ARAB ACADEMY FOR SCIENCE, TECHNOLOGY
AND MARITIME TRANSPORT

COLLEGE OF ENGINEERING
AND TECHNOLOGY

(GRADUATE STUDIES)

Master of Science Programs

STATUS REPORT

ALEXANDRIA

2012

COMPUTER ENGINEERING

M.SC. PROGRAM

M.Sc. in Computer Engineering

OVERVIEW

The Department of Computer Engineering is part of the College of Engineering and Technology, at the Arab Academy for Science, Technology and Maritime Transport. It offers a graduate program of study for men and women who will engage in the professional practice of computer engineering as it relates to design, development, research, other engineering functions, and teaching in industry, government, or a university.

In this specialization, students learn to:

- Design special and general-purpose processors
- Design digital systems
- Design communications' protocols for the Internet
- Write computer programs for various applications
- Design systems for data acquisition
- Design Micro-controller-based applications

The responsibilities of the graduate of the computer engineering program encompass:

- Specifying the most suitable computer equipment for a certain function,
- Offering opinion and consultation in the field, supervising computer installations and operations, planning their sites and environment
- Designing and implementation of software packages in data communication and other applications.
- Designing and implementing special purpose processors and interface cards

The major consulting activities of the department include feasibility studies, analysis, design and specifications of Information Systems:

HARDWARE-ORIENTED APPLICATIONS

- Design and Implementation of Interface cards
- Special-purpose processor design and implementation using FPGA and ASIC
- Realization of embedded systems used in control applications
- Data Acquisition Systems
- Computer-based digital control and Robotics
- Computer-based security systems

SOFTWARE-BASED APPLICATIONS

- Analysis, design and implementation of Data Base systems
- Intelligent Systems analysis and design
- Applications of Artificial Neural Networks
- Analysis and design of Local Area Networks
- Internet-based applications and web programming
- Micro-controller programming
- Digital signal processing
- Data Communication Security

OPTIONS OF THE MASTER'S PROGRAM

Master's degree students may choose one of two graduate degrees offered by the computer engineering department:

1. MASTER OF SCIENCE IN COMPUTER ENGINEERING (THESIS OPTION)

In order to earn the Master of Science (M.Sc.) degree, the student must achieve 24 credit hours of coursework and a thesis equivalent to 12 credit hours. The coursework requires a total of eight 700-level courses: 4 core courses and any 4 courses from the elective group.

2. MASTER OF ENGINEERING IN COMPUTER ENGINEERING (COURSEWORK NON-THESIS OPTION)

In order to earn the Master of Engineering (M.Eng.) degree, the student must achieve 36 credit hours of coursework. This coursework requires a total of twelve 700-level courses: 4 core courses and any 8 courses from the elective group. The holder of the M.Eng. degree cannot apply for a Ph.D. program in Egypt.

Program Detailed Structure

M.SC./M.ENG. PROGRAM

CORE COURSES:

Course Code	Course Title	Credit Hours
CC 711	Advanced Programming Languages	3
CC 721	Advanced Computer Architecture	3
CC 731	Computer Networks and Security	3
CC 741	Systems Science and Engineering	3
Subtotal	**4 Courses * 3 Credit Hours**	**12**

ELECTIVE COURSES:

Course Code	Course Title	Credit Hours
CC 712	Advanced Database Systems	3
CC 713	Software Engineering	3
CC 714	Computer Systems Security	3
CC 715	Neural Networks Systems	3
CC 716	Pattern Recognition	3
CC 722	Advanced Digital Systems	3
CC 723	Embedded Systems Design	3
CC 725	VLSI System Design	3
CC 727	Application-Specific Architectures	3
CC 729	Computer Design and Performance Evaluation	3
CC 732	CAD for Computer Communications Networks	3
CC 733	Analysis and Design of Computer Networks	3
CC 734	Network Security	3
CC 735	Sensor Networks	3
CC 737	Mobile, Wireless and Ad-Hoc Networks	3
CC 742	Real-Time Systems	3
CC 743	Data Compression and Image Processing	3
CC 746	Multimedia Engineering	3
CC 747	Advanced Computer Controlled Systems	3
CC 753	Advanced Topics in Artificial Intelligence	3
CC 755	Distributed and Parallel Systems	3
CC 756	DSP Hardware and Software System Design	3

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CC 757	Modeling and Simulation	3
CC 758	Advanced Applications of Digital Signal Processing	3
CC 759	Advanced Robotics	3
CC 760	Computer Engineering Seminars	3
Subtotal	**4 Courses * 3 Credit Hours**	**12**

RESEARCH THESIS:

Course Code	Course Title	Credit Hours
CC 701	Master's Research Thesis (Part 1)	6
CC 702	Master's Research Thesis (Part 2)	6
Subtotal	**2 Parts * 6 Credit Hours**	**12**

Total	**36**

Students in the M.Eng. Program are required to select 4 courses from the list of elective courses in place of the thesis hours. Thus, the M.Eng. Program student must successfully pass eight elective courses in addition to the four core courses bringing the total credit hours of the program to 36 hours.

Courses

Course Code : CC 711

Course Title : Advanced Programming Languages

Credit Hours : 3

Course Description

Different paradigms of programming languages. Introduction to programming languages, history of programming languages, language design principles, syntax, basic semantics, data types, control and abstract data types. Difference between object oriented, functional logic, parallel programming and visual programming.

Course Objectives

To introduce the major principles and concepts underlying all programming languages with no concentration on one particular language.

