

**Princess Sumaya
University for Technology**

THE | 2021

COURSE CATALOG

Graduate Course Descriptions

THE | 2020

COURSE CATALOG

Graduate Course Descriptions

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King Hussein School of Computing Sciences

Master of Computer Science

11711	Data Communication and Networking	Credits hours: 3
	<p>This is an advanced-level course on the recent developments in computer networks. It covers the principles of computer networking with emphasis on algorithms, protocols, and implementation aspects of advanced networking services. The topics covered in this course include the design of the Internet and its basic mechanisms and protocols in addition to selected advanced recent topics of research in networking such as routing, congestion control, wireless and mobile networks, and performance analysis of computer networks. Most of the course material will be covered via state-of-the-art research papers. The students will be assigned research papers and articles to read, summarize, criticize, and/or present; in addition to working on a research project and writing a research paper.</p>	
11712	Operating Systems	Credits hours: 3
	<p>Theoretical and practical aspects of operating systems. Process and thread communication and synchronization. File systems, disk management, I/O systems, protection and security systems, distributed system, real-time and multimedia systems, mobile operating systems, current trends in operating systems. Study of recent papers in operating systems.</p>	
11713	Computer Architecture	Credits hours: 3
	<p>Fundamentals of Computer Design: overview of history and trends in processor design, measuring and reporting performance, motivations for the modern trend towards simpler architectures. Performance Enhancement Techniques: advanced topics in pipelining topics, fine grain (instruction level) parallelism. Memory System Issues: discrepancies between memory speed and processor speed, introduction to multiple cache systems, overview of advanced storage systems. Parallel Processing: fine-and coarse-grained parallelism, introduction to tightly-and loosely-coupled designs, interconnection networks, multiprocessors.</p>	
11714	Cloud Computing	Credits hours: 3
	<p>The course gives an introduction to cloud computing, its techniques and main components. It covers the topics of data centers, virtualization, cloud storage and programming models. It discusses the motivating factors, benefits, challenges, and service models. It describes several concepts behind data center design and management. It also presents virtualization, data distribution, durability, consistency and redundancy.</p>	

11715	Parallel Processing		Credits hours: 3
<p>With the growing number of cores on a chip, programming them efficiently has become an indispensable knowledge for the future. Modern Parallel Programming is a hands-on course involving significant parallel programming on compute-clusters, multi-core CPUs and massive-core. The main topics of Parallel processing course will cover the basic and Introduction of parallel computer architectures, Parallel computing using the Message-Passing Interface (MPI), Parallel Programming Paradigms, Standard Parallel Architecture, Evaluating parallel programs, Partitioning strategies, Pipelined computations, Load balancing, Algorithms and applications of different important topics related to modeling different algorithms such as: sorting algorithms, numerical algorithms and image processing.</p>			
11722	Human Computer Interaction		Credit Hours: 3
<p>The purpose of this course is introducing human-computer interaction (HCI). HCI as an interdisciplinary field that integrates theories and methodologies from computer science, cognitive psychology, design and many other areas. Course readings will span current theory and practice in interface specification, design and evaluation, as well as current and classic research papers in HCI. There are three major components to the course, treated in parallel during the semester. The central focus of the course is a semester-long team project, in which students will design, implement and evaluate a user interface. Teams will be incrementally led through the phases of ethnographic study and requirements analysis, scenario-based design, paper prototyping, computer prototyping, and several methods of usability analysis and evaluation. The second component of the course involves exposure to current research in HCI, in order to provide students with an understanding of the range of issues addressed in the field, to provide them with practice reading, presenting and critiquing HCI research, and to provide ideas for team projects. This component of the course will be implemented in a seminar style, with students presenting and critiquing short HCI research papers each week. The third component of the course involves an introduction to the study of user experience (UX), involving different types of users groups. At the end of the course, students will be equipped the ability to:</p> <ul style="list-style-type: none"> • Design, implement and evaluate effective and usable graphical computer interfaces • Describe and apply core theories, models and methodologies from the field of HCI. • Describe and discuss current research in the field of HCI. • Describe and apply UX elements in computer interface design 			

11723	Advanced Software Engineering		Credit Hours: 3
	<p>The course will explore advanced specifications and design, component-based software engineering, rapid development processes and techniques, advanced validation and verification methods, configuration management, and other advanced topics.</p> <p>The main objective of this subject is to prepare students for their career as Software Engineers. They will learn a collection of essential techniques that enable them to construct highly reliable software. The study will be done not in the abstract, however, but through the use of actual tools supporting these techniques.</p>		
11724	Software Quality		Credit Hours: 3
	<p>Quality: how to assure it and verify it, and the need for a culture of quality. Avoidance of errors and other quality problems. Inspections and reviews. Testing, verification and validation techniques. Process assurance vs. Product assurance. Quality process standards. Mechanisms for Software test at the unit, module, subsystem and system levels, automatic and manual techniques for generating and validating test data, the testing process, static vs. dynamic analysis, functional testing. Tradeoffs between software cost, schedule, time, and quality, integration of quality into the software development process as well as the principles of test planning and test execution. Upon completion of this course, students will be able to Conduct effective and efficient inspections, design and implement comprehensive test plans, apply a wide variety of testing techniques in an effective and efficient manner, compute different testing metrics according to a variety of criteria, and assess software and evaluate software quality.</p>		
11731	Database Management		Credits hours: 3
	<p>Review of topics related to the engineering and design of database systems, including data models; database and schema design; schema normalization and integrity constraints. Object-Oriented Database Modeling and Development. Query processing; query optimization and cost estimation. Transactions; recovery; concurrency control; isolation and consistency; distributed, parallel and heterogeneous databases; adaptive databases. Large databases and data warehousing. Semi structured data and XML querying. Lectures and readings from original research papers. Semester-long project and paper.</p>		
11732	Information Security		Credits hours: 3
	<p>This course focuses on the fundamentals of information security. Students will learn the principles of information security, security architectures and models, and aspects and methods of information security such as physical security control, operations security, access control, hacks/attacks/defense, systems and programs security, cryptography, network and web security, worms and viruses, and other Internet secure applications. The course covers the following topics: system security issues, authentication systems, IP security, web security, access control, firewalls, data integrity through encryption, virtual private networks, SSL, SSH, and IPsec.</p>		

11734	Data Mining		Credits hours: 3
	Introduction to data mining, data preprocessing and cleaning, data exploration and visualization. Classification: decision trees, Bayesian classifiers, rule-based classifiers, instance-based methods, Neural Networks, ensemble methods, evolutionary computation algorithms, model evaluation and model selection techniques. Clustering: centroid-based clustering, density-based clustering, hierarchical clustering, cluster evaluation techniques. Association Analysis: A priori and FP-Growth algorithms. An introduction to advanced topics like: text mining, graph mining, stream mining, big data processing and big data analytics. Data mining and big data tools and software libraries.		
11739	Selected Topics in Computer and Information Technology		Credits hours: 3
	Topics will be assigned by the department on evolving techniques and related topics to support the study plan and to encourage further research by students.		
11740	Algorithms		Credits hours: 3
	Review of algorithm design and analysis techniques: asymptotic notation and design techniques. Advanced problems in dynamic programming (e. g., edit distance, matrix chain multiplication and the partition problem). Advanced topics in graph algorithms: all pairs shortest paths, graph connectivity. Network flow and bipartite matching. String matching and suffix trees. Randomized algorithms. NP-Completeness: complexity classes (P, NP, NP-complete, NP-hard), NP-completeness reductions, dealing with NP-complete problems (approximation algorithms, branch-and-bound, integer linear programming). Selected advanced topics (if time allows), such as number theoretic algorithms, computational geometry and parallel algorithms.		
11742	Programming Languages		Credits hours: 3
	This course discusses advanced principles in programming language design models. Topics include control, data abstractions, binding, indeterminacy, delayed evaluation and languages and models for parallel and distributed processing. A variety of programming language paradigms are discussed: functional programming, logic programming, object oriented programming and data flow programming.		
11743	Information Theory		Credits hours: 3
	This course provides the students with an understanding of the principles and applications of information theory. It covers the quantitative theory of information and its applications to reliable, efficient storing, coding and communication data. The course topics include mathematical definition and properties of information, source coding theorem, lossless and lossy compression of data, optimal lossless coding, noisy communication channels, channel coding theorem, the source channel separation theorem, multiple access channels, broadcast channels, Gaussian noise, and time-varying channels.		

11745	Numerical Methods		Credits hours: 3
	<p>This course provides an introduction to a range of numerical procedures, methods and algorithms designed to solve advanced problems that cannot be solved by standard techniques. Practical numerical ones, provides alternative algorithms and methods of solution that are practical even for simple and very large systems which cannot be solved analytically. This course will cover floating - point representation, Advanced numerical methods of solutions of Linear and Nonlinear Systems and its applications in environmental, imaging, finance and Igraphic, Application of finite difference methods, Sparse structures of discrete problems, methods for stability and convergence analysis, Fourier analysis, energy method, Rates of convergence and the model problem analysis, advanced methods of Interpolation and error analysis, stability and convergence, Simulation parallel numerical algorithms and its software. Numerical Projects related to: Computer, Engineering, Environmental, Finance, Transportation and other topics will be covered in this course.</p>		
11751	Digital Image Processing		Credits hours: 3
	<p>This course is designed to help students develop a practical understanding of the various techniques of digital image processing. The course starts with the introduction to digital image fundamentals. Other topics include: Sampling and Quantization, Edge Detection Techniques, Image Segmentation, Texture Analysis, Image Restoration, Noise Removal, Character Recognition and various image optimization techniques.</p>		
11753	Artificial Intelligence		Credits hours: 3
	<p>The course is divided into four parts, the first covering knowledge representation, the second introducing heuristic search and constraint satisfaction and the third is dedicated to advanced topics such as rule-based Expert Systems, case-based reasoning, model based reasoning. The fourth part is dedicated to machine learning techniques and theory. The following topics will be discussed in the course: introduction to AI and applications; exhaustive search methods; heuristic search methods; First order logic for knowledge representation; other knowledge representation schemes such as semantic networks, frames; production rule systems; principles of expert systems; Knowledge acquisition, planning and scheduling, machine learning techniques: decision trees, neural networks, Instance-Based-learning, Naïve Bayesian learning, Bayesian networks and learning theory.</p>		
11754	Computer Simulation and Modeling		Credits hours: 3
	<p>Concepts and techniques of computer simulation modeling are presented. Use of computer simulation to design and operate complex processes and systems is discussed. A simulation language is presented. Design, implementation, validation, and analysis of results of computer simulation models and experiments are studied. The course also discusses applications of computer simulations for different topics such as: scheduling activities, application of simulation and modeling using mathematical models related to environment, engineering, and building applied mathematical models to be applied in the different administration topics, manufacturing, finance and commercial one. Studying the mathematical applied part of modeling based on differential or partial differential topics, in addition to the studying the probability and statistical topics related to modeling and simulation, and prediction too.</p>		

