FACULTY OF COMPUTING & INFORMATION TECHNOLOGY
KING ABDULAZIZ UNIVERSITY

FCIT
KAU

كلية الحاسبات وتقنية المعلومات
جامعة الملك عبدالعزيز

برنامج الدكتوراة في علوم الحاسبات
Doctor of Philosophy in Computer Science

المتطلبات العامة للبرنامج:

للحصول على درجة الدكتوراه الفلسفة في علوم الحاسبات يجب أن يكمل الطالب مالا يقل عن (٣٨) وحدة دراسية معتمدة بما فيها رسالة الدكتوراه، وتكون موزعة على النحو الآتي:

- (١٢) وحدة معتمدة للمقررات الإجبارية.
- (٦) وحدة معتمدة للمقررات الاختيارية.
- (٢٠) وحدات معتمدة لرسالة الدكتوراه.

Program General Requirements:

To obtain a Doctor of Philosophy (Ph.D.) degree in Computer Science, the student must complete at least (38) credit hours, including the dissertation, distributed as follows:

- **(12) credit hours for core courses.**
- **(6) credit hours for elective courses.**
- **(20) credit hours for the dissertation.**

أ- المقررات الدراسية الإجبارية (١٢) وحدة معتمدة - Core Courses (12 credits) :

الوحدات الدراسية Course Credits	رمز المقرر Course Code		Course Name	اسم المقرر
	English	عربي		
3	CS 701	ع ح 701	Advanced Topics in Networking	موضوعات متقدمة في الشبكات
3	CS 702	ع ح 702	Software Architecture and Design	بنائية وتصميم البرمجيات
3	CS 703	ع ح 703	Advanced Database Systems	نظم قواعد البيانات المتقدمة
3	CS 704	ع ح 704	Advanced Computer Architecture	بنائية الحاسب المتقدمة

ب- المقررات الدراسية الاختيارية (٦) وحدة معتمدة - Elective Courses (6 credits) :

الوحدات الدراسية Course Credits	رمز المقرر Course Code		Course Name	اسم المقرر
	English	عربي		

3	CS 705	ع ح 705	Advanced Algorithms	الخوارزميات المتقدمة
3	CS706	ع ح 706	Experimental Design	تصميم التجارب
3	CS 720	ع ح 720	Object-Oriented Database Systems	نظم قواعد البيانات الشيئية
3	CS 721	ع ح 721	Distributed Database Systems	نظم قواعد البيانات الموزعة
3	CS 730	ع ح 730	Computer Vision	الرؤية بالحاسب
3	CS 731	ع ح 731	Advanced Image Processing	معالجة الصور المتقدمة
3	CS 732	ع ح 732	Virtual Reality	الواقع الافتراضي
3	CS 740	ع ح 740	Secure Computer Systems	نظم الكمبيوتر الآمنة
3	CS 741	ع ح 741	Applied Cryptography	الترميز التطبيقي
3	CS 742	ع ح 742	Network Security	أمن الشبكات
3	CS 750	ع ح 750	Machine Learning	تعليم الآلة
3	CS 751	ع ح 751	Special Topics	مقدمة في العلوم المعرفية
3	CS 752	ع ح 752	Computational Perception	الإدراك الحوسبي
3	CS 760	ع ح 760	Communication Networks Evaluation	تقييم شبكات الاتصال
3	CS 761	ع ح 761	Networked Applications and Services	التطبيقات والخدمات الشبكية
3	CS 762	ع ح 762	Broadband Networking Systems	نظم شبكات النطاق العريض
3	CS 770	ع ح 770	Large Scale Software Design	تصميم البرامج واسعة النطاق
3	CS 771	ع ح 771	Software Testing and Maintenance	اختبار وصيانة البرمجيات
3	CS 772	ع ح 772	Modeling of Computing Systems	نمذجة منظومات الحوسبة
3	CS 780	ع ح 780	Bioinformatics-1	المعلوماتية الحيوية ١
3	CS 781	ع ح 781	Bioinformatics-2	المعلوماتية الحيوية ٢

ج- الرسالة - PhD Dissertation :

الوحدات الدراسية	رمز المقرر Course Code		Course Name	اسم المقرر
Course Credits	English	عربي		
20	CS 799	ع ح 799	PhD Dissertation	رسالة الدكتوراة

د- توصيف المقررات Courses Description :