Course Topics

- History and Programming Languages
- Language design principles
- Syntax
- Basic Semantics
- Data Types
- Control
- Abstract Data Types
- Object Oriented Programming
- Functional Programming
- Logic Programming
- Parallel Programming
- Visual Programming

References

- Kenneth Louden, "*Programming Languages: Principles and Practice*", 2nd edition, 2002.
- Raphael A. Finkel, "*Advanced Programming Languages Design*", Addison Wesley, 1995.
- Ravi Sethi, "*Programming Languages, Concepts and Constructs*", Addison Wesley, 2000.
- IEEE Transactions on Software Engineering
- R. C. Martine, *Agile Software Development, Principles, Patterns, and Practices*, Prentice Hall 2002.
- R. Sebesta, *Concepts of Programming Languages*, Addison Wesley, 2003.
- Peters Van Ray, Seif Haridi, *Concepts, Techniques, and Models of Computer Programming*, MIT Press, 2004.

Course Code : CC 712

Course Title : Advanced Database Systems

Credit Hours : 3

Course Description

This course introduces material related to current advancements and research topics in the area of distributed heterogeneous database.

Course Objectives

To be able to write survey papers covering a contemporary topic, and implement software tools to enable exchanges among heterogeneous database systems.

Course Topics

- Heterogeneous Database Systems
- Data Warehouse and Data Mining
- Database and World Wide Web
- Object Database
- Active, Temporal, and Deductive Database
- Client Server and Distributed Database Systems
- Digital Library and Multimedia Database

References

- Ramez ElMasri, Shamkant B. Navathe, "*Fundamentals of Database Systems*", Addison Wesley, 2000
- Paolo Atzeni, S. Ceri, "*Database Systems*", McGraw-Hill, 2000
- Barry Eaglestone, Mick Riddley, "*Object Databases*", McGraw-Hill, 2000
- Ahmed Elmagarmid, "*Heterogeneous and Autonomous Database Systems*", Morgan Kaufmann Pub., 1999

Course Code : CC 713

Course Title : Software Engineering

Credit Hours : 3

Course Description

This course introduces software engineering as a concept, software development and the development life cycle. It also introduces different topics of software engineering like software quality, reusability, reliability, maintenance, security, testing, and software psychology. Also requirement analysis software tools and software design topics explained.

Course Objectives

To introduce students to the systematic approach to development, operation, maintenance and retirement of software engineering and its different topics.

Course Topics

- Software Development Life Cycle
- Systems Analysis "Requirement Analysis and Specification"
- Systems Design and Functional Oriented and Object Oriented
- Validation and Verification
- Software Maintenance
- Project Management
- Software Quality
- Software Reliability
- Software Reusability
- Computer Aided Software Engineering (CASE) Tools
- Software Engineering

References

- IAN Sommerville, "*Software Engineering*", 7th Edition, Addison Wesley, 2004.
- Randall W. Jensen, "*Software Engineering*", Prentice Hall, 1979.
- Hans Van Villet, "*Software Engineering: Principle and Practice*", J. Wiley, 2nd edition, 2000.
- IEEE Transactions on Software Engineering
- ACM publications
- Roger, Pressman, *Software Engineering: A Practitioner Approach*, McGraw Hill, 2004.

Course Code : CC 714

Course Title : Computer Systems Security

Credit Hours : 3

Course Description

Conventional encryption (classical and modern algorithm techniques), public-key cryptography, number theory, message authentication and hash functions, hash and MAC algorithm, digital signatures and authentication protocols, mail security, IP security, web security, system security firewalls, projects for teaching cryptography and network security.

Course Objectives

To provide a practical survey of both the principles and practice of cryptography and network security including practical applications previously implemented in encryption techniques and firewalls.

Course Topics

- Network Security Practice
- Encryption Algorithms and Cryptography
- System Security
- Research Projects and Programming Projects
- Internet Security
- Cryptography and Data Security
- Cryptography and Network Security
- Maximum Security (Anonymous)
- Web Security
- Computer Security Policies
- Disappearing Cryptography

References

- William Stallings, "*Cryptography and Network Security: Principles and Practice*", 2nd Edition, 1998.
- K. M. Jackson and Jottruska, "*Computer Security Reference Book*", Linarce House, 1992
- Bruce Schneier, *Applied Cryptography*, John Wiley, 1996

Course Code : CC 715

Course Title : Neural Networks Systems

Credit Hours : 3

Course Description

Introduction to intelligent systems. How does the brain of humans work? Parallel processing through multi nodes and nontraditional processing approach are clarified. Applications in various fields.

Course Objectives

- Introduce main ideas of Neural Networks.
- Construction and concepts.
- Learning as important in the paradigm is considered.

Course Topics

- Introduction
- Theoretical Foundations of Neural Networks
- Networks Approximation and Learning
- Overview of Back propagation and its variants
- Convergence properties of Hopefield model
- Decision regions of multilayer perceptrons
- Entropy nets: From decision trees to Neural Networks
- Applications

References

- No specific references

Course Code : CC 716

Course Title : Pattern Recognition

Credit Hours : 3

Course Description

This course provides in-depth review of various methodologies and techniques used in pattern recognition. This includes: feature extraction, reduction and representation to building complex algorithms for handling problems of data analysis. Concepts used in structural and statistical pattern recognition are also explored.

Course Objectives

To introduce the student to the analysis of difficult data structures, for which no prior models is available in order to be able to grasp basic techniques and learn where to learn more about advanced application-specific techniques.

