



Al-Balqa Applied University
Faculty of Artificial Intelligence
Intelligent Systems Department

**The Curriculum for the
B.Sc. Degree in**

Data Science



Al-Balqa Applied University

Curriculum for the Bachelor Degree in Data Science

September 2019

The curriculum for the B.Sc. degree in Data Science (DS) consists of (132) credit hours distributed as follows:

Requirements	Credit Hours	Percentage
University Requirements	24	18%
Faculty Requirements	20	15%
Compulsory Specialization Requirements	70	53%
Elective Specialization Requirements	12	9 %
Supportive Specialization Requirements	6	5%
Total	132	100%



University Requirements (24 Credit Hours) distributed as follows:

a) University Compulsory Requirements (18 Credit hours)

Course Number	Course Name	Credit hours	Weekly Hours		Pre-requisite
			Theory	Practical	
AAL101	Applied Arabic Language	3	3	0	--
AEL101	Applied English Language (1)	3	3	0	--
AEL102	Applied English Language (2)	3	3	0	AEL101
NE101	National Education and University Behavior	3	3	0	--
35001101	Military Sciences	3	3	0	--
CS101	Computer Skills and E-Learning	1	1	0	--
IEC101	Innovation, Entrepreneurship and Creativity	2	2	0	--
Total		18	18	0	

b) University Elective Requirements (6 Credit Hours)

Course Number	Course Name	Credit Hours
36001101	Communication Skills	3
36002102	Principles of Psychology	3
36003103	Jordanian Society	3
36004104	Sport and Health for all	3
36005105	Islamic Culture	3
36009111	Economic concepts	3
36009110	Contemporary Management Concepts and Skills	3
36012109	History of Righteous Caliphs	3
36007107	Agriculture in Jordan	3
36008108	Environment and Society	3
36009114	Jerusalem (Palestinian Cause)	3
36009112	Law, Media and Society	3
36009109	Islam and Life	3
36009115	Digital Society	3



Faculty Requirements (20 Credit Hours)

Course Number	Course Name	Credit hours	Weekly Hours		Pre-requisite
			Theory	Practical	
AR142	Introduction to Artificial Intelligence	3	3	0	*30202102
AR241	Artificial Intelligence Programming	3	2	3	AR142
30801101	Computer Skills (2) for Science Colleges+	3	2	3	CS101*
30801203	Object Oriented Programming	3	3	0	30801101
30801204	Object Oriented Programming Lab.	1	0	3	30801203*
AR231	Introduction to Unix	1	0	3	--
30202101	Calculus (1)	3	3	0	--
30202102	Calculus (2)	3	3	0	30202101
Total		20	16	12	

Specialization Requirements (79 Credit Hours) distributed as follows:

a) Specialization Compulsory Requirements (70 Credit Hours)

Course Number	Course Name	Credit Hours	Weekly Hours		Pre-requisite
			Theory	Practical	
AR211	Data Structures	3	3	0	30801203
30801214	Discrete Structures and Mathematics	3	3	0	30202101
AR212	Design and Analysis of Algorithms	3	3	0	AR211 *
DS111	Data Science Fundamentals	3	3	0	30801101
DS233	Probability and Statistics for Data Scientists Lab.	1	0	3	30202131
30801243	Database Design and Management 1	3	3	0	30801203
30801244	Database Design and Management 1 Lab.	1	0	3	30801243*
DS210	Data Science Programming Languages	3	3	0	DS111
DS212	Data Science Programming Languages Lab.	1	0	3	DS210*
DS241	Data Analytics	3	3	0	DS233
AR243	Machine Learning	3	3	0	DS233
DS245	Machine Learning Lab.	1	0	3	AR243 *
DS 248	Computers and Networks Security	3	3	0	30801101
DS260	Web Application Development	3	3	0	30801243
DS261	Web Application Development Lab.	1	0	3	DS260*
DS266	Mobile Application Development	3	3	0	DS260



Course Number	Course Name	Credit Hours	Weekly Hours		Pre-requisite
			Theory	Practical	
DS267	Mobile Application Development Lab.	1	0	3	DS266*
DS230	Data Mining	3	3	0	DS233
DS232	Data Mining Lab.	1	0	3	DS230*
DS339	Data Warehousing	3	2	3	30801243
DS350	Information Retrieval Systems	3	3	0	30801243
DS461	Software Engineering for Data Science	3	3	0	DS111
AR347	Pattern Recognition	3	3	0	DS230
DS351	Cloud Computing	3	3	0	DS111
VAR423	Internet of Things	3	3	0	DS111
DS471	Project 1 for Data Science Students	1	-	-	Cr. Hrs 90
DS472	Project 2 for Data Science Students	2			DS471
DS474	Field Training for Data Science Students	6	-	-	Cr. Hrs 90
Total		67	51	21	