Course Code	Course Title	Credits	Description
CS 701	**Advanced Topics in Networking**	**3**	The purpose of this course is to help students be up to date with new network technologies and broadband communication issues as well as traffic characteristics and QOS provisioning. This course introduces advanced concepts of modern computer and telecommunication networks such as new technologies for TCP/IP, Mobile IP, SDN, Cloud computing, 4G and 5G networks and Next Generation Internet: architecture and protocols. In addition, advanced topics such as Internetworking architectures and mobility management issues will be introduced in terms of user mobility, service continuity, and the corresponding performance analysis.
CS 702	**Software Architecture and Design**	**3**	Modeling and design of software at the architectural level. Software architecture styles, Software technologies. Quality attributes: Implementation quality attributes, run-time quality attributes and business quality attributes. Software architecture design space. Models for software architectures. Object-oriented software architectures. Distributed architecture: client-server, multi-tiers, broker architecture style, Service-oriented architecture. Component-based software architecture. Agent-based software architecture. Layered architecture style. Term paper (research problems). Case studies. Introduction to distributed system software.
CS 703	**Advanced Database Systems**	**3**	Current and emerging issues in advanced database systems are covered in the course. The state-of-the-art techniques for various DB topics are studied. Topics include OODBMS, and ORDBMS, DDB, Transaction Management, concurrency methods, NOSQL, and NewSQL.
CS 704	**Advanced Computer Architecture**	**3**	Graduate course on designs, organizations, and methods used to build computers. The course aims to provide students with a sound basis for advanced studies in the subject area. Topics include main components and subsystems (such as instructions, processors, memory, and multiprocessors) and techniques (such as caches, multiple-issue, virtualization, and speculative execution), Flynn's taxonomy, alternate processing models to

			control flow such as data flow, fine and coarse-grained parallelism, quantitative principles (such as Amdahl's law), and examples from seminal machines. Finally, an introduction to supercomputing and future trends rounds out the course.
CS 705	**Advanced Algorithms**	**3**	This course builds on the Design and Analysis of Algorithms course and will extend the concepts learned in the Design and Analysis of Algorithms course. The main focus will be on algorithm design, analysis and optimization for more advanced problem areas. In particular design and analysis of Geometric, Parallel, Distributed and evolutionary computing will be discussed in this course. Implementation of the algorithms will also be done using a suitable programming environment.
CS 706	**Experimental Design**	**3**	Statistics is frequently taught as though the data collection design and data cleansing have already been completed. However, as most competent statisticians rapidly realize, most difficulties that develop during the analysis step might have been avoided if the experimenter had sought advice from a statistician before doing the experiment and collecting the data. This course is aimed to teach students how to construct experiments in such a way that these flaws are avoided when the data is gathered.
CS 720	**Object-Oriented Database Systems**	**3**	The objective of this course is to give a thorough understanding of the advances in data modeling, database design, and a new generation of applications that are a challenge for database management. The course emphasizes the object-oriented modeling approach to support such applications. Basic concepts, research papers, prototypes and approaches will be discussed. The course includes some exposure to commercial implementations.
CS 721	**Distributed Database Systems**	**3**	This course covers the fundamental issues of distributed databases with focus on data fragmentation and allocation, query optimization and transaction processing. Topics include: Distributed database management systems architecture; Distributed and Parallel Database Design; data fragmentation, replication, and allocation; database security, authorization and integrity control; query optimization; transaction management; distributed concurrency control and replica control; parallel database systems; NoSQL database; Big data processing; Database Integration—Multidatabase Systems.

CS 730	**Computer Vision**	**3**	This course will explore some of the basic principles and techniques that are currently being used in real-world computer vision systems and the research and development of new systems.
CS 731	**Advanced Image Processing**	**3**	This course covers topics related to the image processing algorithms, techniques and tools that are used to manipulate images. The course demonstrates methods for enhancing, analyzing, interpreting, and visualizing information of two- and three-dimensional data obtained from a variety of image modalities. The course explores a few major areas of digital image processing at an advanced level. Topics covered include image filtering and enhancement, visualization, image segmentation and image registration. Numerous fields will be presented to give the students exposure to real-world applications.
CS 732	**Virtual Reality**	**3**	Familiarize the students with the virtual reality technology and expose them to the fundamental concepts of VR including mathematical and physics background. Physiology and psychology of VR. All other VR-related technologies are studied including audio, video, motion, and graphics design, rendering, and evaluation.
CS 740	**Secure Computer Systems**	**3**	The course covers a wide spectrum of the security problems related to computer systems and principles of building secure systems. This course will introduce fundamentals of computer security and applied cryptography. This course will expose the student to user authentication and access control mechanisms, malicious software, denial of service attacks, firewalls, intrusion detection and prevention systems, risk assessments, internet security protocols and standards, and the legal and ethical issues associated with computer system security.
CS 741	**Applied Cryptography**	**3**	This course provides an intensive overview of the field of cryptography, a historical perspective on early systems, and the theoretic foundations of modern-day cryptosystems. Students will learn how cryptosystems are designed, and to match cryptosystems to the needs of an application. Students will also study basic cryptanalysis and will be presented with real-life breaches of common cryptosystems so that they better understand the dangers that lurk in cryptosystem design and in the design of systems that rely on cryptography.
CS 742	**Network Security**	**3**	This course provides an in-depth study of network attack techniques and methods to defend against them. Topics include firewalls and virtual private networks; network intrusion detection; denial of service (DoS) and distributed denial-of-