11757	Natural Language Processing		Credits hours: 3
	<p>This course covers the fundamental concepts and ideas of natural language processing (NLP). It develops an in-depth understanding of both the algorithms available for the processing of linguistic information and the underlying computational properties of natural languages with focus on Arabic language. Word level, syntactic, and semantic processing from both a linguistic and an algorithmic perspective are considered. The focus is on modern quantitative techniques in NLP: using large corpora, statistical models for acquisition, disambiguation, and parsing. The main NLP applications will be presented: Information Extraction, Question Answering, Summarization, Dialogue and Conversational Agents, and Machine Translation.</p>		

Master in Information Systems Security and Digital Criminology

11761	Digital Forensics Investigation		Credit hours: 3
	<p>In this cybercrime course, students will become familiar with the basics of solving cybercrimes. By learning how to identify, protect and gather evidence, retrieve data, prepare crime reports and present information in courts, students master the correct methods for investigating cybercrimes so they can be solved and prosecuted. Students read case studies to become familiar with cybercrime scene investigation techniques. Techniques and tools used to build and solve cybercrime cases are presented and analyzed. Also, the requirements for conducting a cybercrime investigation through lecture, practical exercises, scenarios and case studies are presented. Students will learn the processes, techniques, specialized documentation, and legal guidelines necessary to investigate a computer crime.</p>		
11762	Secure Software Development		Credit hours: 3
	<p>This course covers the security and safety analysis in software design and development. It defines and identifies vulnerability detection and avoidance. Topics include threat modeling, defensive programming, web security and the interaction between security and usability authentication, principle of least privilege, buffer overflows, race conditions, time-of-check vs. time-of-use, trust management, access control, and other security relevant issues.</p>		
11763	Data Communication and Network Security	Pre-requisite: 11732	Credit hours: 3
	<p>This course introduces key issues in data communication and network security. Topics covered include definition of security, network security, digital signatures, IP security, secure socket layer, intrusion detection, authentication, firewalls, and denial of service, spam, email viruses, phishing, and an overview of many attacks that the Internet has experienced.</p>		
11764	Hacking Techniques and Intrusion Detection	Pre-requisite: 11732	Credit hours: 3
	<p>This course covers the most common methods used in computer and network hacking with the intention of learning how to better protect systems from such intrusions. These methods include reconnaissance techniques, system scanning, and system access by network and application level attacks, and denial of service attacks. Traffic analysis methods and tools will be studied in this course. Also, it covers the techniques for traffic filtering and monitoring, and intrusion detection.</p>		
11765	Biometrics		Credit hours: 3
	<p>Biometrics is capturing and using physiological and behavioral characteristics for personal identification. It is set to become the successor to the PIN. This course will introduce computational methods for the implementation of various biometric technologies including face and voice recognition, fingerprint and iris identification, and DNA matching</p>		

11766	Advanced Digital Forensics	Pre-requisite: 11761	Credit hours: 3
	This course cover advanced topics in computer security and forensics such as cryptography, automatic intrusion detection, pattern matching and statistical techniques, firewalls, and vulnerability scanning.		
11767	Wireless Security and Forensics		Credit hours: 3
	This course looks at wireless network security in a defensive view. The program is designed to provide fundamental skills needed to analyze the internal and external security threats against a wireless network and to develop security policies that will protect an organization's information. Students will learn how to evaluate network and Internet security issues and design, and how to implement successful security policies and firewall strategies. In addition, they will learn how to expose system and network vulnerabilities and defend against them.		
11768	OS and file systems Forensic Analysis		Credit hours: 3
	This course focuses on configuring a secure OS using command line and graphical utilities. Emphasis is placed on file sharing technologies such as the Network File System, NetWare's NCP file sharing, and File Transfer Protocol. Additional topics include data security, user security, file security, and network intrusion detection. Students will be required to take on the role of problem solvers and apply the concepts presented to situations that might occur in a work environment.		
11769	Cryptography		Credit hours: 3
	This course will cover the cryptography and crypto-analysis techniques. It will introduce the symmetric and asymmetric encryption, private and public key encryption, and key distribution, cryptographic hash functions stream ciphers, zero-knowledge proof systems, cryptanalytic attacks and brute-force attacks.		
11781	Cyber Law and Crime Fundamentals		Credit hours: 3
	This course will explore the legal issues affected and created by on-line crime. The course will examine the evolution of criminal law relative to the development of new technology – primarily as it relates to on-line crime. Students will examine 3 primary areas that include technology relevant to on-line crime, behavior criminalized in cyberspace, and privacy laws governing law enforcement investigations in cyberspace. Topics will include: the evolution, nature and scope of cybercrime; forensic analysis of digital evidence; on-line investigative techniques; including identity theft, Internet fraud, and new technologies affecting on-line crime.		

12782	Forensics Expert in Courtroom	Pre-requisite: 11761, 11781	Credit hours: 3
	Students study the uses of technology and scientifically trained expert witnesses at trial. This course provides “hands-on” experience in developing and presenting computer evidence testimony in a courtroom setting. Topics covered are computer forensic investigations, computer evidence issues and presentation of computer evidence in court or in a deposition. Topics covered are used by members of computer incident response teams, law enforcement computer crime units, military computer specialists, lawyers and judges. However, it is recommended that students have a solid working knowledge of DOS and Microsoft Windows-based computers. Legal experience is not a prerequisite.		
11783	Information System Risk Management		Credit hours: 3
	This course introduces and defines the main types of risks that the information system in organizations may face and need to consider to ensure their security and business continuity. This course focuses on the identification and assessment of assets, threats and vulnerability in order to plan the appropriate information system security in the organization. It will survey preventive and containment techniques available to address the potential risk areas. The contingency planning, incident response planning, business continuity planning and disaster recovery will be covered too.		
11784	Special Topics in Information Systems Security and Digital Criminology	Pre-requisite: 11732	Credit hours: 3
	Topics will be assigned by the department on evolving techniques and related topics to support the study plan and to encourage further research by students		
11786	Information System Auditing		Credit hours: 3
	This course aims at introducing the foundations of auditing information systems. It covers the concepts of the audit process, governance, and compliance regulations, as well as the latest technology tools. Students will learn the role of an auditor and the types of audits performed, various information security and audit frameworks, as well as the tools and techniques of auditing technical controls, foundations of auditing operating systems, and foundations of auditing applications. In addition, this course will cover the following topics: the information systems audit process, data collection methodologies, regulations and compliance, auditing, vulnerability testing, penetration testing, auditing technical controls, auditing networks & operating systems, and auditing business application systems.		
11787	Disaster and Crises Management	Pre-requisite: 11783	Credit hours: 3
	This course covers topics related to disaster recovery and emergency planning and management as applied to the information-systems function in corporations. Topics include security risk evaluation and management, creation of threat profiles, continuity of operations planning, contingency planning, and incident reporting. A self-directed approach/tool for the conduct of information security risk evaluation is introduced. Projects include developing a security protection strategy and plan.		

11789	IT Project Management		Credit hours: 3
	This course defines and covers the characteristics of IT projects and introduces the student to a variety of project management techniques that can be applied in an IT project context. Managing scope, time, cost, and quality will be explored. The course will cover project management issues associated with information systems security projects as well as other IT projects such as packaged software implementation (e.g., ERP systems), in-house developed systems, and outsourced projects.		
11791	Seminar		Credit hours: 3
	In this course students will have the opportunity to merge their studies with their professional interests and experiences. Students will select topics for study and research according to their areas of interest in information systems security, cyber-crimes, computer criminology, legal, ethical and social impacts of ICT and IS security. Ultimately, each student will produce a written paper. Successful course completion requires compliance with rigorous academic research standards, production of a final paper and an oral presentation by the student on the paper topic.		
11792	Project	Pre-requisite: Finish 15 CH	Credit hours: 3
	Students will conduct an individual study to demonstrate the ability to formulate, investigate, and analyze a problem and to report results. Written report and oral presentation are required. The project proposal must be approved by a major professor and/or supervisory committee. The project document should be written with direction from a major professor and/or supervisory committee and in accordance with the description to be provided to students. Upon completion, both the project and the document must be successfully defended to the department in an open forum with approval from the major professor and/or supervisory committee		
11798	Comprehensive Exam	Pre-requisite: Finish 33 CH	Credit hours: 0
	A comprehensive exam is an evaluation that measures a student's competency and mastery of concepts in the field of an academic discipline. Upon the completion of 33 credits, a student is eligible to register for the exam.		
11799	Thesis	Pre-requisite: Finish 15 CH for Computer Science	Credit hours: 9
	Each student must complete, document, present and defend a thesis under the supervision of a faculty member in the fields of Information Systems Security and Digital Criminology or Computer Science. Every candidate must complete a thesis (equivalent to 9 credit hours) describing research work of publishable quality. The thesis must be defended before a committee consisting of the supervisor and at least three other faculty members, one from outside the university, in the relevant fields. The thesis defense is open to all interested faculty and students. Upon the completion of 12 credits, a student is eligible to register for thesis.		

Master of Enterprise System Engineering

13711	Business Data Communications and Networks		Credit hours: 3
	This module covers the computer networking basis and components. It introduces the design strategies used to solve computer networking problems and it explains how the networks work. Such a course will be supported by practical activities.		
13732	Information System Security:		Credit hours: 3
	This course covers issues related to the detection, evaluation, analysis and management of security risks facing the information systems and networks in organizations. Topics include fundamental concepts of information security, network security issues, intrusion detection systems, threat and attack strategies, vulnerability analysis, formal models of security, Authentication and access control systems, cryptography, risk management, contingency planning and incident handling, alarms and responses. The course will study in detail principles and tools related to these topics. The course will also cover security standards, security planning, and ethical and legal issues in information security.		
13741	E-Business		Credit hours: 3
	E-Business is radically changing the ways in which business organizations operate and compete in the global market. This course introduces students to various aspects and models for e-business. It provides an overview of e-business from architectural and managerial perspectives. This includes fundamental concepts and frameworks for exploring e-business opportunities by comparing and contrasting e-business models. The course will also examine E-Business strategies and implementation issues faced by new Internet ventures as well as established firms. Current issues surrounding E-Business practices such as electronic commerce infrastructure, designing on-line storefronts, payment acceptance and security issues, and the legal and ethical challenges of e-business will also be discussed. Students will also gain hands-on experience in creating a web site using an HTML JSP, and PHP, authoring tool.		
13742	Enterprise Systems Architecture		Credit hours: 3
	This module intends to frame the student with the actual situation of Enterprise information systems development and integration. From nowadays and future context emerge the need to develop solutions efficiently integrated with existent ones (legacy) and competitive against new business paradigm rules: flexibility to multimodal support, agility to easily adapt and react to continuous requirements changes and interoperable with different solutions. Cloud-based Multi-Enterprise Information Systems scenarios will be considered.		