*: co-requisite

b) Specialization Elective Requirements (12 Credit Hours)

Course Number	Course Name	Credit Hours	Weekly Hours		Pre-requisite
			Theory	Practical	
DS 411	Advanced Data Structures	3	3	0	AR 211
30801340	Databases Design and Management (2)	3	3	0	30801243
DS480	Big Data Analytics	3	3	0	DS241
AR445	Social network analysis	3	3	0	DS210
DS360	Computer Vision	3	3	0	AR243
VAR306	Parallel Processing	3	3	0	DS230
AR344	Natural Language Processing	3	3	0	DS350
DS482	Sentiment Analysis of Big Data	3	3	0	DS241
DS484	Selected Topics in Data Science +	3	3	0	Cr. Hrs 90

*: Co-requisite +: Department approval



Supportive Specialization Courses (6 Credit Hours)

Course Numbers	Course Name	Credit Hours	Weekly Hours		Pre-requisite
			Theory	Practical	
30801281	Principles of Numerical Analysis	3	3	0	30202102
30202131	Probability and Statistics	3	3	0	30202102
Total		6	6	0	



Advisory Plan

First year					
First semester			Second semester		
#	Course name	C.H	#	Course name	C.H
30801101	Computer Skills (2) for Science Colleges ⁺	3	30202102	Calculus (2)	3
30202101	Calculus (1)	3	AR142	Introduction to Artificial Intelligence	3
AAL101	Applied Arabic Language	3	30801203	Object Oriented Programming	3
AEL101	Applied English Language (1)	3	30801204	Object Oriented Programming Lab.	1
35001101	Military Sciences	3	AEL102	Applied English Language (2)	3
			DS111	Data Science Fundamentals	3
			CS101	Computer Skills and E-Learning	1
Total C.H.		15	Total C.H.		17

Second year					
First semester			Second semester		
#	Course name	C.H	#	Course name	C.H
DS 248	Computers and Networks Security	3	DS210	Data science Programming languages	3
AR241	Artificial Intelligence Programming	3	DS212	Data science Programming languages lab	1
*****	University elective	3	DS241	Data Analytics	3
30202131	Probability and Statistics	3	AR243	Machine learning	3
DS233	Probability and Statistics for data science lab	1	DS230	Data Mining	3
30801243	Database Design and Management 1	3	DS232	Data Mining lab	1
30801244	Database Design and Management Lab. 1	1	DS260	Web Application Development	3
AR231	Introduction to Unix	1	DS261	Web Application Development lab	1
Total C.H.		18	Total C.H.		18



Third year					
First semester			Second semester		
#	Course name	C.H	#	Course name	C.H
AR211	Data Structures	3	AR212	Algorithms Design and Analysis	3
DS351	Cloud Computing	3	DS350	Information retrieval systems	3
VAR423	Internet of Things	3	PE101	Patriotic Education and University Behavior	3
DS266	Mobile Application Development	3	30801281	Principles of Numerical Analysis	3
DS267	Mobile Application Development lab	1	30801214	Discrete Structures and Mathematics	3
DS339	Data Warehousing	3	*****	Specialization Elective	3
DS 245	Machine learning lab	1			
Total C.H.		17	Total C.H.		18

Fourth year					
First semester			Second semester		
#	Course name	C.H	#	Course name	C.H
DS 461	Software Engineering for data science	3	AR 347	Pattern Recognition	3
DS471	Graduation Project for Data Science Students (1)	1	DS472	Graduation Project for Data Science Students (2)	2
*****	University elective	3	DS474	Field Training for Data Science Students	6
*****	Specialization Elective	3	*****	Specialization Elective	3
*****	Specialization Elective	3			
IEC101	Innovation, Entrepreneurship and Creativity	2			
Total C.H.		15	Total C.H.		14



Course Description

Course Name	: Introduction to Artificial Intelligence	Course Number	: AR142
Credit Hours	: [3] Th. : [3] Pra. : [0]	Prerequisites	: 30202102*
Introduction to artificial intelligence, Uninformed, informed and Adversarial search, Partial observability; CSPs, Propositional Logic and related probability, Bayesian, Bayesian Network inference, Approximate inference in Bayesian Networks, Information gathering, Temporal models. Markov Decision Processes, Learning using Regression and Classification, Linear and Logistic regression, introduction to Learning methods using Bayesian Networks, Reinforcement learning, Q-learning, Probabilistic first order logic.			

