جامعة الحسين التقنية
Al Hussein Technical University

School of Computing and Informatics
BSc in Data Science and Artificial Intelligence

➢ **Table 1** University Requirements

Course Number	Course Name	Course Type	CH	Prerequisite(S)
0030301121	English Pre-Intermediate Intensive + Lab	HTU	4	Pre-Foundation English Elementary Intensive + Lab (0030301120)
0030301122	English Intermediate	HTU	3	English Pre-Intermediate Intensive + Lab (0030301121)
0030301123	English Upper - Intermediate	HTU	3	English Intermediate (0030301122)
0030301124	English Advanced	HTU	3	English Upper – Intermediate (0030301123)
0040302111	Professional Skills	HTU	1	
0040302211	Professional Practice	HNC	3	[Professional Skills (0040302111) or Soft Skills I (30302111)] and English Intermediate (0030301122)
0040302231	Entrepreneurship Bootcamp	HTU	4	English Upper – Intermediate (0030301123) + [Professional Practice (0040302211) or Soft Skills II (30302112)]
0030301111	Arabic Language & Communication Skills	HTU	1	Remedial Arabic Language (30301110)
0030302129	Military Science	HTU	1	
0030302232	Leadership Camp	HTU	1	Entrepreneurship Bootcamp (0030302231) or Entrepreneurship Bootcamp (0040302231)
	University Elective I	HTU	1	
	University Elective II	HTU	1	
	University Elective II	HTU	1	
	Total		**27**	

➢ **Table 2** College Requirements

Course Number	Course Name	Course Type	CH	Prerequisite(S)
0030303111	Functional Math	HTU	3	Remedial Math (0030303110)
0040303121	Maths for Computing	HNC	3	Functional Math (0030303111)
0040303130	Fundamentals of Computing	HTU	4	
0040201100	Programming	HNC	3	Fundamentals of Computing (0040303130)
0040303221	Discrete Maths	HND	3	Maths for computing (0040303121) Corequisite Data Structures & Algorithms (0040201201)
0040202190	Planning a Computing Project	HNC	4	Professional Practice (0040302211)

0030303121	STEM Lab I	HTU	1	
	Total		**21**	

- **Table 3** Department Requirements

Course Number	Course Name	Course Type	CH	Prerequisite(S)
0010203180	Networking	HNC	3	Fundamentals of Computing (0040303130)
0040201201	Data Structures & Algorithms	HND	3	Programming (0040201100)
0010204282	Database Design & Development	HNC	3	Programming (0040201100)
0040201341	Operating Systems	HND	3	Data Structures & Algorithms (0040201201)
0010204312	Business Intelligence	HND	3	Database Design & Development (0010204282)
0000201391	Computing Research Project	HND	6	Planning a Computing Project (0040201290)
0000203280	Security	HNC	3	Fundamentals of Computing (0040303130)
0010204250	Artificial Intelligence & Intelligent Systems	HNC	3	Maths for Computing (0040303121)
0000204280	Principles of Data Science and Computing Systems	HTU	3	Maths for Computing (0040303121)
0010204281	Data Science Programming	HTU	3	Programming (0040201100)
0010204210	Data Analytics	HNC	3	Maths for Computing (0040303121)
0000204430	Data Mining	HTU	3	Data Analytics (0010204210)
0010204330	Modeling and Simulation	HTU	3	Artificial Intelligence & Intelligent Systems (0010204250)
0010204350	Machine Learning	HND	3	Principles of Data Science (0000204280s) + Data Analytics (0010204210)
0010204351	Natural Language Processing	HTU	3	Artificial Intelligence & Intelligent Systems (0010204250)
0000204310	Advanced Programming for Data Analysis	HND	3	Data Analytics (0010204210)
0000204311	Big Data Analytics and Visualization	HND	3	Advanced Programming for Data Analysis (0000204310)
0010204450	Deep Learning	HTU	3	Machine Learning (0010204350)
	Elective I	HTU	3	
	Elective II	HTU	3	
	Elective III	HTU	3	
0010204491	Capstone project I	HTU	1	>= 90 hrs including core courses
0010204492	Capstone project II	HTU	2	Capstone project I (0010204491)
0010204390	HNC Training	HTU	12	Minimum number of completed hours >=85
0010204490	HND Training	HTU	6	Pre or corequisite HNC Training (0010204390)
	Total		**87**	

- **Table 4:** List of Elective Courses (9 CH):