13743	Cloud Computing and Big Data		Credit hours: 3
	<p>This module will provide hands on study of cloud computing and big data. The first part of the class will introduce the benefits of cloud computing as well as the challenges associated with it. The course will introduce different models of services that are common in cloud computing, namely: Infrastructure as a Service (IaaS), Platform as a Service (PaaS), and Software as a Service (SaaS). The class will discuss the types of clouds and benefits of each one as well as its cost model. Finally, the class will study current commercial offerings from major providers of cloud computing solutions like Amazon, Google, Microsoft and others. The second part of the class – Big data - will explain the challenges with analyzing the huge amounts of data being generated by worldwide social media and web applications. The course will adopt a map reduce framework (ex: Hadoop) to demonstrate the analysis of big data.</p>		
13745	Enterprise Strategic Management		Credit hours: 3
	<p>The course prepares students to become familiar with strategic vision, strategic planning, strategic diagnosis, strategic choices strategy implementation, creating value for the enterprise stakeholders. It includes an understanding of technology innovation, power relationships and key factors of enterprise competitiveness and performance in each functions especially financial function.</p>		
13746	Testing/Quality Management		Credit hours: 3
	<p>This is an IT development course. Students will be familiar with the roles of both testing and quality management for ESE. Students will be equipped with necessary knowledge, tools, and techniques for developing effective sound tests, analyzing test results, and assessments of both correctness and quality of ESE products</p>		
13747	Enterprise Business Intelligence:		Credit hours: 3
	<p>This module gives an introduction to the electronic business. Graduates will be familiar with the basic and current technologies together with advanced concepts, applications, and competitive strategies in the context of enterprise business intelligence supported by practical examples.</p>		
13751	Human Computer Interactions & Social Media		Credit hours: 3
	<p>The students learn the Understanding the Needs of Users Software, Benefits and Business Areas. In addition he will be able to be Establishing Requirements through Data Gathering and Design Methodologies & Design Principles. The student will be able to Prototyping and Construction and finally Evaluating Interaction Design and Interaction Devices. Finally students will be able to make Information Search and Visualization system.</p>		

13752	Integrated Application Systems		Credit hours: 3
	Based on the following of value chain of industrial enterprises business processes over all its R&D, sales, procurement, production, logistics and service departments, an introduction and overview of standard enterprise activities supported by information systems will be given. It will be shown which functions of the processes are supported by which information systems and by which methods. An "Enterprise Resource Planning system" (ERP) plays here a significant role to integrate and support business process activities. The main key elements and structure of an ERP system will be described and explained.		
13753	Customer Relationship Management (CRM)		Credit hours: 3
	Students will become familiar with the importance of customer relationship servicing in companies, and they will learn what functions and what tools in customer relationship management are necessary. Students will learn and work on recommendation engines as a tool to design a mutually profitable interaction between companies and customers, and become familiar with their functions, requirements and process evaluation mechanisms of recommendation systems.		
13754	SCM/Logistics		Credit hours: 3
	Students will become familiar with logistics and supply chain which include all the activities required to move product and information to, from, and between members of a supply chain. The supply chain provides the framework for businesses and their suppliers to jointly deliver goods, services and information efficiently, effectively, relevantly and in a sustainable manner to customer. Supply Chain Management presents the mission, business processes, and strategies needed to achieves integrated logistical management.		
13755	Enterprise Mobile Computing		Credit hours: 3
	The goal of this course is to provide an in depth understanding of the fundamental problems in the area of integration of Mobile Devices into Enterprise Systems and study the existing and proposed solutions for these problems from both research and development perspective. This course will introduce students to mobile computing and mobile application development. Topics covered include: mobile and wireless environment; mobile device technology; mobile computing architecture and protocols; mobile computing security; and applications in wireless and mobile computing, including distribution applications, mobile middleware, mobile information and database access, mobile multimedia, remote execution, user interface and user experience. Students will be expected to learn at least one mobile application development framework (Android) and use it to implement their assignments and course project.		

13756	Interoperability Systems		Credit hours: 3
	System Interoperability course covers the ability of diverse systems and organizations to work together (inter-operate). It set a broad frame work on the services which allow for information exchange with heterogeneous systems takes into account social, political, and organizational factors that impact system to system performance.		
13757	Human Resource Management		Credit hours: 3
	This is a skill development course designed to equip participants with necessary knowledge, tools and techniques for leading people towards organizational and individual success. The novelty in this course is considering positive psychology a cornerstone towards development of people leadership skills. The course revolves around three main skill sets which are personal skills, interpersonal skills and group skills. Each group of skills include specific skills that proved to be most required in the current labor market such as the ability to solve problems analytically and creatively, communication skills, motivating others, building high performing teams and teamwork and leading positive change. Moreover, the course is designed to help in filling in main leadership skills gap discovered by different survives conducted and funded by Tempus. These survives have been submitted to different sizes and types of enterprises in Egypt, Tunis and Jordan. The main focus is on promoting effective people management practices and addressing current management challenge. This will be achieved pragmatically rather than theoretically. Therefore, active learning is the fundamental mechanism through which this course is delivered. Participants are expected to be engaged in activities and higher order thinking (analysis, synthesis and evaluation) since more emphasis is placed on skill development rather than information transmission.		
13758	Advanced Applied Mathematics		Credit hours: 3
	The advances in technology and business are achieved by applying technical knowledge from statistics, computing science, finance, economics, management and mathematics. The advanced applied mathematical curriculum deals with computer and computational methods that play an important role in all of these areas. It prepares students to deal with mathematical problems that arise in science, engineering, or management. The curriculum will emphasize on the construction, analysis, evaluation of mathematical models of real-world problems and the mathematical methods used to solve them. These models are analyzed to form better decisions in areas such as management, engineering, and the social sciences. In mathematical programming, a problem is modeled as an objective function then the resulting model is optimized. The models are solved using computer programs.		

13759	IT Outsourcing		Credit hours: 3
	<p>Information Technology Outsourcing has become increasingly popular over the past years. This course will outline the major aspects of outsourcing with a focus on IT. It will explore the conditions in which outsourcing makes sense and conditions where short term cost gains are offset by long term systemic issues. The costs of outsourcing may outweigh the benefits, if outsourcing activities are not effectively managed. The course will introduce students to IT outsourcing and why do companies choose to outsource IT functions. Furthermore, the course will discuss the challenges of managing IT outsourcing and managing IT vendor relationships. Techniques which increase IT outsourcing success for both clients and vendors will be discussed.</p>		
13786	Special Topics in Enterprise System Engineering		Credit hours: 3
	<p>Topics will be assigned by the department on evolving techniques and related topics of enterprise system engineering to support the study plan and to encourage further research by students.</p>		
13789	IT Project Management		Credit hours: 3
	<p>This course provides education in the basic principles of project management, starting from concepts from the initiating, planning, executing, monitoring & controlling, and closing process groups. Course provides fundamental knowledge in ten project management knowledge areas: integration, scope, time, cost, quality, human resources, communications, risk, procurement, and stakeholder management. This course provides training and experience with project management tools and techniques, including work breakdown structures, cost estimates, Gantt charts, network diagrams, critical path analysis, risk management, earned value management, and other tools. Students will have opportunity to apply project management principles to real-world situations.</p>		
13791	Research Methodologies		Credit hours: 3
	<p>This course aims to introduce students to a number of research methods useful for academic and professional investigations of information practices, texts and technologies. It provides an understanding of the different decisions and steps involved in executing a research methodology. Students, after this course, will be able to understand the research terminology, ethical and research principals, challenges and processes and using the quantitative/qualitative and hybrid methods approaches to research. In addition to knowing the literature review process and the evaluation methods combined with analyzing and evaluating others' published research - Reporting a project's results.</p>		

13798	Comprehensive Exam		0
	The comprehensive examination aims to measure the student's ability to understand and make correlations between the basic and advanced concepts that he/she has acquired through his/her studies, and to apply them in solving theoretical and applied problems in his/her field of specialization.		
13799	Thesis		9
	The thesis aims to prepare the student for carrying out research in his/her field of specialization. The student should write his/her thesis using sound scientific language and methodology. The work should be original, contain a new scientific achievement, and contribute to deepening knowledge in the field of specialization. It should not violate academic integrity.		

Master of Data Science

14711	Computational Statistics	Credit hours: 3
	<p>The objectives of this course are to develop an understanding of modern computationally intensive methods for statistical inference, exploratory data analysis. Advanced computational methods for statistics will be introduced, including univariate, multivariate and combinatorial optimization methods and simulation methods. In addition, the course will demonstrate how to apply the above techniques effectively for use on large data sets in practice. Finally, this course will show how to make inferences about populations of interest in data mining problems. In addition to that, other topics that will be covered include: theory of sampling distributions; principles of data reduction; interval and point estimation, sufficient statistics, order statistics, hypothesis testing, correlation and regression.</p>	
14721	Data Engineering	Credit hours: 3
	<p>The course starts by examining the modern data ecosystem and how it relates to running a smart and efficient data hub. Then, it shows the student how to perform the principle tasks involved in managing extracting, transforming and loading (ETL) data. This course will explain the data life cycle in a Data science project. In addition, it will cover types of data, such as structured, semi-structured and unstructured and the different formats of data and techniques used in the ETL process. The course also covers the elementary visualization aspects needed to understand the data. It also takes the student through staging, profiling, cleansing, and migrating data.</p>	
14722	Data Mining	Credit hours: 3
	<p>This course provides a practical and technical introduction to knowledge discovery and data mining. The topics that will be covered include problems of data analysis in databases, discovering patterns in the data, and knowledge interpretation, extraction and visualization. The topics include all data mining and machine learning techniques used for descriptive and predictive analysis. Such as clustering, association rules mining, classification, prediction. This course is an absolute necessity for those interested in joining the data science workforce, and for those who need to obtain more experience in data mining.</p>	
14723	Big Data	Credit hours: 3
	<p>This course provides the data science students with understanding of the Big Data and its role in data analysis. It provides the terminology and the core concepts behind big data problems, applications, and systems. It provides an introduction to one of the most common frameworks, Hadoop and Spark that have made big data analysis easier and more accessible. Also, it will provide you with the necessary skill in manipulating big data distributed over a cluster using functional concepts and in-memory distributed collections framework written in Scala or Spark. We'll cover Spark's programming model in detail, being careful to understand how and when it differs from familiar programming models, like shared-memory parallel collections or sequential collections. Through hands-on examples in Spark and Scala, student learns when important issues related to distribution like latency and network communication should be considered and how they can be addressed effectively for improved performance.</p>	