Course Name	: Artificial Intelligence Programming	Course Number	: AR241
Credit Hours	: [3] Th. : [3] Pra. : [0]	Prerequisites	: AR142
This course introduces Python programming, it covers basic programming topics, such as variables, functions and loops, to more advanced topics. Moreover, students are expected to explore their programming skills in Lab. with guided programming exercises focusing on AI algorithms and applications.			

Course Name	: Computer Skills (2) for Science Colleges	Course Number	: 30801101
Credit Hours	: [3] Th. : [2] Pra. : [3]	Prerequisites	: CS101*
Basics of programming, algorithm development using top-down design with syntax and semantics of the C++ programming language, creating, compiling and executing C++ programs, primitive data types, operations, Loops, control structures, procedures and functions, arrays and classes.			

Course Name	: Object Oriented Programming	Course Number	: 30801203
Credit Hours	: [3] Th. : [3] Pra. : [0]	Prerequisites	: 30801101
Object-oriented (OO) programming environment, OO building blocks, input/output, loops, decisions, functions, arrays and strings, data structures, encapsulation, advanced variables, object oriented programming, useful OO features, classes and objects, inheritance, composition, polymorphism, method overloading, handling exceptions, thread programming and multithreading.			

Course Name	: Object Oriented Programming Lab.	Course Number	: 30801204
Credit Hours	: [1] Th. : [0] Pra. : [3]	Co-Prerequisites	: 30801203*
Structured Programming Skills Recap, Object-Oriented Programming(OOP) Skills, Classes And Objects, Access Modifiers, Constructors, Constructor Overloading, Destructors, Using Constant in OOP, Using Static in OOP, Methods and Parameter Passing, Array of Objects, Composition, Inheritance, Abstract Classes, Derived Classes, Interfaces, Method Override, Polymorphism, Working with Files, Exception Handling, OOP and GUI.			



Course Name	: Introduction to Unix	Course Number	: AR231
Credit Hours	: [1] Th. : [0] Pra. : [3]	Prerequisites	: -

Introduction:, A brief history of UNIX, Architecture of the Linux operating system, General format of UNIX commands, The UNIX file system, Typical UNIX directory structure, Inspecting file content, Finding files, Sorting files, File compression and backup, Handling removable media, Processes, Pipes, Redirecting input and output, User Information and Communication, Printer control, Email utilities, Advanced text file processing, Manual pages, UNIX editors, The superuser root, User management, Reconfiguring and recompiling the Linux kernel, Cron jobs, Keeping essential system processes alive, Shells and shell scripts, Shell variables and the environment, Simple shell scripting, More advanced shell scripting, Start-up shell scripts.

Course Name	: Calculus (1)	Course Number	: 30202101
Credit Hours	: [3] Th. : [3] Pra. : [0]	Prerequisites	: --

Functions: domain, operations on functions, graphs of functions, trigonometric functions; inverse functions; logarithmic and exponential functions; inverse trigonometric functions; limits and continuity; the derivative: techniques of differentiation, the chain rule, implicit differentiation; differentials; Roll's theorem; the main value theorem; increasing and decreasing functions; concavity; maximum and minimum values of a function, graphs of including rational functions; the indefinite integral; the fundamental theorem of calculus; integration by substitution; the area between a curve and x-axis.

Course Name	: Calculus (2)	Course Number	: 30202102
Credit Hours	: [3] Th. : [3] Pra. : [0]	Prerequisites	: 30202101

Hyperbolic functions; Techniques of integration; L'Hôpital's rule; improper integrals; applications of the definite integrals; Infinite series: geometric, p-harmonic, simple comparison tests, formal power series for some elementary functions, Taylor series; polar coordinates; parametric equations and applications.