Course Number	Course Name	Course Type	CH	Prerequisite(S)
0000204410	Health informatics	HTU	3	Data Analytics (0010204210)
0000204411	Time series analysis	HTU	3	Data Analytics (0010204210)
0000204412	Applied Analytical Models	HTU	3	Discrete Maths (0040303221)
0010204431	Information retrieval	HTU	3	Discrete Maths (0040303221)
0000204432	Bioinformatics	HTU	3	Machine Learning (10204350)
0000204413	Analytical Methods	HTU	3	Discrete Maths (0040303221)
0000204433	Data engineering	HTU	3	Data Analytics (0010204210)
0010204451	Pattern Recognition	HTU	3	Artificial Intelligence & Intelligent Systems (0010204250)
0010204452	Computer Vision	HTU	3	Discrete Maths(0040303221)
0010204453	Robotics	HTU	3	Artificial Intelligence & Intelligent Systems (0010204250)
0010204454	Optimization theory	HTU	3	Data Structures & Algorithms (0040201201) Discrete Maths (0040303221)
0010204455	Machine Learning Operations	HTU	3	Machine Learning (0010204350)
0040201450	Cloud Computing	HTU	3	Networking (0010203180) Operating Systems (0040201341)
0010204470	Special Topics	HTU	3	Department Approval

➢ **Table 5** Course Brief Description

Course Name	Course Brief Description
Functional Math	This course reviews the fundamental concepts in numerical analysis, linear algebra, functions and graphs, differentiation, integration, and metrics. It strengthens the problem formulation skills (i.e., the ability to translate real application problems into a series of mathematical processes). It also focuses on developing the mathematical reasoning skills, such as mathematical deductions and proofs.
Fundamentals of Computing	This course provides a comprehensive route to developing an in-depth exposure to personal computers, hardware, and a range of operating systems. Students learn the functionality of various hardware and software components and best practices in maintenance and safety issues. In addition to, basic computer skills, programming concepts, algorithms, variables and data types; arithmetic, logical, relational, Boolean, and assignment operators; simple input and output statements, selection structures, loop structures, single and multidimensional arrays, character strings, functions, data structures, input/output file operations.
Programming	Define basic algorithms to carry out an operation and outline the process of programming an application; Comparative programming language paradigms, procedural, object-orientated and event-driven programming languages. Design and tradeoffs of programming language features and implementation, including syntax, control structures, types, and security. Explain the characteristics of procedural, object-orientated and event-driven programming. Analyze Integrated Development Environments (IDEs); Implement basic algorithms in code using an IDE; Determine the debugging process and explain the importance of a coding standard.
Networking	The aim of this course is to provide students with wider background knowledge of computer networking essentials, how they operate, protocols, standards, security considerations and the prototypes associated with a range of networking technologies. This course will provide students with skills to successfully install operate and troubleshoot a small network; and the operation of IP data networks, router, switching technologies, IP routing technologies, IP services and basic troubleshooting.
Professional Practice	This course provides a foundation for good practice in a variety of contexts. The ability to communicate effectively using different tools and mediums will ensure that practical, research, design, reporting and presentation tasks are undertaken professionally and in accordance with various communication conventions. Continuing professional development, self-improvement and working towards various goals is an area that is encouraged in the workplace through the appraisal's framework. Among the topics included in this course are: the development of communication skills and communication literacy; the use of qualitative and quantitative data to demonstrate analysis, reasoning and critical thinking; and tasks that require the integration of others within a team-based scenario and planning and problem-solving.
Planning a Computing Project	The course provides examination of project management principles and modern software project management practices. The fundamental knowledge and skills to enable them to undertake independent research