Course Topics

- General approaches: learning from examples, measurements and features
- Classification Problem
- Clustering techniques
- Structural Pattern Recognition
- Statistical Pattern Recognition
- Image Analysis
- Advanced Applications

References

- R. O. Dude, P.E. Hart and D. G. Stork, *Pattern Classification*, 2nd edition, 2001.
- IEEE. Transactions on Pattern Analysis and Technique Intelligence.
- Journal of Pattern Recognition.
- Journal of Pattern Recognition Letters.
- S. Theodoris, and K. Koutroumbas, *Pattern Recognition*, Academic Press, 1999.

Course Code : CC 721

Course Title : Advanced Computer Architecture

Credit Hours : 3

Course Description

Overview of parallel architectures and programming techniques, parallel processes, models and semantics, parallel, concurrent and distributed programming. Task scheduling, shared memory parallel programming, complexity aspects, parallel processor design considerations, and pipelined processor design consideration, special-purpose parallel architecture design

Course Objectives

To introduce first-year graduate students in computer science and computer professionals to the theory and applications of advanced parallel architectures and programming.

Course Topics

- Parallel Computational Models
- Parallel Processors Design Considerations
- Instruction-Level Parallel Processor (ILP)
- Thread and Process-Level Parallel Architecture

References

- Michael Flynn, Jones and Bartlett, "*Computer Architecture, Pipelined and Parallel Processor Design*", Computer Science series, 1995
- Krishnamurthy, "*Parallel Programming: Principles and Practice*", 1989
- S. G. Shiva, "*Pipelined and Parallel Computer Architectures*", Addison Wesley, 1997
- Khatanga, "*Parallel and Cluster Computing: Scalable Architecture*", 1998
- W. Petersen, P. Arbenz, "*Introduction to Parallel Computing*", Oxford University Press, 2004
- Deszso Sima et al., *Advanced Computer Architectures*, Addison Wesley, 1997

Course Code : CC 722

Course Title : Advanced Digital Systems

Credit Hours : 3

Course Description

This course introduces a range of aspects of advanced digital design. It starts with an introduction to the VHDL, Verilog and ABEL hardware description languages. The course provides techniques for designing and implementing synchronous and asynchronous digital circuits. It explains briefly the various design parameters and tradeoffs such as area, timing and cost of die. Advanced processor design paradigms and architectures such as dataflow, reconfigurable, asynchronous and processor-in-memory are also discussed.

Course Objectives

To become familiar with the major principles and concepts including all aspects of synchronous and asynchronous digital circuit design with emphasis on new processor design paradigms.

Course Topics

- The VHDL, Verilog, and ABEL language constructs and applications
- Design tradeoffs such as area, time, and cost
- Asynchronous circuit design fundamentals
- Static dataflow structures
- Handshake implementations
- Processor design and implementation

References

- J. Spareso, S. Furber, *Principles of Asynchronous Circuit Design*, Kluewer Academic Publishers, 2001.
- J. Silc, B. Robic, T. Ungerer, *Processor Architecture,* Springer-Verlag, 1999.

Course Code : CC 723

Course Title : Embedded Systems Design

Credit Hours : 3

Course Description

Processors, chipsets, busses, and I/O devices for high-end embedded systems. Embedded operating systems; device drivers and applications for embedded systems.

Course Objectives

To present the theory and tools of Embedded systems and invoke students in different aspects of Embedded system design through projects.

Course Topics

- Introduction to Embedded Systems
- Embedded Products (PDAs, Transaction Terminals, Industrial PC Controllers)
- Hardware for Embedded Systems Design
    - Processors and Chipsets
    - X86 ISA - I/O devices and interfaces
    - Common Bus Standards and Interfaces (ISA, PCI, AGP)
    - Programmed I/O - Interrupts
    - DMA - Example Design (i.e. Celeron motherboard)
- Software for Embedded Systems Design
    - Role of an Embedded Operating System
    - Multitasking and Threads
    - Example Operating Systems (Windows CE, NT embedded, Linux, BOS, Wind River)
    - Overview of Windows CE
- Proposed Project Design Review
- Design Project Implementation
- Project Demo and Presentation

References

- J. Henkel and S. Parameswaran, *Designing Embedded Processors: A Low Power Perspective*. 2007
- Herman Kopetz, *Real-Time systems: Design Principles for Distributed Embedded Applications*, Springer, 1997

Course Code : CC 725

Course Title : VLSI System Design

Credit Hours : 3

Course Description

This course focuses on a range of current VLSI design methods, testing and design-for-test techniques. The course presents designs for datapath subsystems including adders, shifters, multipliers, counters and others. Moreover, the course describes memory subsystems and special-purpose subsystems including clocking, I/O, mixed-signal blocks and routing techniques.

Course Objectives

To become versed in VLSI design to face the encountered growing challenges of power consumption and productivity of CAD tools.

Course Topics

- Logic Verification Principles
- Manufacturing Test Principles
- Datapath Subsystems
- Memory Subsystems
- Special-purpose Subsystems
- Analog Circuits
- Power Dissipation
- Clock Generation and Distribution

References

- N. Weste, D. Harris, "*CMOS VLSI Design: A Circuits and Systems Perspective*", Addison Wesley, 2005.
- N. Weste, K. Eshraghian, "*Principles of CMOS VLSI Design*", 2nd Ed., Addison Wesley, 1993.
- R. Troutman, "*Latchup in CMOS Technology: The Problem and its Cure*", Kluwer Academic Publishers, 1986.