Course Name	: Data Structures	Course Number	: AR211
Credit Hours	: [3] Th. : [3] Pra. : [0]	Prerequisites	: 30801203

Introduction to data structures, problem specification and program design, analysis, testing, verification, and correctness of algorithms, logical and physical representation of data, data structure operations, linked lists, queues, stacks, searching and sorting, tree data structures, sorting.

Course Name	: Design and Analysis of Algorithms	Course Number	: AR212
Credit Hours	: [3] Th. : [3] Pra. : [0]	Prerequisites	: AR211

This course is to design efficient computer algorithms, proving their correctness, and analyzing their running times. it includes mathematical analysis of algorithms (summations and recurrences), advanced data structures (balanced search trees), algorithm design techniques (divide-and-conquer, dynamic programming, and greedy algorithms), graph algorithms (breadth-first and depth-first search, minimum spanning trees, shortest paths).



Course Name	: Data Science Fundamentals	Course Number	: DS111
Credit Hours	: [3] Th. : [3] Pra. : [0]	Prerequisites	: 30801101
Introduction to core concepts and technologies: The data science process, data science toolkits, Types of data and example applications. Data collection and management: Sources of data, Data collection and APIs, Exploring and fixing data, Data storage and management, Using multiple data sources. Data analysis: Introduction to statistics, Basic machine-learning algorithms. Data visualization: Types of data visualization: Data for visualization, Technologies for visualization, Future of data science. This course also covers an introduction to programming in Python.			

Course Name	: Probability and Statistics for Data Scientists Lab.	Course Number	: DS233
Credit Hours	: [3] Th. : [3] Pra. : [0]	Prerequisites	: 30202101
Descriptive Statistics. Data Visualization - commonly used charts: Histogram, Box and Whisker Plot and Scatter Plot. Probability Basic Concepts, Permutations, Combinations. Population and Sampling. Probability Distributions - Normal, Binomial and Poisson Distributions. Hypothesis Testing - One Sample and Two Samples - z Test, t Test, F Test, Chi Square Test. ANOVA - Perform Analysis of Variance (ANOVA). The course is based on R statistical programming language.			

Course Name	: Database Design and Management 1	Course Number	: 30801243
Credit Hours	: [3] Th. : [3] Pra. : [0]	Prerequisites	: 30801203
Basic concepts and terminology, database, database administrator, database management systems, characteristics of the database approach, the three level-schema architecture, data independence, the entity relationship model, notations and concepts, the relational model (concepts, constraints and operations), relational algebra, ER to relational mappings, the SQL language, functional dependencies and normalization.			

Course Name	: Database Design and Management 1 Lab.	Course Number	: 30801244
Credit Hours	: [1] Th. : [0] Pra. : [3]	Prerequisites	: 30801243*
Introduction to SQL and environment setup, Working with SQL to query database , create and manage users, Creating schema, DDL statements including CREATE , DROP and ALTER statements , DML including INSERT, UPDATE and DELETE statements, TRUNCATE statement, Retrieving data using the SELECT statement, Restricting and sorting data, Working with single-row functions, Conversion functions and conditional expressions, Reporting aggregated data using the group functions, Displaying data from multiple tables, using subqueries to solve queries, Set operators.			

Course Name	: Data Science Programming Languages	Course Number	: DS210
Credit Hours	: [3] Th. : [3] Pra. : [0]	Prerequisites	: DS111
Introduction to Python. Introduction to NumPy. Data Types in Python, NumPy Arrays, Computations on Arrays, Structured Data. Data Manipulation with Pandas. Visualization with Matplotlib.			



Course Name	: Data Science Programming Languages Lab.	Course Number	: DS212
Credit Hours	: [1] Th. : [0] Pra. : [3]	Prerequisites	: DS210*
This Lab. is to practice the main programming concepts and practices covered in the Data science programming languages course.			

Course Name	: Data Analytics	Course Number	: DS241
Credit Hours	: [3] Th. : [3] Pra. : [0]	Prerequisites	: DS233
Introduction to Data Analytics, Data and Relations. Preparing data for analysis: Cleaning and Pre-processing. Data Visualization, Correlation, Regression, Forecasting, Classification, Clustering.			

Course Name	: Machine Learning	Course Number	: AR243
Credit Hours	: [3] Th. : [3] Pra. : [0]	Prerequisites	: DS233
This course covers essential machine learning algorithms. Topics include supervised learning algorithms (linear and logistic regression, generative models for classification, learning theory), deep learning algorithms (feedforward neural networks, convolutional neural networks, recurrent neural networks), unsupervised learning algorithms (variational autoencoders, generative adversarial networks, mixture models), and reinforcement learning (classic RL, deep RL).			