14724	Data Exploration and Visualization	Pre-requisite: 14721	Credit hours: 3
	<p>This course covers the essential exploratory techniques for summarizing data. These techniques are typically applied before formal modeling commences and can help to inform the development of more complex statistical models. Exploratory techniques are also important for eliminating or sharpening potential hypotheses about the world that can be addressed by the data. We will cover in detail the plotting systems using various tools as well as some of the basic principles of constructing data graphics. We will also cover some of the common multivariate statistical techniques used to visualize high-dimensional data. The course also aims to facilitate the data analytics process through Information Visualization. The challenge for Visual Analytics is to design and implement “effective Visualization methods that produce pictorial representation of complex data so that data analysts from various fields (bioinformatics, social network, software visualization and network) can visually inspect complex data and carry out critical decision making.</p>		
14725	Web and Social Network Analysis		Credit hours: 3
	<p>The course covers concepts and techniques for retrieving, exploring, visualizing, and analyzing social network and social media data, website usage, and clickstream data. Students learn to use key metrics to assess goals and return on investment, perform social network analysis to identify important social actors, subgroups, and network properties in social media. Distributions of Random Variables; Conditional Probability and Stochastic Independence; Some Special Distributions (Discrete and Continuous Distributions); Univariate, Bivariate and Multivariate Distributions; Distributions of Functions of Random Variables (Distribution Function Method, Moment Generating Function Method, and the Jacobian Transformation Method); Limiting Distributions.</p>		
14728	Mining Massive Datasets	Pre-requisite: 14722, 14723	Credit hours: 3
	<p>Pivotal issues pertaining to mining massive data sets will range from how to deal with huge document databases and infinite streams of data to mining large social networks and web graphs. This course will discuss data mining and machine learning algorithms for analyzing very large amounts of data. The emphasis will be on Map Reduce/Spark as a tool to implement parallel algorithms such as PageRank, EdgeRank and graph centrality that can process very large amounts of data. Hands on experience will be obtained through case studies that demonstrate how big data problems and their solutions allow organizations to succeed in the market.</p>		
14729	Selected Topics in Data Science		Credit hours: 3
	<p>Topics are selected from different areas in Data Science that are not covered in the description of the courses listed in the curriculum. This course will cover recent trends and issues in the field of data science and will be chosen at the discretion of the instructor. A sampling of just a few of the subjects covered in this course are: NoSQL, Deep Learning. Students are assigned individual projects in specific fields. Project reports and seminars will be required in order for the students to demonstrate their ability in research and oral presentations. Projects are discussed in groups in order involve the whole class in these subjects.</p>		

14731	Business Modeling for Data Science		Credit hours: 3
	<p>This course aims at providing students with essential skills needed to design and develop innovative and consistent business models to increase profits, decrease expenses, minimize risks, or comply with laws and regulations in smart and proactive ways in organizations. The course introduces students to the dimensions of business models along with their elements and relationships. It also enables students in the area of understanding and analyzing business requirements of data-driven projects. The course introduces students to data analytics lifecycle and allowing them to understand the methodological process that business modelers go through while developing big data applications. Finally, the course will provide students with many practical use cases that are related to various sectors.</p>		
14732	Business Intelligence	Pre-requisite: 14731	Credit hours: 3
	<p>This course is intended to provide an integrative foundation in the field of Business Intelligence (BI) at the operational, tactical, and strategic levels. The course introduces the concept of business intelligence and describes the concept of BI system, The Business Demand for Data, Information, and Analytics. Students are exposed to the classical data warehouse, BI architecture framework, and Business Intelligence development process based on Kimball's project approach. The course will explain what business intelligence can offer to organizations and demonstrate how business intelligence is used in the real world; and finally provide an action plan for identifying and acting on the BI opportunities that exist in an organization.</p>		
14733	IT Projects Management for Data Analysis		Credit hours: 3
	<p>The main goal of this course is to gain a clear understanding of the five IT Project Management Process Groups (Initiating, Planning, Executing, Monitoring and controlling, and Closing) and learn how these processes interact with each other to successfully achieve project objectives. Discover how to integrate the ten Knowledge Area processes, tools and templates in the workplace. Concepts include stakeholders, scope, quality, time, cost, human resources, communication, risk, procurement and project integration management. Students will also apply techniques such as stakeholder analysis, work breakdown structure, scheduling, estimating, risk assessments, contracts and change control. Students will have the opportunity to apply project management principles to real-world situations.</p>		
14791	Research Methodology Seminar		Credit hours: 1
	<p>This one credit hour course will review the major considerations needed in conducting scientific research, particularly in the fields of Computer Science and data science. The topics covered include: Definitions and characteristics of research; Types of research; Topic Selection; Research methodology; Evaluation and validation of research results; writing, publishing, presenting research work; intellectual property and ethics.</p>		

11792	Project		Credit hours: 3
	Students will conduct an individual study to demonstrate the ability to formulate, investigate, and analyze a problem and to report results. Written report and oral presentation are required. The project proposal must be approved by a major professor and/or supervisory committee. The project document should be written with direction from a major professor and/or supervisory committee and in accordance with the description to be provided to students. Upon completion, both the project and the document must be successfully defended to the department in an open forum with approval from the major professor and/or supervisory committee.		
14798	Comprehensive Exam		Credit hours: 0
	The comprehensive examination aims to measure the student's ability to understand and make correlations between the basic and advanced concepts that he/she has acquired through his/her studies, and to apply them in solving theoretical and applied problems in his/her field of specialization.		
14799	Thesis	Pre-requisite: Finish 12 CH	Credit hours: 9
	The thesis aims to prepare the student for carrying out research in his/her field of specialization. The student should write his/her thesis using sound scientific language and methodology. The work should be original, contain a new scientific achievement, and contribute to deepening knowledge in the field of specialization. It should not violate academic integrity.		

**King Abdullah I School of Graduate Studies and
Scientific Research**

Ph.D of Computer Science

11911	Scientific Research Methods	Credit Hours: 2
	This two credit hour course will review the major considerations needed in conducting scientific research, particularly in the fields of Computer Science. The topics covered include: Definitions and characteristics of research; Types of research; Topic Selection; Research methodology; Evaluation and validation of research results; writing, publishing, presenting research work; intellectual property and ethics.	
11912	Research Seminar	Credit Hours: 1
	This one credit hour course allows the new doctoral students to familiarize themselves with research activities in their fields. The students will attend seminars given by researchers from PSUT and other institutions to learn about the professor's areas of research before permanently aligning. In addition, the students are expected to prepare and to give seminars about selected topics of research and get feedback from peer researchers.	
11913	Statistics and Probabilities	Credit hours: 3
	Course topics include Axiomatic probability theory, independence, and conditional probability. Discrete and continuous random variables, special distributions of importance to CS and expectation. Simulation of random variables and Monte Carlo methods. Central limit theorem. Basic statistical inference, parameter estimation, hypothesis testing, and linear regression. Introduction to stochastic processes. Illustrative examples and simulation exercises from queuing, reliability, and other CS/SE applications.	
11914	Advanced Methods in Numerical Analysis	Credit Hours: 3
	This course brings out the role of Numerical Approximation theory in the process of developing a numerical recipe for solving practical computer and engineering problems. It familiarizes the student with ideas of convergence analysis of numerical methods and other analytical aspects associated with numerical computation. It is shown that the majority of problems can be converted to computable forms (discretized) using three fundamental ideas in the approximation theory, namely Taylor series expansion, polynomial interpolation and least square approximation. In addition, the student is expected to clearly understand the role of the following four fundamental tools: Linear Algebraic Equation, Nonlinear Algebraic Equations, Ordinary Differential Equations and Initial Value Problem and Optimization. Topics may vary based on selected research topics.	
11921	Design and Analysis of Algorithms	Credit hours: 3
	This course will cover topics related to design and analysis of algorithms. Topics include Turing machines; NP-Complete theory. Algorithmic techniques: divide-and-conquer, greedy, dynamic programming, graph traversal, backtracking, and branch-and-bound. Applications include sorting and searching, graph algorithms, algorithms for social networks, computational biology, optimization algorithms, randomization and algorithm analysis.	

11922	Theory of Computation		Credit hours: 3
	This course covers an extensive and theoretical treatment of the material in Computability and Complexity. Topics include Automata and Language Theory, Computability Theory, and Complexity Theory.		
11923	Programming Languages and Compiler Design		Credit hours: 3
	This will be a project-oriented course focused on advanced topics in programming languages and compilers. Topics will include detailed studies of new programming languages and advanced compiling and optimization techniques used in the translators of modern programming languages. The course will cover topics such as: new features in legacy languages; program analysis and optimization techniques; solver-aided languages; verifying of compilers; advanced parsing techniques; abstract interpretation and model checking; Lexical Analysis, Syntactic Analysis and Semantic Analysis; regular expression pattern matching; insecure constructs in programming languages and how to overcome them; applications of category theory to programming languages; The students will present papers, and write a project report on a topic of mutual interest.		
11924	Cryptography		Credit Hours: 3
	This course will cover the cryptography and crypto-analysis techniques. It will introduce the symmetric and asymmetric encryption, private and public key encryption, key distribution, cryptographic hash functions stream ciphers, zero-knowledge proof systems, cryptanalytic attacks and brute-force attacks.		
11926	Graph Theory and Applications		Credit hours: 3
	A selected view of advanced topics in graph theory and their applications. Topics drawn from: paths, connectivity, Euler tours, Hamilton cycles, trees, matchings and coverings, vertex and edge colorings, planarity and its generalizations, Ramsey theory and extremal theory, graphical enumeration, random graphs, network flows, graphs and groups, graph algorithms.		
11931	Distributed Systems		Credit hours: 3
	This course provides an in-depth examination of the principles of distributed systems in general, and distributed operating systems in particular. Covered topics include principles and paradigms of distributed systems, communication, processes, naming, synchronization, consistency and replication, fault tolerance and security. Moreover, in-depth coverage of RPC, RMI and socket programming are provided. A brief overview of advanced topics such as cloud computing, green computing, and mobile computing will be provided.		

