School of Science and Engineering

Office of Graduate Studies

Master of Science

Information Technology, Computer Networks and Communications

Academic Program

Fall 2012

Table of Contents

1. Introduction

Information Technology (IT) is the acquisition, processing, storage and dissemination of vocal, pictorial, textual and numerical information by a microelectronics-based combination of computing and telecommunications.

A computer network, often simply referred to as a network, is a collection of computers and devices interconnected by communications channels that facilitate communications and allows sharing of resources and information among interconnected devices.

A computer network is a collection of two or more computers linked together for the purposes of sharing information, resources, among other things. Computer networking or Data Communications is the engineering discipline concerned with computer networks. Computer networking is sometimes considered a sub-discipline of electrical engineering, telecommunications, computer science, information technology and/or computer engineering since it relies heavily upon the theoretical and practical application of these scientific and engineering disciplines.

Networks may be classified according to a wide variety of characteristics such as medium used to transport the data, communications protocol used, scale, topology, organizational scope, etc.

A communications protocol defines the formats and rules for exchanging information via a network. Well-known communications protocols are Ethernet, which is a family of protocols used in LANs, the Internet Protocol Suite, which is used not only in the eponymous Internet, but today nearly ubiquitously in any computer network.

2. Program in a glance

Course Length:	2 years
Number of credits required to graduate for thesis option	A minimum of 29 credits
Courses required to graduate:	a) 9 to 15 credits from core courses (Table 3) b) 6 to 12 credits from optional courses (Table 4) c) 2 credits for "Seminar" (Mandatory) d) 6 credits for "Thesis" (Mandatory)

Course Length:	2 years
Number of credits required to graduate for none thesis option	A minimum of 32 credits
Courses required to graduate:	a) 9 to 15 credits from core courses (Table 3) b) 15 to 21 credits from optional courses (Table 4) c) 2 credits for "Seminar" (Mandatory)

Important Notes:

1. Compensatory courses (Table 1) are mandatory for those students who have not taken any of these courses in Bachelor Degree. The minimum pass mark is 12 out of 20.
2. Students are not allowed to take those courses which have already been taken in bachelor degree.

Table 1: Compensatory Courses

No	Course Name	Credit	Code
1-1	Operating Systems	3	52-424
1-2	Computer Networks	3	52-443
1-3	Data and Networks Security	3	52-442
1-4	Computer Architecture	3	52-323

Table 2: Thesis and Seminar

No	Course Name	Credit	Code
2-1	MSc Thesis	6	52-640
2-2	Seminar	2	52-900

*** Note: "Seminar" is mandatory for all students.**

Table 3: Core Courses

No	Course Name	Credit	Code
3-1	Advanced Computer Networks	3	52-693
3-2	Modeling and Analysis of Computer Networks	3	52-657
3-3	Advanced Network Security	3	52-949
3-4	Distributed Systems	3	52-663
3-5	Stochastic Processes	3	52-695

Table 4: Optional Courses

No	Course Name	Credit	Code
4-1	Multimedia Networks (Advanced Topics)	3	52-873
4-2	Fault-Tolerant Systems Design	3	52-632
4-3	Network-Based Processing	3	52-863
4-4	Data Communication	3	52-883
4-5	Wireless Sensor Networks (Advanced Topics)	3	52-873
4-6	Performance Evaluation of Computer	3	52-824
4-7	Wireless Communication	3	52-626
4-8	Embedded Systems Design	3	52-747
4-9	Advanced Data Storage Systems	3	52-638
4-10	Advanced Topics in Information Technology	3	52-227
4-11	Dynamics of Complex Networks	3	52-639
4-12	Computer Networks Management	3	52-656
4-13	Green Computing (Advanced Topics)	3	52-873
4-14	Network Storage Systems (Advanced Topics)	3	52-873
4-15	Advanced Operating Systems	3	52-553

3. Research areas

Computer Architecture, Computer Networking, Multimedia Networking, Peer-to-Peer Networking, Wireless Communication Networks, Network on Chips, System on Chips, Fault-Tolerant, Distributed System, Image Processing, Speech processing, Video Processing, Computer Network Modeling, Network Security.

4. Course Syllabus

The following contains the recent course syllabus for the master of engineering program in Information Technology Engineering

Course Title : **ADVANCED OPERATING SYSTEMS**
Course Number : **52533**
Field : **IT**
Credits : **3**
Prerequisite : **OPERATING SYSTEMS**

Course Objective:

- To know related concepts
- To know the role of data structures in IT projects
- To know usual data structures and their applications
- To know usual operations on data structures
- Try to provide insight for selection and design of correct data structures

Outlines:

- Distributed systems
- Transparency
- Network OS/ Distributed OD / Middleware
- Message passing
- Remote procedure call
- Synchronization
- Clock synchronization
- Mutual exclusion
- Dead lock
- Selection algorithm
- Naming
- Distributed shared memory

Text Book:

- A.S. Tanenbaum, *Distributed Operating Systems*, 1st edition, Prentice Hall, 1994.
- S. Tanenbaum, and M. Van Steen, *Distributed Systems: Principles and Paradigms*, 2nd edition, Prentice-Hall, 2006.
- P. K. Sinha, *Distributed Operating Systems: Concepts and Design*, 1st edition, Wiley-IEEE Press, 1996.