	and investigation for carrying out and executing a computing project which meets appropriate aims and objectives. Methods for managing and optimizing the software development process are discussed along with techniques for performing each phase of the systems development lifecycle. Present the project and communicate appropriate recommendations based on meaningful conclusions drawn from the evidence findings and/or analysis. Reflect on the value gained from conducting the project and its usefulness to support sustainable organizational performance.
STEM Lab I	This course develops the basic skills in the fields of science, technology, engineering, and mathematics through a set of practical experiments, covering mechanical, electrical, electronics, automation, mechanics of materials, robotics, computer applications, and process control.
Maths for Computing	This course introduces students to the mathematical principles and theory that underpin the computing curriculum. Through a series of case studies, scenarios and task-based assessments students will explore number theory within a variety of scenarios; use applicable probability theory; apply geometrical and vector methodology; and finally evaluate problems concerning differential and integral calculus. Among the topics included in this course are prime number theory, sequences and series, probability theory, geometry, differential calculus and integral calculus.
Data Analytics	This course will introduce the theoretical foundation of data analytics and a range of data analytic processes and techniques to provide hands-on experience for enhancing students' skills. Topics included in this course are: data analytic terminologies, types of data analytics, data exploration and visualization, understanding data with descriptive, predictive and prescriptive analytics. On successful completion of this course students will be able to understand the theoretical foundation of data analytics, data analytic processes and techniques. Moreover they will gain hands-on experience of implementing data analytic processes and techniques using a programming language such as Python, R, or a tool such as Weka, KNIME, PowerBI, Excel etc.
Data Structures & Algorithms	This course introduces students to data structures and how they are used in algorithms, enabling them to design and implement data structures. The course introduces the specification of abstract data types and explores their use in concrete data structures. Based on this knowledge, students should be able to develop solutions by specifying, designing and implementing data structures and algorithms in a variety of programming paradigms for an identified need. Topics included in this course are abstract data types specification, formal data notations, data encapsulation, complex data structures, programming language implementations using handles, pointers, classes and methods, algorithm types, data structure libraries, algorithm complexity, asymptotic testing and benchmarking.
Business Intelligence	Discuss business processes and the mechanisms used to support business decision-making; Compare the tools and technologies associated with business intelligence functionality; Demonstrate the use of business intelligence tools and technologies; Discuss the impact of business intelligence tools and technologies for effective decision-making purposes and the legal/regulatory context in which they are used.
Discrete Maths	This course introduces students to the discrete mathematical principles and theory that underpin software engineering. Through a series of case

	studies, scenarios and tasked-based assessments students will explore set theory and functions within a variety of scenarios; perform analysis using graph theory; apply Boolean algebra to applicable scenarios; and finally explore additional concepts within abstract algebra. Among the topics included in this course are: set theory and functions, Eulerian and Hamiltonian graphs, binary problems, Boolean equations, Algebraic structures and group theory.
Data Mining	This course will introduce the theoretical foundation of data mining and a range of data mining processes and techniques. The course will also provide hands-on experience in developing data mining applications using an appropriate programming language or data mining tool. Topics included in this course are: data mining terminologies, scope of data mining such as classification, regression and clustering methods and techniques, associate pattern mining, mining time series data, and mining text data.
Applied Analytical Models	This course introduces students to applied analytical models used in business to discover, interpret and communicate meaningful patterns of data held in silos or data warehouses, and to derive knowledge to gain competitive advantage. Organizations may apply analytical methods and models to predict/prescribe business outcomes and improve performance in diverse areas such as stock control, financial risk and fraud analysis. Analytical models use mathematical algorithms and require extensive computation to process large amounts of data
Analytical Methods	This course introduces students to more advanced analytical techniques that are relevant to them as they progress within their studies in computing, and advances knowledge of mathematical modelling and application of theory. Among the topics included in this course are: complex numbers, numerical methods, matrices, formal logic and Z specification.
Computing Research Project	The course offers the opportunity to engage in sustained research in a specific field of study. They conduct an individual research project under a close supervision. Expose to theoretical or experimental research techniques. In Conduct and present a survey of the literature relevant to the research topic. Prepare a thesis reporting on the research project and its outcomes. They will also be expected to present a poster and a short seminar describing their work.
Database Design & Development	The aim of this course is to give students opportunities to develop an understanding of the concepts and issues relating to database design and development, as well as to provide the practical skills to translate that understanding into the design and creation of complex databases. Topics included in this course are: examination of different design tools and techniques; examination of different development software options; considering the development features of a fully functional robust solution covering data integrity, data validation, data consistency, data security and advanced database querying facilities across multiple tables; appropriate user interfaces for databases and for other externally linked systems; creating complex reports/dashboards, testing the system against the user and system requirements; and elements of complete system documentation.
Security	The aim of this course is to provide students with knowledge of security, associated risks and how security breaches impact on business continuity. Students will examine security measures involving access authorization,