Course Code : CC 727

Course Title : Application-Specific Architectures

Credit Hours : 3

Course Description

This course tackles the micro-architectures that are non Von Neumann architectures. These architectures are dataflow, processor-in-memory, reconfigurable computing and asynchronous processor approaches. The course also discusses special-purpose architectures

Course Objectives

To become familiar with the design principles associated with non von Neumann architectures, and special-purpose machine design.

Course Topics

- Basic Pipeline and Simple RISC Processors
- Dataflow Processors
- Processor in Memory (PIM)
- Asynchronous Processors
- Artificial Neural Net (ANN)
- Reconfigurable Processors
- Finite Element and Finite Difference Processors
- Steganographic Processor
- Encryption Processors
- Genetic Optimization Processors
- Design Project

References

- J. Sparso, S. Furber, "*Principles of Asynchronous Circuit Design: A Systems Perspective*", Kluwer Academic Publishers, 2001
- J. Silc, B. Robic, T. Ungerer, "*Processor Architecture: From Dataflow to Superscalar and Beyond*", Springer Verlag, 1999.
- M. J. Flynn, "*Computer Architecture, Pipelined and Parallel Processor Design*", Jones and Bartlett Publishers, Subury, 1995.

Course Code : CC 729

Course Title : Computer Design and Performance Evaluation

Credit Hours : 3

Course Description

This course compares between the two major design methodologies based on ISA (Instruction Specific Architecture) and Special-purpose Architecture. The course covers the topics of queuing theory and Markov processes as a tool for computer system performance evaluation. Moreover, the students are introduced to operational analysis techniques regarding performance of computer systems. The course introduces the student to the principles of design, build and test of special-purpose processors. Moreover, the students are introduced to the concepts of evaluating the performance of such processors. It is in tended for first year graduates specializing in computer engineering. These include Markov continuous and discrete processes. Benchmarking processor and computer system architectures have become extremely difficult due to the complexity of the processors and the complexity of the applications that run on the computers. This course will focus on quantitative and analytical characterization of processors and applications from general purpose and scientific computing. Several papers from recent computer architecture, performance evaluation, and workload characterization related conferences will be used as supplemental material.

Course Objectives

To become familiar with the principles of design, build and test of special-purpose processors, and to be able to evaluate the performance of such processors.

Course Topics

- Introduction to ISA-based Computer Design, Sequencing and Control
- Hardwired and Micro-Programmed Control
- Pipelined Control and Performance Evaluation
- Instruction Set Architecture and Addressing Architecture
- Central Processing Unit Design
- High Performance CPU Concepts
- Design Parameters; Area, Time, and Cost
- Operational Analysis
- M/G/1 Queuing Model
- Discrete-Time Markov Chains
- Benchmark System Evaluation
- Design Project

References

- Mano, M. M., *Computer System Architecture*, 3rd Ed. Englewood Cliffs, NY, Prentice Hall, 1993.
- Patterson, D.A., and Hennessy, J. L., *Computer Organization and Design: The Hardware/Software Interface*, 2nd Ed., San Francisco, CA: Morgan Kaufmann, 1998

- Desrochers, G. R, *Principles of Parallel- and Multi-Processing*, McGraw-Hill, 1989.
- Hayes, J.P., *Computer Architecture and Organization*, McGraw Hill, 1998.
- David Lilja, "*Measuring Computer Performance: A Practitioner's Guide*", Cambridge, University Press, 2000.
- A Collection of papers from conferences and journals. Reading list to be posted on course web page.

Course Code : **CC 731**

Course Title : **Advanced Computer Networks**

Credit Hours : **3**

Course Description

Fundamental concepts of computer network architectures and protocols with Internet as case study.

Course Objectives

To give the student the required background in the field of computer networks by studying the fundamental concepts of network architectures, protocols.

Course Topics

- Network architecture and protocols
- Network applications
- Transport Layer
  - Transport Protocol Mechanisms
  - Examples of Transport Protocols (UDP, TCP)
- Network Layer
  - Routing and IP
- Data Link Layer
  - ARQ protocols
- Physical Layer
- Internet case study

References

- Kurose and Ross, *Computer Networking: A Top Down Approach*, 4th Ed., Prentice Hall, 2007.
- Garcia, *Communication Networks: Fundamental Concepts and Key Architectures* (2nd ed.), McGraw Hill, 2003.
- Eric Maiwad, *Fundamentals of Network Security*, McGraw Hill
- William Stallings, *Data and Computer Communications*, 8th Ed., Prentice Hall, 2007

Course Code : CC 732

Course Title : CAD for Computer Communications Networks

Credit Hours : 3

Course Description

The course illustrates how computer-aided-design (CAD) tools can be used to simulate computer communications networks and systems. A student hands on series of lab sessions will be used to demonstrate how the various properties of networks effect the quality of the service, and shows how modern computer-aided design (CAD) software can be used to evaluate and optimize the design of a communication networks in general.

Course Objectives

- To investigate the methodologies and algorithms used for designing and optimizing computer/communications networks.
- To focus on the algorithmic aspects of network design.
- To use various CAD tools for the analysis and evaluation of networks

Course Topics

- Modeling Networks as Graphs
  - Representations of Networks
  - Computational Complexity
- Fundamental Graph Algorithms
- Topological Design
- Algorithms
  - Flow Deviation Algorithm
  - Bertsekas-Gallager Algorithm
  - Generalized Cut-Saturation Algorithm for Distributed Computer
- Communications Network Optimization
- Communication Networks
  - Algorithm for the Access Facility Location Problem
  - Dimensioning Schemes
- Mesh Topology Optimization
- MENTOR Algorithm (Mesh Network Topology Optimization and Routing)
- CAD software to support the monitoring and analysis of networks

References

- IEEE/ACM Transactions on Networking
- IEEE/ACM Transactions on CAD and Modeling and simulation

Course Code : CC 733

Course Title : Analysis and Design of Computer Networks

Credit Hours : 3

Course Description

To provide the advancements in research and technology of the field of computer networking to emphasize the hot research topics of the analysis, design, architecture and methodology of computer networking and their standards.