Course Name	: Machine Learning Lab.	Course Number	: DS245
Credit Hours	: [1] Th. : [0] Pra. : [3]	Prerequisites	: AR243*
This Lab. is to practice the main concepts and practices covered in the machine learning course.			

Course Name	: Data Mining	Course Number	: DS230
Credit Hours	: [3] Th. : [3] Pra. : [0]	Prerequisites	: DS233
Basic concepts behind data mining (DM) (knowledge discovery in databases), DM applications, DM techniques and models, ethics and privacy issues in data mining, main data mining methods, data cleaning, clustering, classification, association rules mining, recent techniques for web mining			

Course Name	: Data Mining Lab.	Course Number	: DS232
Credit Hours	: [1] Th. : [0] Pra. : [3]	Prerequisites	: DS230*
This Lab. is to practice the main concepts and practices covered in the data mining course.			



Course Name	: Information Retrieval Systems	Course Number	: DS350
Credit Hours	: [3] Th. : [3] Pra. : [0]	Prerequisites	: 30801243
Introduction to information retrieval, managing unstructured and semi-structured information, web or enterprise search engines, categorization and recommended systems, information extraction, knowledge management tools, efficient text indexing; Boolean and vector space retrieval models; evaluation and interface issues; Web search including crawling, link-based algorithms, and Web metadata.			

Course Name	: Software Engineering for Data Science	Course Number	: DS461
Credit Hours	: [3] Th. : [3] Pra. : [0]	Prerequisites	: DS111
Principles and practices of software engineering, software quality concepts, process models, software requirements' analysis, design methodologies, software testing and software maintenance, hands-on experience in building a software system using the waterfall life cycle model in the lab environment, software development life cycle deliverables, the requirements, specification and design documents, the system code, test plan, and user manuals. Building and managing a data science team, roles in the data science team: data scientist and data engineer, Qualifications of different data science team members, managing the onboarding process for the team.			

Course Name	: Data Warehousing	Course Number	: DS339
Credit Hours	: [3] Th. : [3] Pra. : [0]	Prerequisites	: 30801243
Data Warehousing, Basic Concepts, OLTP and OLAP, Data Cube, Data Warehouse Implementation, Data Warehouse Architecture, Data Preprocessing, Cleaning, Integration and Transformation, Reduction, Data Mining Techniques, Association rule mining, Apriori algorithm, Mining Association Rules, Cluster analysis, outlier analysis.			

Course Name	: Pattern Recognition	Course Number	: AR347
Credit Hours	: [3] Th. : [3] Pra. : [0]	Prerequisites	: DS230
Pattern Recognition (PR), classification, and description, pattern and feature extraction with examples, training and learning in PR Systems, PR approaches; the Gaussian Case and Class Dependence, Discriminant Functions, Classifier Performance, Risk, Errors., Parametric Estimation and Supervised Learning, Maximum Likelihood (ML) Estimation, The Bayesian Parameter Estimation Approach, Supervised Learning Using Non-parametric Approaches, Parzen Windows, k-nn Non-parametric Estimation, Direct Classification Using the Training Set [The Nearest Neighbor Role (NNR)]; Performance issues of a nearest neighbor classifier, Linear Discriminant Functions, Fisher's Linear Discriminant. Applications of PR techniques.			



Course Name	: Cloud Computing	Course Number	: DS351
Credit Hours	: [3] Th. : [3] Pra. : [0]	Prerequisites	: DS111
This course presents the cloud concepts and capabilities across the various cloud service models including Infrastructure as a Service (IaaS), Platform as a Service (PaaS), Software as a Service (SaaS), and Business Process as a Service (BPaaS). It teaches how to develop Cloud-based software applications for big data on top of various Cloud platforms, how to integrate application-level services built on heterogeneous Cloud platforms.			

Course Name	: Internet of Things	Course Number	: VAR423
Credit Hours	: [3] Th. : [3] Pra. : [0]	Prerequisites	: DS111
This course gives a foundation in the Internet of Things, including the components, tools, and analysis by teaching the concepts behind the IoT and a look at real-world solutions, Introduction to networking, Applications, IoT data management requirements, Architecture of IoT, Technological challenges, RFID and the Electronic Product Code (EPC) network, the web of things, Issues in implementing IoT.			