References and Supplementary Readings:

- W. Stallings, *Operating Systems: Internals and Design Principles*, 7th edition, Prentice Hall, 2011.

Course Title : **MODELING AND ANALYSIS OF COMPUTER NETWORKS**
Course Number : **52657**
Field : **IT**
Credits : **3**
Prerequisite :

Course Objective:

To make acquainted the graduate students with good knowledge of mathematical foundations of computer networks modeling and simulation.

Outlines

Computer Networks Modeling and Analysis is a graduate course that investigates modeling of computer networks. The main focus will be analytical modeling - probability models, Markov models, Queuing models. To do this course you should like to model systems by deriving and solving mathematical equations, as well as learning about various phenomena empirically (with simulation experiments).

The course will involve extensive use of mathematical skills. There will be a few simulation and (possibly) measurement assignments, which involve minor programming. The mathematics needed is a basic knowledge of Probability and Statistics. A brief refresher in probability will be done (combination of self-study + lectures) initially.

The course contents will be as follows:

- Introduction to Probability Refresher
  - Bayes theorem and Conditional probability
  - Random Variable, Probability Distributions and Densities
  - Joint distributions of Random Variables
  - Linear Transformations
  - Inequalities and Bounds
  - Markov Chains
  - Random processes
- Queuing systems (M/M/1, M/M/c/k, M/G/1)
- Queuing networks
- Applications of Markov Chains to Multiplexing and Access
- Fluid Flow Analysis and Burst Traffics
- Self-similarity and Long-range Dependencies
- The Matrix Geometric Techniques
- Monte Carlo Simulations

Text Book:

- "J. F. Hayes, V. J. Thimma, and Ganesh Babu, *Modeling and Analysis of Telecommunications Networks*, John Wiley, 2004.
- S. Ross, *Introduction to Probability Models*, 9th edition, Academic Press, 2007.

References and Supplementary Readings:

- Chee-Hock Ng, and Soong Boon-Hee, *Queuing Modelling Fundamentals: With Applications in Communication Networks,* John Wiley, 2008.
- K. S. Trivedi, *Probability and Statistics with Reliability, Queuing, and Computer Science Applications*, John Wiley and Sons, New York, 2002.
- D. Bertsekas and R. Gallager, *Data Networks*, Prentice Hall, 1992.
- V. B. Iversen, *Teletraffic Engineering and Network Planning*, retrieved from http://oldwww.com.dtu.dk/education/34340/material/telenook2009pdf.pdf on Feb. 10, 2009.
- M. Schwartz, *Telecommunication Networks: Protocols, Modeling and Analysis,* Addison-Wesley Longman Publishing Co., 1986.
- G. Bolch, S. Greiner, H. de Meer, and K. S. Trivedi, *Queueing Networks and Markov Chains Modeling and Performance Evaluation with Computer Science Applications*, John Wiley publications, 2006.

Course Title	**: ADVANCED NETWORK SECURITY**
Course Number	**: 52949**
Field	**: IT**
Credits	**: 3**
Prerequisite	**: DATA AND NETWORKS SECURITY**

Course Objective:

This course consists of two major topics, cryptography and security protocols. The topics in cryptography part are cryptography architecture, symmetric and asymmetric cryptography, one way hash function, message authentication code, digital signature, public key certificate, random number, and PGP. The topics in security protocols part are SSL/TLS, IPSec (details) and Radius (Authentication and Accounting).

Outlines

- Orientation
- Introduction to Cryptography
- Symmetric Cryptography, One-Time Pad
- Block Cipher (DES, AES)
- ECB, EBC, CFB, OFB, CTR
- Public Key Cryptography & Modular Arithmetic
- RSA
- Hybrid Cryptosystem
- Authentication: One Way Hash Function
- Message authentication Code (MAC)
- Digital Signature
- PKC: Public Key Certificate
- Key, Diffiie-Hellman, PKB
- Random Number
- PGP
- SSL/TLS
- IPSec Architecture and the Standards
- Cryptography Technology in IPSec
- Packet Format: AH and ESP
- Input and Output
- IKE: Internet Key Exchange
- IPComp
- IPSec and Internet VPN
- Radius: Remote Authentication Dial in User Service (RFC 2865)
- Radius Accounting (RFC 2866)

Text Book:

- W. Stallings, *Cryptography Textbook: Cryptography and Network Security Principles and Practices*, 4th edition, Prentice Hall, 2005.