Course Objectives

- To build solid knowledge of network protocols, HDLC, X.25, Frame relay, ISDN, ATM implementation and performance evaluation.
- To highlight the research topics in these areas.

Course Topics

- Computer Networks Taxonomy
- WAN Protocol and Standards
- LAN Protocol and Standards
- MAN Protocol and Standards
- HDLC
- Routing Protocol and Congestion Control
- X.25
- Frame Relay
- ISDN
- ATM
- Student Seminars of Selected Topics

References

- Andrew S. Tanenbaum, "*Computer Networks*"
- William Stallings, "*Data and Computer Communication*", Pearson P. Hall, 2004
- IEEE/ACM Transactions on Networking

Course Code : **CC 734**

Course Title : **Networks Security**

Credit Hours : **3**

Course Description

Fundamental concepts of computer network security and computer networks security issues.

Course Objectives

To give the student the required background in the field of networks security by studying the fundamental concepts of security in network architectures, protocols and network management.

Course Topics

- Network Reconnaissance Techniques
  - Network Mapping and Vulnerability Assessment
- Network Security Problems and Schemes
- Identifying Threats to Network Devices
- Network Intrusion Detection Systems, Firewalls and VPN
- Network Security services and Tools
- Wireless Network Security
- Risk Analysis and Management

References

- Eric Maiwad, *Fundamentals of Network Security*, McGraw Hill
- William Stallings, *Cryptography and Network Security: Principles and Practice*, Prentice Hall

Course Code : CC 735

Course Title : Sensor Networks

Credit Hours : 3

Course Description

Basics of sensor network communications. Applications, architectures, and communication protocols for sensor networks are treated in depth.

Course Objectives

- To become familiar with the basics of sensor network communications.
- To become versed in applications, architectures, and communication protocols for sensor networks in depth.

Course Topics

- Introduction
- Sensor Networks Architecture and Protocol Stack
- Factors influencing the design of sensor networks
- Sensor Network Applications
- Application Layer
- Transport Layer Protocols
- Routing Algorithms
- Medium Access Control Protocols
- Error Control Algorithms
- Physical Layer Solutions
- Localization and Target Detection Algorithms
- Time Synchronization Algorithms
- Sensor and Actor (Actuator) Networks
- Coordination and Communication Problems

References

- Holger Karl, A. Willig, *Protocols and Architectures for Wireless Sensor Networks*, Wiley, 2005.

Course Code : CC 737

Course Title : Mobile, Wireless and Ad-Hoc Networks

Credit Hours : 3

Course Description

Mobile and wireless networking. Architectures and communication protocols for wireless local area networks, ad-hoc networks, cellular systems, WiMAX, and Wireless Mesh Networks.

Course Objectives

The student will be familiar with the fundamental concepts of mobile wireless networking and gain technical details of emerging wireless network standards.

Course Topics

- Wireless Sensor Networks
  - Network Architecture, Applications, Factors Influencing Network Design
  - Application Layer Framework, Transport Layer Solutions
  - Routing Algorithms, Medium Access Control Schemes, Error Control
- Ad Hoc Networks
  - Topologies and Characteristics, Routing Algorithms
  - Proactive and Reactive Routing Protocols
- Wireless Local Area Networks (WLANs)
  - Reference Architecture, Protocol Architecture
  - Family of Wireless LAN Standards and Details (IEEE 802.11; a; b; d; e; f; g; h; I; n)
  - Physical Layer Functions, CSMA and its Problems for WLANs, MAC Layer Solutions
- Wireless Personal Area Networks (Bluetooth)
- Mobile IP
  - Agent Discovery/Advertising Care-of Addresses
  - Registration, Tunneling (Encapsulation), Triangle Routing, Optimized Routing
  - Mobility Management, Handovers
- 2.5 Generation Wireless Systems (GPRS)
  - Reference Architecture, Devices and Terminal Types
  - Location Management and Handoffs in GPRS
  - Short Messages Services (SMS)
- Third Generation Wireless Systems
  - IMT-2000 (International Mobile Telephone)
  - UMTS (Universal Mobile Telephone Systems)
  - Evolution from 2G to 3G; Differences
- WiMAX
  - Motivation, Architecture and IEEE 802.16 Standards
- Wireless Mesh Networks
  - Architecture (Mesh Clients, Mesh Routers), WMNs vs. Ad Hoc Networks (Differences)
  - Application Scenarios, Critical Factors Influencing Network Design

- Physical Layer Solutions, Existing MAC Solutions, Routing Protocols, Research Challenges
- IEEE Standard Activities and their Status

References

- George Aggelou, *Mobile Ad Hoc Networks from Wireless LANs to 4G Networks*, McGraw-Hill, 2005.

Course Code : CC 741

Course Title : Systems Science and Engineering

Credit Hours : 3

Course Description

This course introduces a range of techniques for analyzing continuous and discrete linear time invariant systems. It starts with a review to techniques of solving differential and difference equations using Fourier and the Z-transforms. Subsequently, the course veers to applications involving digital filter design. Afterward, it provides an introduction to the Discrete Fourier Transform (DFT), and Fast Fourier Transform (FFT) with various applications. In addition, the course introduces students to the theory and applications of wavelets transforms.