11932	Computer and Network Security		Credit hours: 3
	<p>This course introduces key issues in data communication and network security. Topics covered include advanced concepts in encryption, authentication, digital signatures, hashing, mobile security, cloud computing security, intrusion detection firewalls, viruses, access control, and network security protocols. One or more recent research topics are included such as IoT, security in Software Defined Networks, Cloud Computing Security, and others. The recent research topics may vary according to the importance of the topic at the time of the course. Each student is expected to perform a research project during the course.</p>		
11933	Advanced Computer Architecture		Credit hours: 3
	<p>This course aims to offer a firm background for research in computer architecture. The course explores current trends and future directions in processor micro-architecture as well as various hardware and software techniques in high-performance computing. A review of unconventional and parallel architectures, VLSI computer structures, and memory hierarchies is followed by advanced topics including branch prediction, dynamic scheduling, process variability, superscalar techniques, speculative execution, VLIW, multi-core processors, application-specific processors such as those for embedded and multimedia systems, Programmability, speculative threading and parallelization. Course work includes both reading, criticizing and summarizing research papers in advanced computer architecture topics and also a final course research project is required.</p>		
11934	Advanced Computer Networks		Credit hours: 3
	<p>This course explores advanced topics in computer networks, focusing on fundamental research being conducted to improve computer networks and the internet. Topics include advanced developments in the data link layer especially for wireless and cellular networks, advanced Network Protocols and Security, Internet of things, advanced issues of the transport layer, Wireless Ad Hoc Networks, Network traffic measurement. Emphasis will be placed on network performance issues for next-generation Internet protocols and applications. Presentations of research papers and survey articles selected from recent conferences and journals will be discussed and proposing new ideas in the form of a research paper is expected as the final project of the course.</p>		
11935	Mobile Computing		Credit hours: 3
	<p>This course discusses advanced mechanisms that support mobile computing systems. Topics include developments of various wireless networks and their integration with the internet in order to support ubiquitous mobile computing. Advanced routing protocols over heterogeneous networks that could combine MANET, VANET, WSN, cellular, and other wired and wireless networks in order to achieve the goal of anytime, anywhere computing. Advanced Mobility management and location based service management. Data management and organization for mobile computing applications. Security issues in mobile computing environments. Presentations of research papers and survey articles selected from recent conferences and journals will be discussed. Proposing new ideas in the form of a research paper is expected as the final project of the course.</p>		

11936	Cloud Computing		Credit Hours: 3
	<p>Cloud computing represents the emerging Internet-based services/platforms with elastic and scalable computation powers operating at costs associated with services. Topics of the course include advanced web technologies, distributed computing models and technologies, software cloud tools and languages, SaaS, PaaS, IaaS, virtualization, palletization, security/privacy and the advances in cloud computing. Course work includes both reading, criticizing and summarizing research papers in cloud computing topics and also a final course research project is required.</p>		
11941	Advanced Database		Credit Hours: 3
	<p>The course aims at advancing database system topics through combining complexity and a more hands-on experience on modern database systems, such as NoSQL, spatio-temporal, data warehousing databases. Students will concentrate on obtaining knowledge on advanced topics including but not limited to: query processing and optimization, query evaluation, transaction processing, concurrency control and recovery in both a centralized and a distributed environment. In addition, students will learn the single and multi-dimensional indexing methods, join evaluation algorithms and SQL Analytics. Students are expected to demonstrate their obtained knowledge by conducting a research-oriented project. The project can be on some specific aspect of the emerging fields in Database systems. Finally, students are expected to present their methodologies and results in a scientific research paper.</p>		
11942	Artificial Intelligence		Credit Hours: 3
	<p>The course will provide students with information on advanced artificial intelligence concepts. The course will cover knowledge representation, search techniques and problem solving methods. Topics include Expert systems, fuzzy expert systems, genetic algorithms, AI tools and languages, case-based reasoning, decision trees, machine learning, support vector machines and neural networks. Coursework includes both reading, criticizing and summarizing research papers in advanced AI topics and also a final course research project is required.</p>		
11943	Information Retrieval		Credit Hours: 3
	<p>This course covers Information Retrieval concepts and search engine technologies. Students will learn the basic concepts, principles, and the major techniques in modern information retrieval, which is the underlying science of search engines. This course will cover algorithms, design, and implementation of modern information retrieval systems. Topics include, but not limited to: retrieval system design and implementation, text analysis techniques, retrieval models (e.g., Boolean, vector space, probabilistic, and learning-based methods), search evaluation, retrieval feedback, search log mining, and applications in web information management are included. Students will learn the underlying technologies of modern information retrieval systems, and obtain hands-on experience by using existing information retrieval toolkits to solve real-world problems. In addition, students are expected to demonstrate their obtained knowledge by conducting a research-oriented project and presenting their methodologies and results in a scientific research paper.</p>		

11944	Data Mining		Credit Hours: 3
	<p>This course aims to provide students with a practical and technical experience on knowledge discovery and data mining. Topics to be covered include problems of data analysis in databases, discovering patterns in large data, knowledge interpretation, extraction and visualization. The course also covers analysis, comparison and usage of various types of data mining and statistical techniques, such as clustering, classification, association rules, graph mining, prediction, description and scientific visualization. Students are expected to demonstrate their knowledge by conducting a research oriented project. The project can be on some specific aspect of the emerging fields. This will allow students to explore some in-depth issue(s) and gain unique data mining experience and insights. They are expected to present their methodologies and results in a scientific research paper.</p>		
11945	Natural Language Processing		Credit Hours: 3
	<p>This course covers statistical, ruled-based and hybrid-model-based approaches to natural language processing. There will be a focus on corpus driven methods that make use of supervised and unsupervised machine learning methods and algorithms. We will examine some of the core topics in natural language processing including morphological analysis, syntactical analysis and parsing, semantic analysis, discourse analysis, and language modeling. Applications such as information extraction, summarization, question and answering, classification, and machine translation will be discussed. In addition, the evaluation of natural language algorithms will also be covered. During the course, a number of problems related to Arabic language NLP systems will be examined, along with the strategies that have been developed to handle these problems. Students should be able to identify the merits and deficiencies of each proposed solution. Upon completion of this course, students will be able to explain and apply fundamental algorithms and techniques in the different areas of natural language processing (NLP) and propose new and profitable avenues of NLP research.</p>		
11946	Machine Learning		Credit Hours: 3
	<p>The course covers a wide range of machine learning baseline algorithms and techniques with focus on practical aspects. The course utilizes theory as well as state-of-the-art research topics to provide students with adequate knowledge for understanding and applying machine learning solutions. Topics covered include: supervised, unsupervised and reinforcement learning, statistical and probabilistic models, ensembles, implementation issues, applications and best practices. Students will apply classroom knowledge in learning techniques to implement a research-based system using real-world application and present their methodologies and results in a scientific research paper.</p>		

11947	Machine Translation		Credit Hours: 3
	<p>This course provides the data science students with understanding of the Big Data and its role in data analysis. It provides the terminology and the core concepts behind big data problems, applications, and systems. It provides an introduction to one of the most common frameworks, Hadoop and Spark that have made big data analysis easier and more accessible. Also, it will provide you with the necessary skill in manipulating big data distributed over a cluster using functional concepts and in-memory distributed collections framework written in Scala or Spark. We'll cover Spark's programming model in detail, being careful to understand how and when it differs from familiar programming models, like shared-memory parallel collections or sequential collections. Through hands-on examples in Spark and Scala, students learn when important issues related to distribution like latency and network communication should be considered and how they can be addressed effectively for improved performance.</p>		
11948	Statistical Methods for NLP		Credit Hours: 3
	<p>This course covers several important machine learning algorithms for natural language processing including decision trees, k-Nearest Neighbors, Naive Bayes, transformation-based learning, Support Vector Machines, Maximum Entropy and Conditional Random Fields. Students implement many of the algorithms and apply these algorithms to NLP tasks.</p>		
11951	Software Engineering Methods		Credit Hours: 3
	<p>This course presents the theoretical aspect of software development processes, tools and techniques from the perspective of learning what they can and cannot do; deciding when, how and why to apply them; and selecting among the available alternatives. Topics relating to Software methods and processes will be discussed. Topics include personal software development process (PSP), team software process (TSP), Six sigma, DFSS, requirements analysis and specification techniques, life-cycle models, process modeling, software design methods; project planning and management; quality assurance; configuration management; program and system testing. Course work includes both reading, criticizing and summarizing research papers in software engineering method topics and also a final course research project is required.</p>		
11952	Software System Architecture		Credit Hours: 3
	<p>This course introduces students to the architectural patterns and abstractions used in the design of software systems. It covers principles and practices for structuring software—how to model and organize large systems so that they are understandable, efficient, and most importantly extensible. Students analyze, implement, and document software structures utilizing common object-oriented and module-level design patterns. They also consider how these software structures shape the effectiveness and use of different libraries, frameworks, and APIs, so that they are better able to choose and integrate these tools when developing information systems. In the end, students will understand the ways that large software systems are structured, and how to consider these structures when making decisions about the development and management of information technology.</p>		

11961	Advanced Digital Image Processing		Credit Hours: 3
	<p>The course covers the fundamental concepts of image analysis, video manipulation and computer vision technologies that can perceive and understand the complex visual world. The student will be exposed to theory and state-of-the-art research in image processing and computer vision with emphasis on real-world applications. Topics covered include: foundational image processing techniques, fundamental models and algorithms in computer vision, object and pattern recognition, Fourier and wavelet transforms, color and multispectral image processing, texture identification, shape theory and analysis, radiometric and geometric correction, spectral analysis, classification, change detection, feature detection, statistical methods for multi-dimensional signal processing, medical image processing. Papers from the current literature will be discussed and student participation in a seminar style format may be expected. A final publishable paper is required by each student that gives the opportunity to apply both analytical and synthesis skills, starting with their ability to analyze and provide solutions to an image processing task.</p>		
11962	Computer Graphics		Credit Hours: 3
	<p>This course provides an in-depth knowledge of advanced algorithms and techniques used in several areas of computer graphics. Topics include advanced ray tracing, global illumination, photon mapping, subsurface scattering, weathering, and physical simulation. Classic papers and current research in computer graphics will also be surveyed.</p>		
11963	Human Computer Interaction		Credit Hours: 3
	<p>This course covers advanced topics in: user-centered design methods and techniques, skills of task analysis, analytic and empirical usability and interaction design evaluation methods (both quantitative and qualitative). It includes the collection, analysis, and presentation of HCI data as well as a deep review of ethnography, affinity diagrams, state-of-the-art methods of interaction, case studies, laws and models of interaction, and empirical research. The course uses theory and state-of-the-art research from human factors, cognitive science, and social science to understand and design the interactions. Students will apply classroom knowledge in analysis, evaluation and design to implement a research-based project.</p>		
11971	Special Topics in Computer Science		Credit Hours: 3
	<p>Topics will be selected by the CS department on evolving topics related to computer science in order to support the study plan and to encourage further research by students.</p>		
11972	Selected Topics in Computer and Network security		Credit Hours: 3
	<p>Topics will be selected by the department on evolving topics related to networks and computer security in order to support the study plan and to encourage further research by students.</p>		

11973	Independent Study		Credit Hours: 3
	Independent study in specific areas not covered by organized graduate courses. An independent study is an opportunity to work intensively under the supervision of a professor on a topic that falls within that professor's expertise and to receive course credit and a grade for the work. The proposed topic must be one that is not currently covered by an existing course and should be decided upon after a meeting between the student and the professor. At the end of the semester, the professor submits a grade, like in a regular course.		
11998	Qualification Exam	Passing the 21 CH of mandatory courses	Credit Hours: 0
	Students must successfully take a written and oral qualifying examination administered by the department after passing the 21 credit hours of mandatory courses at the end of the second year of study.		
11999	Dissertation	Pre-requisite: 11998	Credit Hours: 18
	The Doctoral Dissertation Research should represent original research. A prospectus for the dissertation must be successfully defended by the end of the fourth or fifth year and approved by the supervisor, external examiner, and the department research committee. Candidates must undergo a final oral examination in which they defend their dissertation and demonstrate a mastery of their field of specialization in relation to their dissertation.		