	regulation of use, implementing contingency plans and devising security policies and procedures. Among the topics included in this course are detection of threats and vulnerabilities in physical and IT security, and how to manage and assess risks relating to organizational security. Network Security design and operational topics, including address translation, DMZ, VPN, firewalls, AV and intrusion detection systems. Remote access will be covered, as will the need for frequent vulnerability testing as part of organizational and security audit compliance. Assess risks to IT security; Describe IT security solutions; Review mechanisms to control organizational IT security; Manage organizational security.
Machine Learning	Topics included in this course are: the foundations of machine learning, types of learning problems (classification, regression, clustering etc.), taxonomy of machine learning algorithms (supervised learning, unsupervised learning, reinforcement learning), machine learning algorithms (Decision Tree, Naïve Bayes, k-Nearest Neighbour, Support Vector Machine etc.).
Artificial Intelligence & Intelligent Systems	This course is designed to introduce the philosophy behind artificial intelligence, the most efficient techniques of AI and various intelligent systems that help us to overcome various challenges. This course guides the student to investigate the emerging AI technologies which could solve various real-world challenges and problems. Topics included in this course are the philosophical background to AI, current trends and the future of AI, ethics and issues in AI ,a range of AI applications (computer vision, speech processing and so forth), top-down approach of AI techniques, fuzzy logic, knowledge-based systems, natural language processing), bottom-up approach of AI techniques (neural networks, evolutionary computing, swarm intelligence), and emerging AI technologies (Brain Computer Interfacing, Ambient AI, Smart City, GPU AI etc).
Principles of Data Science	This course helps students understand and apply concepts, techniques, algorithms, and tools to analyze, manage and visualize data to help them discover information and knowledge to guide effective decision-making and gain new insights from large data sets. The student acquires the concepts and skills needed for programming in the Python language as well as statistical inference, along with the practical analysis of real-life data sets, including economic data, document collections, geographic data, and social networks. The course also helps students to understand the underlying computing systems used to perform the analyses mentioned above along with big data analysis and machine learning and the storage infrastructure used. Students will also learn how to measure and monitor the computing systems performance, availability, scalability, and the foundations on how to design such systems. The course briefly addresses the social and legal issues surrounding data analysis, including privacy and data ownership issues.
Optimization Theory	This course offers an introduction to nonlinear mathematical optimization with applications in data science. The theoretical foundation and the fundamental algorithms for nonlinear optimization are studied and applied to supervised learning models, including nonlinear regression, logistic regression, support vector machines, and deep neural networks. Students write their own implementation of the algorithms in the Python programming language and explore their performance on realistic data sets.
Data visualization	This course will give you the skills you need to leverage data to reveal valuable insights and advance your career. The course will focus on

	studying algorithms for creating effective visualizations capable of promoting data comprehension and analysis. The course discusses the key techniques and theory used in visualization, including data models, graphical perception, and visual encoding and interaction. Students will learn about the variety of existing approaches and systems in data visualization and develop skills in evaluating different visualization techniques as applied to particular tasks. The course also discusses visual representation methods, such as graph drawing, parallel coordinates, tree mapping, and encourages students to design new innovative visualizations and experiment their potentials on case studies of various data sources.
Natural Language Processing	This course covers the origins of Natural Language Processing (NLP); Language structure representation; The role of knowledge; Knowledge representation; Parsing techniques; Finite-state techniques; Recursive and augmented transition networks; Language ambiguity; Well-Formed constructs; Features and the lexicon; Language semantics; Applications. Weekly practice in the lab.
Deep Learning	This course will introduce students to the concept of Deep learning and it will help students to understand its key principles. The course covers feed-forward neural networks, convolutional neural networks, recurrent neural network, sequence modelling, deep reinforcement learning, and other fundamental concepts and techniques. This course will also teach the students the key computations underlying deep learning. It is expected by the end of the course, students will be able to build, train and apply fully connected deep neural networks, and to know how to implement efficient neural networks using the most popular libraries for Deep Learning such as Keras, PyTorch; and Tensorflow. The course will introduce students also to a wide spectrum of deep learning applications in real-word problems.
Elective I Elective II Elective III	The student can choose three courses from a list of advanced topic courses in Data Science and Artificial Intelligence field that will be offered by the department.
Capstone project I Capstone project II	A project-based course intends to reflect different skills and competencies acquired by the student in different courses. The students will learn how to handle a project, starting with the specifications, requirements, design, and implementation then preparing a comprehensive report.
HNC Training HND Training	On-the-job training is a hands-on method of teaching the skills, knowledge, and competencies needed for students to perform a specific job within the workplace. Students learn in an environment where they will need to practice the knowledge and skills obtained during their training.
Data science programming	This course introduces students to the main programming languages used in the field of data science such as Python or R. The students will learn how to use the programming language to explore, analyze, preprocess, and visualize data and how to solve data science problems analytically.
Data engineering	This course aims to provide an overview of the techniques used for data collection and wrangling, preprocessing, and how to build automatic data pre-processing pipelines. Students will learn how to perform feature extraction and feature selection from data for downstream machine learning models.