The course also covers the following bodies of knowledge: Phenomena of real world systems, different imposed boundary conditions as well as symbolic systems manipulations and analysis.

Course Objectives

To become familiar with the major principles and concepts behind discrete and continuous linear time-invariant system analysis with emphasis on wavelet theory and applications.

Course Topics

- Linear Systems and Signal Analysis
- Difference Equations
- The Z-transform
- Solution of D.E
- A/D Conversion
- Digital Filters
- Fourier Transform
- DFT, FFT
- Discrete Cosine Transform, Hartely Transform
- Wavelets (Haar, Daub, Coiflet, Gabor)

References

- N. Sinha, *Linear Systems*, Wiley, 1991.
- J. S. Walker, *The Fourier Transform*, 2nd Edition, McGraw Hill, 1992
- R.N. Bracewell, *The Fast Fourier Transform*, McGraw Hill, 2000
- J. S. Walker, *A Primer on Wavelets and Their Scientific Applications*, Chapman and Hall, 1999.

Course Code : CC 742

Course Title : Real-Time Systems

Credit Hours : 3

Course Description

Real-time systems are characterized by the fact that it is not only the result of the calculation that is of importance but also the time when the result is available. A computer used for controlling a process is a good example of a real-time system. It must operate in a time-scale that is determined by the time scale of the process. At the same time it should be reactive to external events, often with time constraints on the reaction time.

Course Objectives

To study methods for design and implementation of computer control systems with focus on the application classes mentioned and to implement some systems in a project.

Course Topics

- Real-time programming
- Synchronization and mutual exclusion
- Real-time kernels and operating systems
- Periodic controller tasks
- Computer implementation of control algorithms
- Scheduling theory
- Formal methods
- Sequence control
- Set-point handling
- Industrial control systems
- Real-time communication

References

- Giorgio C. Buttazzo, "*Hard Real-time Computing Systems: Predictable Scheduling Algorithms and Applications* (Real-Time Systems Series)", Springer-Verlag Telos, 2nd Edition, 2004.
- Phillip A. Laplante, "*Real-Time Systems Design and Analysis*", Wiley-IEEE Press, 3rd Edition, 2004.
- Jane W. S. Liu, "*Real-Time Systems*", Prentice Hall, 1st Edition, 2000.

Course Code : CC 743

Course Title : Data Compression and Image Processing

Credit Hours : 3

Course Description

Theory and algorithms of signal encoding and decoding for data compression. Applications in information systems, digital telephony, digital television, and multimedia Internet.

Course Objectives

- To cover the theory and algorithms of signal encoding and decoding for data compression.
- To study applications in information systems, digital telephony, digital television, and multimedia Internet.

Course Topics

- Introduction: signal compression, lossless and lossy compression
- Quantization theory
  - Uniform quantization, distortion and bit rates
  - Amplitude distribution and high-rate quantization theory
  - Bennett approximations and optimal performance, Lloyd's code optimality and algorithm
  - Elementary distortion-rate theory
- Architecture for data compression and introduction to data modeling
  - Signal models and spectral analysis
  - Quantization with memory
  - Fixed-rate vs. variable-rate code
  - Entropy, estimated entropy, complexity and typical sequence of an ergodic source
  - Variable rate quantization: lossless codes, prefix code
- Lossless Coding Techniques
  - Huffman coding, arithmetic coding
  - Universal lossless codes, adaptive and predictive lossless coding
- Distortion and Similarity Measures
  - Sample difference, sum of squared deviations and Euclidean distance
  - Lp-norm, city-block distance, Mahalanobis distance
  - Transformation and transformation invariant similarity measures
  - Spectral distortion measures
  - Mutual-information, divergence, and Kullback-Liebler number
  - Perceptual issues
- Coding algorithms scalar quantization
  - Clustering algorithms for quantizer design
  - The Lloyd algorithm and its generalization
  - Entropy-constrained quantizers
- Coding algorithms - vector quantization (VQ)
- Sphere packing and optimal uniform lattice quantizers
- Progressive vector quantization
- Variations of vector quantization

  - Finite-state VQ and Markov models
  - Tree and Trellis encoding
- Applications
  - Speech and audio coding
  - Image and video coding
- Compression standards and formats
  - Historical and evolutional aspects behind development of standards
  - Application areas

References

- K. Sayood, *Introduction to Data Compression* (2nd edition), Morgan Kaufmann, 2000.
- A. Gersho, R. M. Gray, *Vector Quantization and Signal Compression*, Kluwer Academic Press, 1992.
- Gibson, Berger, Lookabaugh, Lindbergh and Baker, *Digital Compression for Multimedia: Principles and Standards*, Morgan Kaufmann, 1998.

Course Code : CC 746

Course Title : Multimedia Engineering

Credit Hours : 3

Course Description

Introduce multimedia concepts, how to build and face technical complications of multimedia. Design and implementation of multimedia facilities.

Course Objectives

To study the important and new technology of multimedia facilities and transmission.

Course Topics

- Multimedia Basics and Technology
- Steps to producing a multimedia application
- Staffing and skills for multimedia production
- Multimedia hardware
- Designing the application:
    - Graphic design
    - Capturing still images
    - Creating Full-Motion videos
    - Creating soundtracks and bringing all together with programming or authoring
- Object oriented multimedia programming

References

- No specific references

Course Code : CC 747

Course Title : Advanced Computer Controlled Systems

Credit Hours : 3

Course Description

Introduction to the concepts of computer as a part of the system working as the brain which play the decision maker of the system.

