology has facilitated development of current strategies for disease intervention.
Prerequisites: Eligible for students who have successfully completed BBMS1001 and BBMS2001.
Assessment: 40% continuous assessment; 60% examination.

BBMS3008 Essential Proteomics **Year 3 or 4 (6 credits)**

This course will introduce protein structure and contemporary proteomics relevant to biomedical sciences. Protein structure will include protein structure classification and identification, protein modelling, and structure determination by X-ray crystallography and cryo-EM. Proteomics will include protein mass spectrometry, isotope labelling, and protein-protein interaction techniques.
Prerequisite: Eligible for students who have successfully completed one of the following courses: BBMS2007, BIOC2600, BIOL2220 or BIOL3401.
Assessment: 50% continuous assessment; 50% examination.

BBMS3009 Genome Science **Year 3 or 4 (6 credits)**

This course will present topics applicable to human genetics and genomic biology in the "post-genome" era. Main topics include The Human Genome Project; technologies for genomic analysis such as microarrays and high-throughput sequencing; and bioinformatics for handling, analysing and interpreting genomic data, making use of standard analysis programs and public genomic resources such as the HapMap, 1000 Genome, ENCODE and Epigenetic Roadmap. We also show how the application of genome science to human diseases has led to improved understanding of disease aetiology and mechanisms. Students will gain knowledge and understanding in genomics that will be useful in their future career, be it in science or industry.
Prerequisite: Eligible for students who have successfully completed BIOL2102 and one of the following courses: BBMS2003, BBMS2007, BIOL3401 or BIOL3408.
Assessment: 40% coursework; 60% examination.

BBMS4003 Developmental Genetics **Year 3 or 4 (6 credits)**

This course covers the genetic bases as well as cellular and molecular processes of embryo development. Topics include: genetic control of body plans and pattern formation, morphogenesis, cell fate determination, formation of organ systems such as lung, kidney, vascular, skeletal and nervous systems, germ cells and sex determination, stem cells, regeneration, common congenital malformations, and key signaling molecules involved. Methods and technologies for studying developmental genetics, studies of model organisms, and examples relevant to human diseases and modern medicine are discussed.
Prerequisite: Eligible for students who have successfully completed one of the following courses: BBMS2003, BBMS2007, BIOL3401, BIOL3408, BBMS3002 or equivalent courses.
Assessment: 40% continuous assessment; 60% examination.

BBMS4004 Public Health Genetics **Year 3 or 4 (6 credits)**

Public health genetics is the study of variation in the genome, its inheritance, and its contribution to health and disease. The main features of public health genetics research will be highlighted including how genetic and environmental factors play a role in disease susceptibility; emergence of biobanks; cancer genomics; precision medicine; and Mendelian randomisation. This course will also discuss the use of genetic epidemiology in the study of human diseases, the use of genetic testing in the diagnosis and screening of diseases as well as the use of genetic information in the treatment of diseases. It will also explore the ethical, legal and policy questions raised when applying genomics to health care.
Prerequisite: Eligible for students who have successfully completed STAT2601 and BBMS2003.
Assessment: 100% continuous assessment.

BIOC3605 Sequence Bioinformatics **Year 3 or 4 (6 credits)**

This course will examine existing bioinformatics tools for DNA and protein sequence analysis. The underlying principles of these analysis programs and services will be presented. Students will learn how to retrieve, analyze, and compare protein and DNA sequences using bioinformatics tools available on the internet. A basic introduction to the principles and tools for the analysis of next generation sequencing data will also be presented.
Prerequisite: Eligible for students who have successfully completed one of the following courses: BIOC2600, BIOL2220, BBMS2003 or BBMS2007.
Assessment: 30% coursework; 70% examination.

BIOC4612 Molecular Biology of the Gene **Year 3 or 4 (6 credits)**

To provide an up-to-date knowledge of molecular biology, especially with respect to the regulation of eukaryotic gene expression.
Prerequisite: Eligible for students who have successfully completed one of the following courses: BIOC3601, BIOL3401, BIOL3402, BIOL3404 or BBMS2007.
Assessment: 30% assignment; 70% examination.

BIOF3001 Big Data Biomedical Informatics **Year 3 or 4 (6 credits)**

This course uses a problem-based approach to introduce analytical skills to tackle practical biomedical problems via integration of diverse biomedical big data. Students will be given structured scenarios in groups to solve a variety of biomedical problems using diverse data types. These may include data from genome sequencing and non-sequencing-based omics, electronic medical records, wearable/IoT technology, medical imaging, and social media. In the course, the students will learn the theory (algorithm, statistics), and hands-on skills (data collection, programming, data analysis, visusalisation) to support integrative data analysis tasks.
Prerequisite: Eligible for students who have successfully completed or are enrolled in BIOF2001.
Assessment: 100% continuous assessment including reports, presentation, and projects.

BIOF3002 Genome Sequencing and Analysis **Year 3 or 4 (6 credits)**

This course aims to give students end-to-end experience in high throughput genome sequencing from sample preparation, sequencing to data analysis using a portable DNA sequencing device. Students will gain hands-on knowledge of how portable DNA sequencers generate genomics data. Using these datasets, the students will then apply bioinformatics analyses to answer specific biological questions. This course will also provide students with knowledge of current publicly available genomic resources.
Prerequisite: Eligible for students who have successfully completed BIOF1001 plus completed or are enrolled in BBMS3009.
Assessment: 100% continuous assessment including project reports and presentation.

BIOF3005 Structural Bioinformatics **Year 3 or 4 (6 credits)**

This course will theory and computational methods for determining, analysing, comparing and predicting the structure of DNA, chromatin, RNA, and proteins. It covers the biophysical basis of structural determination and prediction, as well as modern machine learning methods for molecular structure prediction and analysis.
Prerequisite: Eligible for students who have successfully completed BIOF2001 and BIOC1600.
Assessment: 70% continuous assessment; 30% examination.

BIOF3006 Biomedical Software Systems **Year 3 or 4 (6 credits)**

There are many software systems in modern biomedical data sciences – from standalone bioinformatics software, molecular sequence databases, web services, electronic health record system, telehealth system, mobile app, cloud-based systems, and embedded software in wearable devices. This course introduces design principles and practical hands-on experience in designing and evaluating various biomedical software systems. It will also discuss the impact of biomedical software in the healthcare system and scientific process.
Prerequisite: Eligible for students who have successfully completed COMP2119.
Assessment: 100% continuous assessment and project.

BIOF4002 Global Health Informatics **Year 3 or 4 (6 credits)**

This course aims to present key biostatistical, computational, and epidemiology concepts and techniques that are useful for monitoring, modelling, predicting, and managing infectious and non-communicable diseases. This course will introduce practical techniques for data collection, data analysis, and predictive modelling for global health applications. This course will also discuss issues related to communication of public health information, and formulation of public health policy.
Prerequisite: Eligible for students who have successfully completed BIOF3001.
Assessment: 70% continuous assessment; 30% examination.

BIOF4003 Biomedical Image Informatics **Year 3 or 4 (6 credits)**

This course aims to introduce common medically relevant images data, and computational techniques to process them. Image processing and computer vision techniques will be introduced.
Prerequisite: Eligible for students who have successfully completed BIOF2001.
Assessment: 70% continuous assessment; 30% examination.