Health informatics	This course will introduce students to the principles of health informatics and the technologies used to support healthcare data management and healthcare information systems e.g., patient electronic health records. Cover the legal, social, and privacy issues and challenges surrounding healthcare data storage and healthcare data communication. Explore new and emerging technologies in the field of health informatics.
Information retrieval	This course introduces students to the principles and algorithms used for information retrieval systems and text mining including document categorization, classification, clustering, and recommender systems. The theories behind internet search engines, page ranking, and modern information retrieval systems will be covered as well.
Bioinformatics	This course introduces students to the algorithms used in the field of bioinformatics and computational biology and the techniques used for mining biological data. Students will learn how to use available genomic and proteomic databases to retrieve and present data efficiently. Students will become familiar with the latest genome sequencing technologies and how to analyze genomic sequencing data. The necessary biology knowledge will be covered during the course.
Time series analysis	This course aims to introduce students to the concepts, techniques, and statistical methods to analyze time series data. Topics covered will include time series regression, smoothing, autoregressive moving average (ARMA) models, autoregressive integrated moving average (ARIMA) models, and forecasting techniques.
Cloud Computing	This course is designed to develop an understanding of the fundamental concept of Cloud Computing, cloud segments, and cloud deployment models, the need for Cloud Computing, an appreciation of issues associated with managing cloud service architecture and to develop a critical awareness of Cloud Computing based projects. Topics included in the course are the paradigms of networking, fundamentals of Cloud Computing, Cloud Computing architecture, deployment models, service models, security, technological drivers, and cloud service providers.
Pattern Recognition	This course introduces students to the basics of pattern recognition, pattern representation, pattern classification, and how to extract meaningful information from patterns. Students will learn how to apply techniques and models to design a pattern recognition system to solve real world problems.
Computer Vision	This course aims to introduce students to the theory behind image computing and processing, fundamentals of image formation, image object recognition and detection, image classification, and image feature extraction and selection. Students will learn how to use machine learning and deep learning models to solve real world problems.
Robotics	This course is designed to explore robotic systems, both historically and as an area of rapid contemporary development. The student will be introduced to the different types and applications of robotic systems and will be encouraged to discuss and reflect on the implications of using robots. Topics included in this course are an introduction to robotic systems, types of robots, industrial robots, automation system components, developing a solution, sensors, and sensor-based robots, ethical considerations, safety, social and economic impacts.
Machine Learning Operations	This course introduces students to the techniques used to effectively deploy a machine learning model to production. The students learn how

	to test, monitor, evaluate machine learning models in production, and successfully scale them.
Modeling and simulation	This course aims to introduce students to modeling and simulation concepts and definitions, and how to utilize modeling and simulation effectively for data science projects. Topics include how to use statistical models to solve problems and analyze the statistical results, how to use existing simulation programs and libraries, and how to interpret and visualize simulation results.
Special Topics	Selected state-of-the-art topics in Data science and AI.
Advanced Programming for Data Analysis	This unit is designed to develop the skills required to become a skilled data analyst. It includes investigation of a range of different programming languages, aimed at both data analytics and general use, good development guidelines and the design, development and testing of a sizeable tool to analyse and utilise a large data set. These skills are especially relevant to today's data analyst, data scientist, social researcher, market researcher and others who utilise large data sets in their work.
Big Data Analytics and Visualization	This course introduces students to the concepts of big data and visualisation and how this is used for decision making. It explores the industry software solutions available to investigate and present data, before assessing the role and responsibility of data specialists in this current environment. Topics include data driven decision-making, manipulating data and automation, and building ethics into a data-driven culture are examined. Students will demonstrate their use of tools and software to manipulate and prepare a visual presentation for a given data set. They will also assess how data specialists are responsible for adhering to legislation and ensuring data compliance. The students will also be able to compare how different industry leading tools and software solutions are used to analyse and visualise data, carry-out queries to summarise and group datasets.
Data Analytics for IT professionals	This course will introduce the theoretical foundation of data analytics and a range of data analytic processes and techniques to provide hands-on experience for enhancing students' skills. Topics included in this course are: data analytic terminologies, types of data analytics, data exploration and visualization, understanding data with descriptive, predictive and prescriptive analytics. On successful completion of this course students will be able to understand the theoretical foundation of data analytics, data analytic processes and techniques. Moreover they will gain hands-on experience of implementing data analytic processes and techniques using a programming language such as Python, R, or a tool such as Weka, KNIME, PowerBI, Excel etc.
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	techniques, fuzzy logic, knowledge-based systems, natural language processing), bottom-up approach of AI techniques (neural networks, evolutionary computing, swarm intelligence), and emerging AI technologies (Brain Computer Interfacing, Ambient AI, Smart City, GPU AI etc).