Course Name	: Project 1 for Data Science Students	Course Number	: DS471
Credit Hours	: [1] Th. : [-] Pra. : [-]	Prerequisites	: +90 Credit Hours
The student is expected to put into action his knowledge gained from the different courses in this study plan through a graduation project. In this level of the course, the student needs to work on the theoretical and design part of his/her project.			

Course Name	: Project 2 for Data Science Students	Course Number	: DS472
Credit Hours	: [2] Th. : [-] Pra. : [-]	Prerequisites	: DS471
The student is expected to put into action his knowledge gained from the different courses in this study plan through a graduation project. In this level of the course, the student needs to work on the implementation and experimentation part of his/her project.			

Course Name	: Field Training for Data Science Students	Course Number	: DS474
Credit Hours	: [6] Th. : [-] Pra. : [-]	Prerequisites	: +90 Credit Hours
Practical training in the field, where students should register as trainees in Data-Science-related sector, under the supervision of the department.			



Course Name	:	Databases Design and Management (2)	Course Number	:	30801340
Credit Hours	:	[3] Th. : [3] Pra. : [0]	Prerequisites	:	30801243
Advanced concepts in the design and implementation of database systems, query optimization, concurrency control, recovery, transaction processing, distributed databases, web and semi-structured data.					

Course Name	:	Advanced Data Structures	Course Number	:	DS 411
Credit Hours	:	[3] Th. : [3] Pra. : [0]	Prerequisites	:	AR211
Advanced Binary Search Trees (BST), Generalized Trees, Red-Black trees, AVL trees, Heaps, Priority Queues, Hash Tables, Graphs, Dynamic Programming, Set Representation.					

Course Name	:	Big Data Analytics	Course Number	:	DS480
Credit Hours	:	[3] Th. : [3] Pra. : [0]	Prerequisites	:	DS241
This course combines multimedia analysis and visual analytics to create systems that analyze large-scale multimedia collections, focuses on images, video, audio and analyzing individual media types. It also introduces a framework for multimedia big data management and retrieval, ranging from multimedia data processing to indexing, query, retrieval, and presentation.					

Course Name	:	Social Network Analysis	Course Number	:	AR445
Credit Hours	:	[3] Th. : [3] Pra. : [0]	Prerequisites	:	DS210
Introduction to social networks, Graph Preliminaries, Max Flow Min Cut, Approximation Algorithms, Types of Networks, Centrality Measures, Community Detection, Proximity Measures, Link Prediction, Network Formation, Event Detection, Social Influence Analysis, students are expected to conduct a survey and/or a term project in groups.					

Course Name	:	Computer Vision	Course Number	:	DS360
Credit Hours	:	[3] Th. : [3] Pra. : [0]	Prerequisites	:	AR243
Introduction to computer vision, fundamentals of image formation, camera imaging geometry, feature detection and matching, stereo, motion estimation and tracking, image classification, scene understanding, and deep learning with neural networks.					



Course Name	: Parallel Processing	Course Number	: VAR306
Credit Hours	: [3] Th. : [3] Pra. : [0]	Prerequisites	: DS230
An introduction to fundamental concepts of parallel processing systems, parallel architectures and topologies of networks, parallel architectures metrics, parallel algorithms, parallel communications, performance evaluation metrics, speedup and efficiency of a parallel interconnection network. Parallel languages, granularity, parallel programming design and debugging. Students will learn about different kinds of parallel architectures and programming environments			

Course Name	: Natural Language Processing	Course Number	: AR344
Credit Hours	: [3] Th. : [3] Pra. : [0]	Prerequisites	: DS350
Words, morphology, and lexicons, Information extraction, question answering, and NLP in information retrieval, Probability and language models, Language model evaluation and smoothing, Noisy channel models, edit distance, and spelling correction, Classification, Word categories and parts of speech, Hidden Markov models and part-of-speech tagging, Chomsky hierarchy and natural language, Syntactic representations of natural language, Parsing algorithms, Treebanks and parsing evaluation, Probabilistic context-free grammars and statistical parsing, Word Embedding and Dense Word Vectors, Beyond context-free parsing, Lexical semantics, Semantic disambiguation problems: word-sense and co-reference, Semantic role labeling, Compositional semantics, Clustering and Expectation Maximization, Machine translation.			