King Abdullah II School of Engineering

Master of Electrical Engineering

20701	Seminar & Research Methodology	Prerequisite: None	Credit Hours: 1
	This course aims at exposing students to the most current developments and trends in the field of electrical engineering. It also aims to improve students' presentation, communication, and writing skills. In addition, the seminar covers basic research methodologies to prepare students for their master's thesis, and provides them with a forum to represent their research work and offer critiques of others' work.		
20719	Special Topics in Electrical Engineering (1)	Prerequisite: To be set by Dept.	Credit Hours: 3
	The objective of this course is to introduce advanced and new topics in Electrical Engineering. The topics may change from one semester to another according to latest technological advances and available faculty specializations.		
20720	Special Topics in Electrical Engineering (2)	Prerequisite: To be set by Dept.	Credit Hours: 3
	The objective of this course is to introduce advanced and new topics in Electrical Engineering. The topics may change from one semester to another according to latest technological advances and available faculty specializations.		
20731	Advanced Numerical & Statistical Methods	Prerequisite: None	Credit Hours: 3
	Probability: Probability distributions, Bayesian statistics and learning, Monte Carlo method for simulation, Markov chains, transition matrix, Information theory, entropy, mutual information. An Introduction to optimization: Lagrange multipliers, Introduction to convex optimization. Matrix analysis: matrix factorization, Singular value decomposition.		
20790	Project	Prerequisite: 20701	Credit Hours: 3
	This is a practical project to be conducted by students opting for the comprehensive exam track. The project allows students to integrate knowledge gained in multiple courses into a fully functional practical project. A written report and an oral presentation are due upon the completion of the project. Projects are to be evaluated by a committee formed by the department.		
20799	Thesis	Prerequisite: Finish 15 Credit Hours Co-requisite: 20701	Credit Hours: 9
	After reviewing literature, the student defines a research problem under the supervision of a faculty member. Then he/she develops a suitable solution and writes the thesis, describing the targeted problem, his/her suggested solution and obtained results. Afterwards, the student defends his thesis against an appointed examining committee.		
21701	Advanced Electronics	Prerequisite: None	Credit Hours: 3

	Linear and non-linear operational amplifier circuits. Frequency response and compensation. A/D converters. CMOS logic design. Introduction to radio frequency logic circuits.		
21702	VLSI Design	Prerequisite: None	Credit Hours: 3
	This course covers all the major steps of the design process which includes: logic, circuit and layout design; a variety of computer aided tools are discussed and used in class; the main objective of this course is to provide VLSI design experience that includes the design of basic VLSI CMOS functional blocks, verification of the design, testing and debugging.		
21703	Communication Circuits and Systems	Prerequisite: None	Credit Hours: 3
	This course covers circuit- and system-level design issues of high speed communication systems with primary focus on wireless and broadband data link applications. Specific circuit topics include: transmission lines, high speed and low noise amplifiers, VCO's and high speed digital circuits. Specific system topics include: frequency synthesizers, clock and data recovery circuit and transceivers.		
21704	Optoelectronics	Prerequisite: None	Credit Hours: 3
	Technology of ultrafast diode LASERs, from the basic physical principles to applications in communications. Ultrafast optoelectronics and applications of semiconductor diode LASER arrays. Coherent and incoherent LASERs. Edge- and surface-emission. Horizontal- and vertical-cavity. Individually addressed, lattice- and strained-layer systems.		
21705	Mixed Signal IC Design for Data Communication		Credit Hours: 3
	Transistor level design and analysis of mixed signal circuits for high performance wire line data communications. Introduction to data communications terminology and signaling conventions. Data transmission media, noise sources. Data transceiver design: Signal coding/decoding, transmit signal wave shaping, receiver equalization. Timing Circuits: Clock generation and recovery techniques.		
23701	Stochastic Processes	Prerequisite: None	Credit Hours: 3
	Review of probability theory and random variables. Mathematical description of random signals. Linear system response. Wiener, Kalman and other filters. Time averages and ergodicity. Systems response to random signals. Markov chains.		
23702	Digital Communication	Prerequisite: None	Credit Hours: 3
	Review of random processes and analytic signals. Digital modulation schemes and communications channels, optimum receivers for AWGN channels. Information theory and channel capacity. Multichannel and Multicarrier systems.		
23703	Wireless and Mobile Communications	Prerequisite: 23702	Credit Hours: 3

	Digital signaling over fading multipath channels. Spread spectrum signals for digital communications. Multiple access systems. Time-division multiple access. Code-division multiple access. Frequency-division multiple access. Diversity and MIMO systems.		
23704	Advanced DSP	Prerequisite: None	Credit Hours: 3
	Wiener filters. Linear prediction. Least Mean Square (LMS) adaptive filters. Normalized NLS adaptive filters. Recursive Least Square algorithms. Kalman filters. Implementing adaptive filters using MatLab.		
23705	Coding Theory	Prerequisite: 23702	Credit Hours: 3
	Coding techniques: Reed Salmon, Hamming, and convolution. Concatenated serial and parallel, hard and soft decision decoding methods. Turbo codes decoding. The maximum a posteriori algorithm (MAP). The soft output algorithms. Bit Error Rate evaluation (BER).		
23706	Optical Communications	Prerequisite: None	Credit Hours: 3
	Introduction to optical communications. Propagation of light in an optical fiber. Semiconductor losses for optical communications. Optical components: passive, WDM, optical filters, optical modulators and optical amplifiers. Analogue and digital coding. Signal to noise considerations. Optical systems and networks. System design.		
23707	Advanced Wireless Networks	Prerequisite: None	Credit Hours: 3
	This course comprises of Wireless Personal Area Networks (WPAN), Wireless Local Area Networks (WLAN), Wireless Sensor Networks (WSN), Internet of Things, Wireless Body Area Networks (WBAN), Cellular Networks (CN), Wireless Vehicular Networks (WVN) and Cognitive Networking. This course discusses the key technologies and standards behind the mentioned networks from different layering aspects. It also introduces the students to some methodologies for performance evaluation of wireless local area networks.		
23708	Wireless Internet of Things (IoT)	Prerequisite: None	Credit Hours: 3
	Overview of the Wireless Internet of Things (WIoT) concepts, standards, including benefits, limitations, and operation. Identifying the key drivers behind the development of WIoT as well as implementation. Key technology concepts of the radio interface, design requirements of the cellular IoT standards (EC-GSM-IoT, LTE-M, NB-IoT, and 5G) are explored as well as unlicensed spectrum technologies (LoRa, SigFox, Inginue, ...etc). Performance comparisons will be carried-out.		

24701	Advanced Power Electronics	Prerequisite: None	Credit Hours: 3
	Electronic conversion and control of electrical power: semiconductor switching devices, power converter circuits and control of power converters. AC/AC, AC/DC, DC/DC and DC/AC power converters. Circuit simulation. Advances in batteries.		
24702	Distributed Generation	Prerequisite: None	Credit Hours: 3
	Steady state operation of Distributed Generation (DG): voltage rise, losses and reactive power control. Fixed and variable speed induction generators. Fault currents from DG. Fault current limiters and protection. Active distribution networks. Contribution of DG to system security.		
24703	Protection of Power Systems	Prerequisite: None	Credit Hours: 3
	Protection system components. Types of relays and circuit breakers. Protection of generation, bus bars, transformers and lines.		
24704	Digital Control	Prerequisite: None	Credit Hours: 3
	Discrete-time systems. Difference equations. Z-transform. Inverse Z-transform. Flow graphs. State variables. Transfer functions. Sampling and reconstruction of control systems. Zero-order and first-order hold. System time response characteristics. Stability analysis. Bi-linear transform. Jury's stability test. Pole assignment and state estimation. Controllability and observability. Ackerman's formula. Linear quadratic optimal control.		
24705	Optimal Power Systems	Prerequisite: None	Credit Hours: 3
	Economic Dispatch, Optimization Techniques, Unit Commitment, Review of AC and DC Power Flow, Optimal Power Flow, State Estimation in Power Systems, Contingency Analysis		
24706	Power System Control & Stability	Prerequisite: None	Credit Hours: 3
	State Space Modelling of Power Systems, Generation Control Methodologies: (PID, Pole Placement Design, Linear Quadratic Regulator (LQR) , and Model Predictive Control (MPC)), Reactive Power Control, Computer Simulation Methods for Power System Control. Stability Part: Transient Stability Analysis Review, Small signal stability analysis, Models Based Stability Analysis, Lyapunov's stability methods in power systems, Excitation system, automatic voltage regulator (AVR), power system stabilizer (PSS), Voltage collapse, Effect of renewable energy penetration on small signal stability.		
24707	Advanced Machines	Prerequisite: None	Credit Hours: 3

	Magnetic Circuits and Magnetic Materials. Electro-Mechanical Energy Conversion Principle, Reference Frame Theory. Converter, Inverter, and Rectifier. Design, Modeling, and Drives for Synchronous Machines. Design, Modeling and Drives for Permanent Magnet Machines. Design, Modeling and Drives for Induction Machines. Finite Element Modeling, Electric Machines in Power System.
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Smart Systems & Computing Engineering

22700	Seminar & Research Methodology	Prerequisite: None	Credit Hours: 1
	<p>This course aims to expose students to the latest developments and trends in the field of intelligent systems and computer engineering. It also aims to improve students' presentation, communication, and writing skills. In addition, the seminar covers basic research methodologies to prepare students for their master's thesis, and provides them with a forum to present their research ideas and offer critiques of others' work.</p>		
22701	Embedded Systems Design	Prerequisite: None	Credit Hours: 3
	<p>Microprocessor-Based Embedded Systems Design. Hardware and Software Design using 16-bit or higher MCUs. Embedded hardware and software components. Design requirements, constraints and standards. Conventional vs. Model-Based Design approaches. Embedded Software Design and programming using low-level and high-level programming languages. Model-Based and autocode generation approaches for rapid prototyping. Advanced topics in embedded systems such as Real-time Operating Systems (RTOS), multi-tasking application software, main loop designs, inter-task communication, cooperative and priority pre-emptive designs, Controller Area Networks (CAN).</p>		
22702	Real-Time Computing	Prerequisite: None	Credit Hours: 3
	<p>Principles of real-time computing. Hard and soft real-time systems. Multitasking. Scheduling policy. Periodic and aperiodic task scheduling. Priority driven schedulers. Earliest deadline first algorithm. Adaptive partition scheduler. High performance systems. Reliability applications.</p>		
22703	Advanced Computer Architecture	Prerequisite: None	Credit Hours: 3
	<p>Review of computer design principles. Software and hardware to exploit instruction level parallelism (ILP). Limits on ILP-level parallelism, multiprocessors, multi-core processors and multi-threading. Cache coherence and memory consistency. Advanced memory hierarchy design. Advanced topics in storage systems. Designing and evaluating I/O systems.</p>		

22704	Advanced Computer Networks	Prerequisite: None	Credit Hours: 3
	Overview of computer networks. Wireless and mobile networks. Multimedia networking. Security in computer networks. Network management. Network modeling and simulation.		
22705	Algorithms and Architectures	Prerequisite: None	Credit Hours: 3
	Design methodology including: algorithm representation pipeline and retiming, unfolding and folding. Systolic array. Bit-level and redundant arithmetic. Sub expression sharing. Synchronous and asynchronous waves. Synthesis and CAD.		
22710	IoT & Cloud Computing Technologies	Prerequisite: None	Credit Hours: 3
	This course provides an introduction to the Internet of Things (IoT), IoT Architectures, IoT Sensors and Devices, IoT Networks and Protocols, IoT applications and services, and IoT security. In addition, the course provides an introduction to cloud computing fundamentals, cloud-enabling technologies, the different cloud service and delivery models, cloud architectures, cloud security, and the business perspective of cloud usage.		
22720	Advanced Digital Design	Prerequisite: None	Credit Hours: 3
	Advanced techniques in the design of digital systems. Hardware description languages, combinational and sequential logic synthesis and optimization methods, partitioning, mapping to regular structures. Emphasis on reconfigurable logic as an implementation medium. Memory system design.		
22721	High Performance Computing	Prerequisite: None	Credit Hours: 3
	Fundamentals of high-performance computing (HPC). Parallel architectures, algorithms and software tools. Performance modeling and enhancement. Message-passing and multi-threaded programming. Application of HPC techniques to Artificial Intelligence (AI) and Machine Learning (ML).		
22730	Information and Systems Security	Prerequisite: None	Credit Hours: 3
	This course provides a deep and comprehensive study of the security principles and practices of information systems. Topics include basic information security concepts, common attacking techniques, vulnerabilities in information systems, common security policies, basic cryptographic tools, access control, software security, operating system security, and legal and ethical issues in information systems security.		