			service (DDoS) attacks; DoS and DDoS detection and reaction; worm and virus propagation; tracing the source of attacks; traffic analysis; techniques for hiding the source or destination of network traffic; secure routing protocols; protocol scrubbing; and advanced techniques for reacting to network attacks.
CS 750	**Machine Learning**	**3**	This course gives thorough grounding in the methods, theory, mathematics and algorithms needed to do research and applications in machine learning. The topics of the course are drawn from machine learning, classical statistics, data mining, Bayesian statistics, and from information theory.
CS 751	**Special Topics**	**3**	This course covers topics related to new and advanced concepts to address a variety of theoretical and/or technological issues related to computer science, such as distributed database systems, parallel processing, multimedia, speech processing, translation systems, cyber security, deep learning etc.
CS 752	**Computational Perception**	**3**	This course teaches advanced aspects of perception and scene analysis in both the visual and auditory modalities, concentrating on those aspects that allow us and animals to behave in natural, complex environments. In this course, students will learn how to reason scientifically about problems and issues in perception and scene analysis, how to extract the essential computational properties of those abstract ideas, and finally how to convert these into explicit mathematical models and computational algorithms. In the process, students will cover a wide range of literature that provide very different perspectives on problems and properties of natural perception. The course will consider both classical and modern theories that relate biological sensory systems to ecological context and behavioral function. Readings will be drawn from systems neurophysiology, neuroethology, computational theory, psychophysics and cognitive psychology.
CS 760	**Communication Networks Evaluation**	**3**	The primary goal of this course is to provide an intensive research overview of the performance analysis techniques for communication networks for computer science. Research level of this module is the study of the efficient measurement issues, methods and modelling of the communication network evaluation and possible algorithms which allow us to optimize and improve the accuracy and analyze for evaluating the performance within the communication network environments. Topics include: Methods for evaluating the performance of communication networks with emphasis on modeling, mathematical analysis, computer simulation, and measurement. Error, flow and

			congestion control protocols, multiplexing and multiple access, switching, routing. Selected case studies on Access networks, packet networks, Broadcasting network, satellite and terrestrial radio networks.
CS 761	**Networked Applications and Services**	**3**	The primary goal of this course is to provide an overview of End-to-end functional building blocks and their use in adaptive and non-adaptive applications, including multimedia: coding, compression, security, directory services, underlying principles of personal communications and Cellular systems.
CS 762	**Broadband Networking Systems**	**3**	Focus on the data link layer and its relationship to layers below and above. Gigabit Ethernet, SONTET, fiber channel; media including wireless, satellite, xDSL, cable. In addition to latest broad-band technologies. In Wireless & Multimedia Networks: Standards: 802.11, 802.11e, 802.11n, 802.15, and 802.16, etc. QoS, wireless and multimedia networks new trends and applications.
CS 770	**Large Scale Software Design**	**3**	Designing architectures: architectural conception, styles and architectural patterns. Connectors: connector types, connector dimensions, event-based data distribution connectors, grid-based data distribution connectors, client-server-based data distribution connectors, P2P-based data distribution connectors. Deployment and mobility: software architecture and deployment, soft-ware architecture and mobility. Applied architectures and styles: distributed and networked architectures, architectures for network-based applications, decentralized architectures, service-oriented architectures and web services, agent-based architectures.
CS 771	**Software Testing and Maintenance**	**3**	Concepts and techniques for testing and modifying software in evolving environments. Topics include traditional Software testing: types, phases. Integration Testing: function decomposition approaches, call graph approaches, and path testing. Software testing techniques: static testing, and dynamic testing. Testing of HPC-parallel programming models programs: types of parallel programming models errors in (MPI, OpenMP, and others): Parallel Error detection techniques: static testing techniques of parallel programming models programs, dynamic testing techniques, and Hybrid testing techniques. Software Maintenance: corrective maintenance, adaptive maintenance, and perfective maintenance. Reverse-engineering, re-engineering,

			restructuring programs and data, and Decompilation techniques. Scientific research paper in the field of testing or maintenance.
CS 772	**Modeling of Computing Systems**	**3**	This course will cover the techniques for modeling and formally analyzing computing systems, with a focus on applications in software, hardware, and security. Students will learn the fundamentals of classical logic, induction and recursion, program semantics, rewriting, reactive systems, temporal logic, model checking, and abstraction. We will examine how these methods can be used to verify software, hardware, and security protocols. Students will learn how to use various tools, including theorem proving and model checking tools, and will work in groups to apply the tools to various domains. We will discuss the limitations of current techniques and systems and we will examine promising research directions including building more useful systems and developing more powerful techniques.
CS 780	**Bioinformatics-1**	**3**	Introduction to biological databases and bioinformatics software. Sequence comparison algorithms and tools. Sequence analysis and molecular phylogenetic. Biomolecular 3D structure and modeling. Bioinformatics theory, tools, and techniques.
CS 781	**Bioinformatics-2**	**3**	This course studies computational biology problems along both algorithmic and statistical approaches. It covers different methods for multiple sequence alignment, genome sequencing, comparative analysis of genome information, gene prediction, finding signals in DNA, phylogenetic analysis, and protein structure prediction. Other topics covered include microarray gene expression analysis and computational proteomics.
CS 799	**Thesis**	**20**	The dissertation serves as evidence of research skills, independent thought, and professional writing in the field of study.