Course Name	: Sentiment Analysis of Big Data	Course Number	: DS482
Credit Hours	: [3] Th. : [3] Pra. : [0]	Prerequisites	: DS241
This course presents to students the process of using large-text analytics to mine various sources of data for opinions. It provides an introduction to the techniques, algorithms and software used in sentiment analysis for big data. It also employs natural language understanding techniques, statistics, or machine learning methods to extract, identify, or otherwise characterize the sentiment content of a text unit.			

Course Name	: Selected Topics in Data Science	Course Number	: DS484
Credit Hours	: [3] Th. : [3] Pra. : [0]	Prerequisites	: +90 Credit Hours
Students are introduced to advanced selected topics in different areas of Data Science not covered in other courses.			

Course Name	: Principles of Numerical Analysis	Course Number	: 30801281
Credit Hours	: [3] Th. : [3] Pra. : [0]	Prerequisites	: 30202102
This course analyzed the basic techniques for the efficient numerical solution of problems in science and engineering. Topics spanned root finding, interpolation, approximation of functions, integration, differential equations and direct and iterative methods in linear algebra			



Course Name	:	Probability and Statistics	Course Number	:	30202131
Credit Hours	:	[3] Th. : [3] Pra. : [0]	Prerequisites	:	30202102

Descriptive statistics, Probability; axioms of probability, rules of probability, conditional probability, independence. Discrete and continuous random variables, expectation, probability distributions. Sampling distributions; t and Chi square and F distributions, CLT. Point estimation: for mean and variance, the difference between two means and the ratio of two variances, testing hypotheses for small, large and dependent samples, correlation, simple linear and multiple regression. Goodness of fit tests.

Course Name	:	Discrete Structures and Mathematics	Course Number	:	30801214
Credit Hours	:	[3] Th. : [3] Pra. : [0]	Prerequisites	:	30202101

Introduction to Logic, Propositional Logic, Predicate Logic, Formal and Informal Proofs, Sets, Set Operations. Functions, Countable and Uncountable Sets. Integers and Modular Arithmetic, Sequences, Summations, Mathematical Induction, Recursion, Counting, Permutations, Combinations, Probability, Relations, Graph Theory, Trees.

Course Name	:	Computers and Networks Security	Course Number	:	DS 248
Credit Hours	:	[3] Th. : [3] Pra. : [0]	Prerequisites	:	30801101

Introduction to computer security , understanding the security issues in computing platforms and operating systems, database security, security policies, entity authentication, defense methods , writing secure programs, computer security threats and attacks including: vulnerabilities in the password authentication system, file system, virtual memory system, respond to potential violations, access control, threats and vulnerabilities to network architectures and protocols, e-mail security, IP security, web security, network attack propagation modeling, traffic analysis, network security management techniques, firewalls.

Course Name	:	Web Application Development	Course Number	:	DS260
Credit Hours	:	[3] Th. : [3] Pra. : [0]	Prerequisites	:	30802323

Introduction to the Web, Web applications, Web application architecture: server-side and client-side scripting, Web standards and technologies, Web application components: The backbone database, the application logic and the user interface, Web-based forms using the HTML language, MySQL database management system, Introduction to the PHP programming language, Building Web services using PHP. This course is taught based on HTML, PHP, and MySQL database management system technologies.

Course Name	:	Web Application Development Lab.	Course Number	:	DS261
Credit Hours	:	[1] Th. : [0] Pra. : [3]	Prerequisites	:	DS260*

This lab is to practice the main concepts and practices covered in the web application development course.



Course Name	:	Mobile Application Development	Course Number	:	DS266
Credit Hours	:	[3] Th. : [3] Pra. : [0]	Prerequisites	:	DS260
Introduction to mobile application development: Market opportunities, challenges, and architectural models. Front-end mobile application clients, Data handling, Connectivity to back-end services, Comparison of technical approaches by Apple (iOS), Google (Android) and Microsoft (Windows Mobile). Install, develop, test, and distribute mobile applications. As mobile environments are changing rapidly, this course provides a broader understanding for specialization in one of these major platforms. Challenges of application development for the mobile market: limited screen size, power, and memory.					
Course Name	:	Mobile Application Development Lab.	Course Number	:	DS267
Credit Hours	:	[1] Th. : [0] Pra. : [3]	Prerequisites	:	DS266
This lab. is to practice the main concepts and practices covered in the mobile application development course.					