22760	Applied Machine Learning	Prerequisite: None	Credit Hours: 3
	This course provides an introduction machine learning (ML), supervised and unsupervised ML techniques. In addition, it covers topics like; Dimensionality Reduction, Recommender Systems, Reinforcement learning, and Bayesian learning. The course also covers deep learning with different types of Neural Networks; CNN, RNN, and LSTMN.		
22761	Computer Vision	Prerequisite: 22760	Credit Hours: 3
	Fundamental concepts of image formation and filtering, image enhancement and filtering, color representations, image segmentation, edge detection, feature extraction and matching, face detection, depth reconstruction, target tracking, statistical shape models, modern approaches in object detection, and evaluation of computer vision.		
22762	Fundamentals of Big Data Analytics	Prerequisite: None	Credit Hours: 3
	This course introduces the principles of Big Data analysis and the distributed file systems associated with it. The course also covers the common programming models and techniques needed to process such data. In addition, the typical life cycle of a data analytics project is presented in this course, which includes data cleansing, extraction, transformation, and loading (ETL), analysis, and visualization.		
22770	Fundamentals of Intelligent Systems	Prerequisite: None	Credit Hours: 3
	This course introduces the basics of AI terminology like agents, knowledge, and reasoning. The course covers multiple computational intelligence techniques that are used for modeling, optimization, and control of intelligent systems, such as Evolutionary Computing, Bio-inspired algorithms, Fuzzy Systems and Neural Networks. In addition, the course covers the basics of systems design and how to build a practical system-of-systems.		
22771	Design of Robotics & Autonomous Systems	Prerequisite: 22770, 22701	Credit Hours: 3
	Course Description: Robot and autonomous systems principals including sensing, actuating and embedded processing components. Covers embedded robot operating systems, software development, autonomy and control algorithms design, autonomous systems navigation including positioning systems, sensor fusion, visual systems. Addresses robot and autonomous systems guidance like 6 and 9 DoF sensors, path following, waypoint planning. Covers autonomous systems communication. Autonomous systems machine interaction and actuation. Recent advances in robotics and autonomous systems in addition to sample applications.		

22780	Special Topics in Intelligent Systems (1)	Prerequisite: Set by Dept.	Credit Hours: 3
	This class presents recent advances in the field of intelligent systems. The topics may change from one semester to another.		
22781	Special Topics in Intelligent Systems (2)	Pre-requisite: Set by Dept.	Credit Hours: 3
	This class presents recent advances in the field of intelligent systems. The topics may change from one semester to another.		
22782	Special Topics in Computer Engineering (1)	Pre-requisite: Set by Dept.	Credit Hours: 3
	This class presents recent advances in the field of computer engineering. The topics may change from one semester to another.		
22783	Special Topics in Computer Engineering (2)	Pre-requisite: Set by Dept.	Credit Hours: 3
	This class presents recent advances in the field of computer engineering. The topics may change from one semester to another.		
22791	Comprehensive Exam	Prerequisite: Per Exam Regulations	Credit Hours: 0
	The comprehensive examination aims to measure the student's ability to understand and make correlations between the basic and advanced concepts that he/she has acquired through his/her studies, and to apply them in solving theoretical and applied problems in his/her field of specialization.		
22792	Project	Prerequisite: Finish 22 Credits (including 22700)	Credit Hours: 3
	This is a practical project to be conducted by students opting for the comprehensive exam track. The project allows students to integrate knowledge gained in multiple courses into a fully functional practical project. A written report and an oral presentation are due upon the completion of the project. Projects are to be evaluated by a committee formed by the department.		
22799	Thesis	Prerequisite: Finish 16 Credits (including 22700)	Credit Hours: 9
	After reviewing literature, the student defines a research problem under the supervision of a faculty member. Then he/she develops a suitable solution and writes the thesis, describing the targeted problem, his/her suggested solution and obtained results. Afterwards, the student defends his thesis against an appointed examining committee.		

Master of Engineering Management

26723	Mathematical Decision Making		Credit hours: 3
	<p>The advances in technology and business are achieved by applying technical knowledge from statistics, computing science, finance, economics, management and mathematics. The mathematical decision making course curriculum will emphasize on optimization, decisions and constraints, linear programming, simple and multiple regression, sensitivity analysis, randomness, probability and expectation, Bayesian analysis, Markov models, Monte Carlo simulation and stochastic optimization and risk.</p>		
26724	Law for Engineers and Scientists		Credit hours: 3
	<p>Topics covered in this course include patents, trade secrets, trademarks, copyrights, product liability contracts, business entities, employment relations and other legal matters important to engineers and scientists. Graduate-level requirements include an in-depth research paper on a current topic.</p>		
26725	Engineering Decision-Making under Uncertainty		Credit hours: 3
	<p>Application of principles of probability and statistics to the design and control of engineering systems in a random or uncertain environment. Emphasis is placed on Bayesian decision analysis. Graduate-level requirements include a semester research project.</p>		
26754	Technical Sales and Marketing		Credit hours: 3
	<p>Principles of the engineering sales process in technology-oriented enterprises; selling strategy, needs analysis, proposals, technical communications, electronic media, time management and ethics; practical application of concepts through study of real-world examples. Graduate-level requirements include a term paper on a course topic selected from a short list of topics, other graded components of the course and creation of a PowerPoint presentation to the class.</p>		
26755	Project Management		Credit hours: 3
	<p>Processes and tools used to plan and control large scale projects. Topics include organizational design alternatives, formation and management of teams, construction and control of project schedules, risk assessment, and issues specific to global ventures and software development.</p>		

26756	Supply Chain Management		Credit hours: 3
	<p>The course will provide students with a wealth of knowledge in the various areas of business analysis and business management. The course covers all areas of supply chain starting from handling suppliers to manufacturing, warehousing and retailing. Various aspects of procurement management and decision making in the supply chain is discussed. During this course, student will study the concept of Supply Chain Management, understand its impact on enterprise efficiency, and understand various business functions, processes and supply chain terminology, master concepts and mathematical models behind various supply chain software packages, and clearly link supply chain management and logistics. In addition, students will understand the various activities of logistics, understand all aspects of distribution management, understand the various activities of warehousing and inventory management, appreciate the importance of coordination between various supply chain entities, understand the best methods of sourcing and supplier selection, realize the various decision making strategies in supply chains, understand the bullwhip phenomenon and how to deal with it.</p>		
26757	Financial Modeling for Innovation		Credit hours: 3
	<p>Strategic, tactical and operational planning; innovation and technological cycles; the elements of entrepreneurship, and human relations topics for technical managers. Graduate-level requirement includes two term papers.</p>		
26758	People Leadership/Human Resources Management		
	<p>The course will equip students with the necessary knowledge, tools and techniques that will help them to achieve organizational and individual success. The new aspect of this course is making positive psychology a cornerstone for the development of students' leadership skills. The course revolves around three main skill sets which are personal skills, interpersonal skills and group skills. Each group of skills includes specific skills that have proved to be most in demand in the current labor market, such as the ability to solve problems analytically and creatively, communication skills, motivating others, building high performance teams, teamwork, and leading positive change. Moreover, the course is designed to bridge the main gaps in leadership skills discovered by different surveys conducted and funded by Tempus. These surveys were distributed to enterprises of different sizes and types in Egypt, Tunis and Jordan. The main focus is on promoting effective people management practices and addressing current management challenges. This will be achieved pragmatically rather than theoretically. Therefore, active learning is the fundamental mechanism through which this course is delivered. Participants are expected to be engaged in activities and higher order thinking (analysis, synthesis and evaluation) since more emphasis is placed on skill development rather than information transmission.</p>		

26790	Advanced Topics in Engineering Management		Credit hours: 3
	This course covers the advanced topics in the Engineering Management field, and vary from course to another.		
26797	Comprehensive Exam		Credit hours: 0
	The comprehensive examination aims to measure the student's ability to understand and make correlations between the basic and advanced concepts that he/she has acquired through his/her studies, and to apply them in solving theoretical and applied problems in his/her field of specialization.		