Course Objectives

To study how to integrate the computer in controlling dynamic systems within system limitations and specific design conditions.

Course Topics

- Computer interfacing with systems.
- Operating systems for specialized computers.
- Time scheduling .
- Distributed computing using several processors.
- Hierarchical implementation of computer control.
- Case studies.

References

- *Computer-Controlled Systems: Theory and Design*, 3rd Ed., Prentice Hall, Information and SysScience Series.

Course Code : **CC 753**

Course Title : **Advanced Topics in Artificial Intelligence**

Credit Hours : **3**

Course Description

This course allows the introduction of material relating to current artificial intelligence research topics, and current advances in artificial intelligence technology.

Course Objectives

To write-up survey papers about a narrow topic, and implement software tools to practice the different advanced topics.

Course Topics

- Learning Systems
- Fuzzy Logic
- Genetic Algorithm
- Hybrid Intelligent Systems
- Case Based Reasoning
- Knowledge Discovery in Database Systems
- Intelligent Agents

References

- Russel, S., Peter Norvig, "*Artificial Intelligence: A Modern Approach*", 2nd ed., 2002.
- Elaine Riche, K. K, "*Artificial Intelligence*", McGraw Hill, 1983.
- M. T. Jones, *AI Applications Programming*, Charles Rives Media, 2003.

Course Code : CC 755

Course Title : Distributed and Parallel Systems

Credit Hours : 3

Course Description

This course studies the fundamental aspects of distributed systems and applications. Early foundations and recent developments in distributed systems will be investigated. Both client-server and peer-to-peer application designs will be discussed. Other topics include sockets, reliability, replication, group membership protocols, clock synchronization, and logical timestamps.

Course Objectives

To introduce the students to the studies of distributed and parallel systems.

Course Topics

- Distributed architectures
- Communication among systems
- Naming
- Synchronization
- Consistency
- Replication
- Fault tolerance
- Distributed systems: object-based, file, web-based, coordination-based

References

- Andrew S. Tanenbaum, Maarten van Steen, *Distributed Systems: Principles and Paradigms*, Prentice Hall

Course Code : CC 756

Course Title : DSP Hardware and Software System Design

Credit Hours : 3

Course Description

A study of theory and practice in the design and implementation of DSP algorithms on programmable processors, multiprocessors, and ASICs. Specification, evaluation, and implementation of real time DSP applications on embedded DSP-based environments.

Course Objectives

- To study the theory and practice in the design and implementation of DSP algorithms on programmable processors, multiprocessors, and ASICs.
- To present the specification, evaluation, and implementation of real time DSP applications on embedded DSP-based environments.

Course Topics

- Introduction to Programmable DSPs
  - Skillikorn's taxonomy and classification
  - Architectures of DSP; Examples of DSPs
  - Memory architectures; External interface units
- Data Path Design for DSP
  - SISC architectures; Reservation tables and optimization
  - Pipeline control; Synchronous data path design and retiming
  - Arithmetic circuits for DSP; Multiprocessor scheduling theory
- DSP ASIC design and VHDL
  - Introduction to VHDL and Language Fundamentals
  - Modeling DSP data and control path in VHDL
- DSP Chip Synthesis
  - Design recommendations; Compilation and coding issues
  - Joint simulation and synthesis issues
  - Synthesis Examples
  - DSP processor design
- Specification of DSP algorithms and processors
  - Programming models and virtual machines
  - Graphical specification and requirements capture
  - Textual specification and requirements capture
  - Compilation and execution environments
  - Fixed point and floating point issues
- Software architecture for DSP boards and systems
  - Host interfaces
  - I/O interfaces
  - Real-time operating systems
- DSP program framework and API
- Real-time program architecture
- Operating system dependencies
- Application modules and libraries
- Implementation of virtual machines

- Virtual prototyping of DSP applications: Examples
  - Single processor implementations
  - Multiprocessor implementations
  - Code development and debugging
- DSP Application Demonstrations
  - Sample implementations: equalizers, coders.
  - Performance measurement and optimization

References

- Meyer-Baese, Uwe, *Digital Signal Processing with Field Programmable Gate Arrays* (2nd edition), Springer-Verlag, 2004.

Course Code : CC 757

Course Title : Modeling and Simulation

Credit Hours : 3

Course Description

To emphasize the topics of fundamental importance concerning the broad field of modeling and simulation to demonstrate the different stages included in conducting a simulation study, suing the discrete event simulation model.

Course Objectives

- To highlight system models and corresponding simulation methodology.
- To demonstrate the discrete event simulation model and its implementation.
- To discuss random number generators, generating random distributions, selecting input distributions, output analysis and comparing alternative system configurations.

Course Topics

- Systems Models and Simulation
- Discrete Event Simulation
- Single Server System
- M/M/1 Simulation
- Stage of Conducting a Simulation Study
- Random Number Generators
- Generating Random Distribution
- Selecting Input Probability Distribution
- Data Analysis of Simulation Outputs
- Building Valid and Credible Simulation Models

References

- Averill M. Low and W. David Kelton, "*Simulation Modeling and Analysis*", 1991
- IEEE Modeling and Simulation Transactions
- Barry L. Nelson, "*Stochastic Modeling: Analysis and Simulation*", 1995

Course Code : CC 758

Course Title : Advanced Applications of Digital Signal Processing

Credit Hours : 3

Course Description

Discrete time transfer function, realization topology, IIR filter design, FIR filter design, DFT, FFT, Floating Point, sub-band transform and sub-band coding, sinusoidal signal generation, compression techniques, Multi-rate signal processing, Filter Banks, Wavelets and Applications to mp3 and JPEG 2000.