Course Title	**: SEMINAR**
Course Number	**: 52900**
Field	**: IT**
Credits	**: 3**
Prerequisite	**:**

Course Objective:

A two-credit course on how to prepare and deliver an effective oral presentation. All full-time IT graduate students are required to attend .The lecture and practice topics will include writing scientific reports, searching for literature, speaking skills and preparing a scientific oral presentation.

Outlines

- Fundementals of Research
- Selecting a Problem and Preparing a Research Proposal
- Research Report
- Experimental Research
- Qualitative Research
- Methods of Tools of Research
- Preparation for Presentation

Text Book:

- J. W. Best, J.V. Kahn, *Research In Education*, 10^{th} edition, Pearson Publishing , 2006.
- A. Mackey, S. M. Gass, *Second Language Research Methodology and Design*, Lawrence Erbahm Assoc. Publishing. , 2005.

Course Title	**: MULTIMEDIA NETWORKS (ADVANCED TOPICS)**
Course Number	**: 52873**
Field	**: IT**
Credits	**: 3**
Prerequisite	**:**

Course Objective:

To make the students familiar with the fundamental of Network aspects of Multimedia especially multimedia coding for network delivery in various networking environments.

Outlines

- Multimedia Compression Fundamentals & Coding Standards
  - Basics of Digital Video
  - Coding of Still Picture: lossless/lossy compression algorithms and JPEG Standard
  - Subband and Wavelet coding and JPEG2000 Standard
  - Principle of Video Compression: Motion Estimation/Compensation
  - Video coding standards: H.261, MPEG-1, MPEG-2, MPEG-4, H.263, H263+, and H26L
  - Video Content Description, Search and Delivery: MPEG – 7 and MPEG-21
  - Basics of audio compression
- Scalable Video Coding for Heterogeneous Networks
- Multimedia networking concepts: QoS requirements of multimedia content, timing constraints of multimedia stream delivery and playout, Video on Demand (VoD) and real-time video streaming.
- QoS networking concepts: Integrated Services paradigm, Differentiated Services paradigm, Content distribution networks (CDNs) and multimedia caching.
- Application layer: Real-Time Protocol (RTP), RTP Control Protocol (RTCP), Real-Time Streaming Protocol (RTSP), Session Initiation Protocol (SIP), video steaming mechanisms (FEC, ARQ, Hybrid) and multimedia transcoding.
- Transport layer: Stream Control Transmission Protocol (SCTP).
- Network layer: multicast routing, traffic engineering, multiple protocol label switching (MPLS)
- Link layer: packet scheduling disciplines, weighted fair queueing and related QoS guarantees, relationship with Resource Reservation Protocol (RSVP), as well as IntServ and DiffServ paradigms
- Multimedia delivery in emerging networking environments
  - wireless
  - peer-to-peer (P2P) networks
  - wireless multimedia sensor networks (WMSN)

Text Book:

- Ze-Nian Li, M. Drew, *Fundamental of Multimedia*, Prentice-Hall, 2003.
- M. Ghanbari, *Standard Codecs: Image Compression to Advanced Video Coding*, Institution of Electrical Engineers (IEE), 2003.
- J. Kurose, K. Ross, *Computer Networking: A Top-Down Approach*, 4th edition, Addison-Wesley, 2008.

References and Supplementary Readings:

- Y. Wang, J. Ostermann, Ya-Qin Zhang, *Video Processing and Communications*, Prentice Hall, 2002.
- K. R. Rao, Z. S. Bojkovic, D. A. Milovanovic, *Introduction to Multimedia Communications*, Wiley-Inter-science, 2006.
- K. I. Park, *QoS in Packet Networks*, Springer 2005.
- G. D. Gibson, *Multimedia Communications, Directions and Innovations*, Academic Press, 2001.

Course Title	**: STOCHASTIC PROCESSES**
Course Number	**: 52695**
Field	**: IT**
Credits	**: 3**
Prerequisite	**:**

Course Objective:

In probability theory, a stochastic process, or sometimes random process, is the counterpart to a deterministic process (or deterministic system). Instead of dealing with only one possible reality of how the process might evolve under time (as is the case, for example, for solutions of an ordinary differential equation), in a stochastic or random process there is some indeterminacy in its future evolution described by probability distributions. This means that even if the initial condition (or starting point) is known, there are many possibilities the process might go to, but some paths may be more probable and others less so.

Outlines

- Basic Random Processes
- Wide Sense Stationary Random Processes
- Linear Systems and Wide Sense Stationary Random Processes
- Multiple Wide Sense Stationary Random Processes
- Gaussian Random Processes
- Poisson Random Processes
- Markov Chains
- Bayesian Inference
- Least Square Error, Wiener–Kolmogorov Filters
- Hidden Markov Models

Text Book:

- S. M. KAY, *Intuitive Probability and Random Processes Using Matlab*, Springer, 2006.
- S. M. Ross, *Probability Models for Computer Science*, Academic Press, 2002.
- A. Papoulis, *Probability, Random Variables, and Stochastic Processes*, 3rd edition, McGraw-Hill, 1991.