King Talal School of Business Technology

Master of Business Analytics

33723	Simulation & Decision Analysis	
	In this course students will learn how to design, model, and implement discrete-event computer simulation models of real or conceptual systems. Simulation studies will be conducted using contemporary software such as ProModel. Student will learn random number generation, applying distribution sampling, and conducting output analysis.	
33724	Information Management & Assurance	
	This course introduces the concerns of assuring information and managing risks in the IT environment. Topics covered are: principles of security from a managerial perspective, issues and consequences of using insecure information systems, the means to prevent security breaches (including physical, technical and administrative controls, and how to respond to a breach when it happens. In addition, students learn how to develop security plans and conduct security audits. Coursework will include extensive reading and seminar participation.	
33725	Business Intelligence	
	This course introduces the Business Intelligence approach to support decision-making. Topics included are: fundamentals of data warehouses and data mining, data models, data warehouse architecture, techniques for data extraction, cleaning, transformation, and loading, online analytical processing (OLAP), and managerial issues of data warehouse implementation. In addition, the course introduces the concept of big data and how it can be used to support business decisions.	
33726	Data Mining for Business Applications	
	The purpose of this course is to provide students with both quantitative and qualitative exposure to the field of Data Mining, a topic of immense importance and relevant to the study of Business Analytics. Data Mining is the process of discovering meaningful correlations, patterns and trends in large data sets and employs statistical and mathematical techniques. Students will be exposed to theory, computation, tools & techniques to analyze repositories of data from a vast array of business applications with a view to implement successful business strategies aimed at improved decision-making. Selected software packages are used in exercises to solve data mining problems.	
33728	Applied Statistical Modeling & Forecasting	

	<p>This course explores statistical modeling and analysis techniques for aiding managerial decision making. Topics include: introduction to descriptive statistics, sampling methods and sampling distribution, confidence interval estimation, one sample hypothesis tests, one-way and two-way analysis of variance, simple and multiple linear and nonlinear regressions, and time series forecasting. Selected software packages are used to apply the theoretical part into practical business cases.</p>	
33730	<p>Analytics Experience Capstone (Practical Project)</p>	
	<p>This course enables students to demonstrate application of integrative knowledge aimed at addressing an industry relevant decision-making problem by drawing on the breadth and depth of the Business Analytics programmatic curriculum. The plan of studies requires that the student complete this course under the direction and guidance of the Instructor who may enroll the services of an industry expert for advice. Depending on the size and complexity of the problem, one or many students may be assigned to the project. The deliverables for the course are a detailed project report describing evaluation and analysis of the problem to be presented at a public setting.</p>	
33732	<p>Process Mining</p>	
	<p>The course explains the key analysis techniques in business process mining. This course starts with an overview of approaches and technologies that use event data to support decision making and business process (re)design. Then the course focuses on process mining as a bridge between data mining and business process modeling. Topics include: process discovery, compliance checking, and process enhancement.</p>	
33733	<p>Information Systems Quality</p>	
	<p>This course examines two related areas of study: (1) the concepts of information systems analysis and design in business organizations and (2) the management of information quality in organizations. Students will learn to plan and manage information systems projects. This course covers the dimensions of information quality, the assessment and improvement of information quality in organizational settings, cognitive and behavioral aspects of information quality, and the effect of information quality on organizational decision making. The implications of information quality for systems analysis and design and applications of systems analysis and design methodologies for the management of information quality will be examined.</p>	

33734	Derivatives and Risk Management	
	The focus of this course is on understanding the derivative securities and their use in risk management. This course provides an in-depth introduction to options and option pricing as well as an extensive overview of forward, future and swap contracts. This course will draw upon the intuition and analytic tools developed to examine sophisticated financial products or strategies that firms and investors have used in their risk management.	
33735	Corporate Strategy Valuation	
	This course examines a variety of financial management topics, such as project and enterprise valuation and risk analysis, corporate restructuring, dividend policy, corporate governance, and current asset management using case studies and readings.	
33736	Investment Process: Management and Analysis	
	This course provides an examination of the process of investment analysis and management. Topics include: analysis of fixed income securities, stock valuation, and introduction to derivative securities; discussion of portfolio theory and management; and an overview of investment environment. Wherever it is appropriate, the above topics will also be discussed in a global context.	
33737	Customer Behavior Analytics	
	This course introduces students to concepts and theories developed in the behavioral sciences (economics, marketing, psychology, sociology, and anthropology) in relation to their influence on consumer behavior. The course is designed to provide students with an in-depth understanding of consumer markets in order to develop effective marketing strategies.	
33738	Social Media Analytics in the Global Market	
	This course draws from key concepts in marketing, business economics, and operations management to provide a comprehensive account of global marketing issues and strategies. This course is designed to give students several opportunities to apply the theories and concepts they have learned in class, primarily through the use of Country Manager simulation and a series of case analyses.	
33739	Advanced Marketing Management	
	This course examines the current challenges facing the marketers, ranging from industry deregulation, Internet revolution to globalizing. Looked at closely are the emerging issues impinging on marketing decision, particularly in regard to focused marketing, relationship marketing, competitive advantage, positioning, and the marketing mix strategies. Term project and case analyses are important components of the course.	

33740	Computer and Information Systems	
	This course focuses on the management concepts and information technology needed to create effective information systems. Topics include: a survey of information technology, information systems and organizations, strategic information systems, management support systems, and ethical and social issues in information systems.	
33745	Big Data & in-Memory Technology	
	The main learning objectives & acquired competencies in this course includes concepts of big data technologies, theoretical principles, and how to apply these technical approaches to solve practical issues. Topics included: MapReduce, Hadoop, IoT, In-Memory & SAP HANA, Data warehouse off-loading, Machine Learning (Regression & Classification)	
33796	Comprehensive Exam	
	The comprehensive examination aims to measure the student's ability to understand and make correlations between the basic and advanced concepts that he/she has acquired through his/her studies, and to apply them in solving theoretical and applied problems in his/her field of specialization.	

Master of Business Entrepreneurship

31731	Engineering Analysis	Credit Hours: 3
	Power series solution of differential equations and special functions (Bessel's functions and the Fourier-Bessel Series). Solutions of partial differential equations, heat and wave equations and Laplace equation. Sturm-Liouville problems and orthogonal functions in orthogonal coordinate systems. Separation of variables. Fourier series and Fourier integral. Complex Integration.	
33750	Introduction to Entrepreneurship and Innovation	Credit Hours: 3
	This course aims introduce students on the behavior and attributes of entrepreneurs who operate in a competitive environment. It elaborates on the role of entrepreneurs in a competitive market and the role of government in the creation of a business environment conducive to entrepreneurship. The course also highlights the relevance of attitudes, values and beliefs to entrepreneurial activity; the management of risks; the process of new product development; and the reasons for the high failure rate of new businesses. The course aims to develop skills and an understanding of the risks and rewards of entrepreneurial activities.	
33752	Leadership Skills of Business	Credit Hours: 3
	This course aims to provide the students with an understanding of how to create a leading personality in addition to the main capabilities required for a businessman to become a leader, the dynamic path leaders pass especially in transforming their personalities from managerial to leadership personalities, how to identify teams, supervise them, and developing a range of soft skills and the business acumen necessary to maximize the likelihood of success in an entrepreneurial environment. The course also aims to provide the students with interpersonal skills and negotiation skills through integrated cases, simulations, and interaction with the local business community.	
33753	Fundamentals of Entrepreneurial Finance and Accounting	Credit Hours: 3
	This course aims to provide students with essential skills for effective management of new ventures operating in risky and uncertain environments. Development of pro forma financial statements and techniques for financial decision-making under uncertainty are explored. Principles that guide the financing of new venture are presented, including considerations of capital structure, management of working capital, asset financing and forms of private and public equity. The requirements of the venture capital due diligence process, negotiating with VC's, business valuation and exit alternatives are discussed. The role of accounting information in assisting entrepreneurs is examined. By analyzing and presenting financial statements of local or abroad technology companies, students develop proficiencies in understanding and interpreting financial statement information.	
33760	Entrepreneurial Marketing Strategies	Credit Hours: 3

	This course aims on the role of marketing in start-up ventures and the role of entrepreneurial thinking in marketing efforts. 'Customer needs' as the driving force in entrepreneurship is the theme of this course. The course explores novel approaches to defining markets and market segments, examines inexpensive ways to conduct relevant market research, and identifies ways to leverage marketing resources and rely on networks to accomplish marketing tasks. Students are encouraged to focus on identifying unique approaches to creating value through each of the elements of the marketing mix.	
33762	Strategic Management of Entrepreneurial Organization	Credit Hours: 3
	This course aims examined strategy development and implementation as a mean to guide decisions at each stage of the innovation and commercialization process. Insight is gained into the strategic issues faced by new ventures as they progress from seed / concept through market execution stages. Strategic analysis techniques are used to identify and analyze issues and as input into the design of the business concept and business model. The organizational structures, processes and policies used to build and maintain an entrepreneurial culture are key topics for the market execution stage.	
33763	International Business	Credit Hours: 3
	This course aims to covers an International system overview (trade, politics, economics, WTO and other relevant organizations), relevant international law, cross-cultural management, multinational finance, importing/exporting, global strategy, supply chain management, international patents/licensing. In addition to developing managerial skills, enhancing confidence and professional background for leading initiatives and refining the required skills for working in teams with people from all over the world to gain the application of theoretical knowledge and dealing with the real world through business scenario cases in an international context.	
33765	Legal Environment of Business	Credit Hours: 3
	This course aims to present the theoretical understanding of the legal environment of business at both national and international levels.	
33766	Business Economics	Credit Hours: 3
	This course aims to introduce students to the concepts of economic analysis, how to use these concepts to understand the problems of micro and macroeconomics. And to prepare economists interested in the optimal use of scarce economic resources and how to produce and distribute them to society, as well as forecasting and developing economic changes, and to shed light on the consumer, the company and government decisions. This course evaluates important aspects such as competition and market power, the role of laws, and direct foreign and international financing.	
33767	Sustainability & Social Responsibility of Entrepreneurship Organizations	Credit Hours: 3

	This course aims to introduce the concepts of social entrepreneurship and corporate social responsibility from multidisciplinary perspectives. Students are challenged to become leaders in shaping socially responsible businesses and building a civil society through the examination of emerging theory and practice, analysis of cases and an applied project with a community-based organization. In addition to supporting the culture of social responsibility within the organization's strategic planning priorities, and providing full support from top management towards sustainable development for their societies.	
33768	Special Topics in Business Entrepreneurship and Technology	Credit Hours: 3
	Sector-specific subjects such as health care, biotechnology, agriculture, ICTs, clean technologies, education reform, and other topics are covered.	
33772	New Product Development	Credit Hours: 3
	This course aims to define the concept of new venture, its attributes, the extent to which the product matches the organization's production capabilities, the phases of developing and preparing the product and the elements related to developing and selling the new successful product in the complicated environment. It also focuses on introducing the importance of providing new products and the internal and external forces affecting the organization in addition to strategies of evaluating new products.	
33773	Management of Innovation	Credit Hours: 3
	This course aims to understand the interaction of technology with all aspects of the organization to build and maintain a sustainable, competitive advantage. The focus of this course is the creation of new products and services from concept through to launch. Evaluating new technologies, product development and deployment strategies are key topics. In addition to introducing the students to new and beneficial ideas that are connected to ideal solutions for particular problems or developing methods or goals or deepening a vision or integrating or reconstructing known patterns in managerial attitudes in distinct and modern ways that push people forward.	
33774	Research Methodology	Credit Hours: 3
	This course aims to equip the students with the skills in conducting scientific research through introducing them to scientific research methods and providing the basic skills in writing scientific research. Which includes defining the problem of study and its variables, the research significance and objectives, the research model and its variables based on literature review, how to define the population and sample of the study, data collection and hypotheses writing and testing methods in addition to their analysis and interpretation using statistical methods, writing the conclusions and recommendations and linking them to the literature review, and introducing the students to various documentation methods.	
33798	Comprehensive Exam	Credit Hours: 9

	The comprehensive examination aims to measure the student's ability to understand and make correlations between the basic and advanced concepts that he/she has acquired through his/her studies, and to apply them in solving theoretical and applied problems in his/her field of specialization.	
33799	Thesis	Credit Hours: 0
	The thesis aims to prepare the student for carrying out research in his/her field of specialization. The student should write his/her thesis using sound scientific language and methodology. The work should be original, contain a new scientific achievement, and contribute to deepening knowledge in the field of specialization. It should not violate academic integrity.	