Course Objectives

To become versed in advanced techniques of filter and hardware design.

Course Topics

- Overview of DSP: LTI systems, Z-transform and DTFT.
- Connecting Analog and Digital Worlds: Sampling, A/D, D/A, Cost-Benefit trade-offs of over-sampling.
- Multi-rate signal processing.
- Filter Banks, Wavelets and Applications to mp3 and JPEG 2000.
- Overview of FIR and IIR filter design techniques.
- DFT, FFT, and role of DCT in MPEG and JPEG.
- Spectral Analysis.

References

- Oppenheim, Alan V., Schafer, Ronald W., and Buck, John R., "*Discrete-Time Signal Processing*," 2nd Edition, Prentice Hall, 1999.
- Proakis, John G., Manolakis, Dimitris G., "*Digital Signal Processing: Principles, Algorithms, and Applications*," 3rd Ed., Prentice Hall, 1996.
- Mitra, Sanjit K., "*Digital Signal Processing: A Computer-Based Approach*," 2nd Edition, McGraw Hill, 2001
- McClellan, James H., Schafer, Ronald W., and Yoder, Mark A., "*DSP First: A Multimedia Approach*," Prentice Hall, 1998
- G. Strang and T. Q. Nguyen, *Wavelets and Filter Banks*. Cambridge, MA: Wellesley-Cambridge Press, 1996

Course Code : CC 759

Course Title : Advanced Robotics

Credit Hours : 3

Course Description

Robot algorithms are abstractions of for controlling motion and perception in the physical world. In this course the student will study advanced topics related to current research in robotics. Planning and control issues for realistic robot systems, taking into account: dynamic constraints, control and sensing uncertainty and non-holonomic motion constraints. Analysis of friction for assembly and grasping tasks. Sensing systems for hands including tactile and force sensing. Environmental perception from sparse sensors for dexterous hands. Grasp planning and manipulation.

Course Objectives

To explore the kinematics, dynamics, and control of robotic manipulators, and to briefly discuss other areas including machine vision, CAD and AI in recent research topics.

Course Topics

- Rigid Motion and Homogeneous transformations
- The Denavit-Hartenberg representation
- Inverse and velocity kinematics
- Dynamics
- Independent joint control
- Multivariate control
- Force control
- The feedback linearization
- Variable and adaptive control
- Optimal control
- Stochastic control
- Advanced research topics

References

- W. Chung, "*Nonholonomic Manipulators* (Springer Tracts in Advanced Robotics)", Springer Verlag, 2004.
- Thomas R. Kurfess, "*Robotics and Automation Handbook*", CRC Press, 2004.
- J. H. Kim, K. T. Seow, "*Soccer Robotics* (Springer Tracts in Advanced Robotics)", Springer-Verlag, 2004.
- M. W. Spong, *Robot Dynamics and Control*, Wiley, 1989.

Course Code : CC 760

Course Title : Computer Engineering Seminars

Credit Hours : 3

Course Description

A series of seminars with topics related to different fields of computer engineering such as networking and computing fields: mobile ad hoc networks, voice and video over IP, state of the art in computer architecture design, etc…

Course Objectives

The student will gain knowledge about new trends in the field of computer engineering and be aware of the current research topics. The student will prepare a seminar on selected topic(s), present the seminar and get feedback from academic members and classmates.

Course Topics

- Voice and Video over IP
- MANET
- Cognitive Radio
- Computer vision
- System on a Chip

References

- According to the seminar subject

Faculty Members

(in alphabetical order)

- **ABD EL-BAES MOHAMED**
  Ph.D. (1992) Vienna University, Austria
  Computer System Security

- **FATMA ZADA**
  Ph.D. (1994) Mansura University, Egypt
  Intelligent Robotics

- **HESHAM EL-ZOUKA**
  Ph.D. (2006) University of Nottingham, UK
  Network Security

- **KHALID MAHAR**
  Ph.D. (1996) Cairo University, Egypt
  Image Processing, Pattern Recognition

- **MAGDY SAEB**
  Ph.D. (1985) University of California, Irvine, USA
  Advanced Computational Techniques

- **MEDHAT FAKHRY**
  Ph.D. (1982) Université Paul Sabatier, France
  Computer Database Systems Management

- **MEER HAMZA**
  Ph.D. (1998) Paisley University, UK
  Software Engineering

- **MOHAMED ABOU EL-NASR,** Head of Department
  Ph.D. (2003) Georgia Institute of Technology, USA
  Computer Networks Architecture, Security and Control

- **MOHAMED KHOLIEF**
  Ph.D. (2003) Old Dominion University, USA
  Digital Libraries, Database Systems and Web Applications

- **MOHAMED TAHER EL-SONNI**
  Ph.D. (1978) University of Illinois, Urbana-Champaign, USA
  Computer Architecture and Pattern Recognition

- **OSSAMA BADAWY**
  Ph.D. (1992) Ain Shams University, Egypt
  Intelligent Systems

- **OSSAMA ISMAIL**
  Ph.D. (1994) Queens University, Canada
  Robotics, Mechatronics, Computer Control

- **SHERIN YOUSSEF**
  Ph.D. (2004) University of Nottingham, UK
  Artificial Intelligence, Intelligent Mobile Agents, Swarm Intelligence

- **WAEL HOSNY**
  Ph.D. (2006) University of Western Ontario, Canada
  Feedback Control, Optical Burst Switching

- **YASSER HANAFY**
  Ph.D. (1995) Duke University, USA
  Computer Aided Design