MAKERERE UNIVERSITY

FACULTY OF COMPUTING AND INFORMATION TECHNOLOGY

DEPARTMENT OF NETWORKS

P.O. BOX 7062, KAMPALA, UGANDA

POST GRADUATE DIPLOMA IN DATACOMMUNICATIONS AND SOFTWARE ENGINEERING

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1 Introduction

There has been a wave of changes in the ICT field, not only in Uganda, but in the whole region. The boom of mobile communications technology and the demand for relevant services has been exponential. To harness the benefits of mobile infrastructures we require to have local content and service developers. Secondly, there is huge investment initiatives to connect the countries in the region with fiber optical networks, meaning programs need to consider this new communications infrastructure. Finally, Makerere University and the Faculty of Computing and Information Technology have recently changed their missions to emphasize on world class teaching and research that is relevant not only for the region, but the whole world.

Our objective is to build a world-class and competitive research oriented program with unique options. The program emphasizes on the all aspects of learning, i.e., theory, research, practical and hands-on skills, transferable skills, group working, and so forth. The goal is to fulfill the needs of the booming telecommunication industry, the needs for advanced high speed network infrastructure, the societies need for relevant and innovative services, as well as the needs of our academic institutions for skilled researchers.

This design o the program has demanded a comprehensive look at course content to avoid duplication and to minimize overlap amongst courses.

1.1 Fundamentals of the program

The M.Sc in Data Communications and Software Engineering program has following options:

- Communication Networks
- Mobile Computing and Application Software Development
- Software Engineering

The Communication networks option shall cover all aspects of networking, namely, computer networks, network security, wireless and mobile networks, and optical networks, sensor networks. On the other hand, Mobile Computing and Application Software Development shall focus on Mobile communication, mobile content development, mobile phone programming, mobile service innovation, and wireless security. The need for mobile computing experts is widely recognized and emphasized. The consultation work, namely, A satellite workshop on innovative mobile services for developing countries, that was held in August 2008 at the Faculty of Computing and IT emphasized the need for the Mobile Computing and Application Software Develpment. The workshop invited a number of local and international mobile stakeholders such as Nokia, Google, Warid, MTN, etc.

The Software Engineering option covers new trends in secure software and service-oriented software design. On research in Software Engineering, formal methods are highly emphasized.

In addition, the option of Mobile Computing and Application Software Development, as the name implies, has related courses to software engineering and communication networks. Thus, the options have light linkage but not full overlap.

1.2 Objectives of the program

The objectives of the proposed programs include:

- To provide students with in-depth understanding of the communication and network infrastructure that is already existing and that is emerging in the country and the region.

- To provide students with in-depth understanding and practical skills in software engineering.
- To prepare students with required skills to meet the demands of the emerging market in communication technology and services, and software development.
- To equip students with necessary research methodologies for their research theses and projects
- To strike a balance between theory, practice, and research so that graduates have skills required for playing a wider role relevant job market.
- To provide the region with localized mobile services and content developers. With the aim to develop competence and capacity for the creation of a local mobile service and content provider sector, leading to sustainable social and economic development.
- To prepare professionals with knowledge in ethical and legal issues

2 Research and development

To make learning more research and development oriented in the curriculum, it is necessary to deliver every course (depending on course type) both core and elective with either a strong research or development bias. In other words, the mode of delivery of respective courses should emphasize on students spending more time researching (including reporting/presenting their work/results) and development rather than keeping in class. This is to enable students to learn how to conduct research as well as to learn the various research methodologies. In the curriculum, the courses in each of the three areas of specialization accommodate the two components i.e. research and development. Regards the development component, courses on Structure and Interpretation of Computer programs, mobile computing and content development, requirement analysis are identified to be taught with a strong development bias using the practical hours as reflected in the curriculum. For the research component, all courses taught in the 2nd semester of both plans (Plan A and B), will be taught with a strong bias in research. The output from the research component are to be considered as research lab papers and will constitute end of semester course work assessment.

3 The Program

3.1 Target Group

The revised programs is targeted to graduates from Computer Science, Software Engineering, Information Technology, Computer Engineering, Electrical and Electronics Engineering, Telecommunication Engineering who want to gain expert knowledge on communication networks, mobile programming, and software engineering.

3.2 Admission Requirements

To qualify for admission, a candidate must fulfill the general Makerere University entry requirements for masters degree, and in addition the candidate must be a holder of either

- A bachelors degree in Computer Science, Information Technology, Software Engineering, Computer Engineering, Electrical and Electronics Engineering or a closely related field from a recognized University/Institution.

3.3 Nature of the Programme

This is a day and evening programme that is completely privately sponsored and its duration is one year.

3.4 Duration

The duration for the Post graduate Diploma in Data Communitactions and Software Engineering (DCSE) programme is one (1) academic year comprising of 2 semesters and one recess term.

3.5 Tution Fees

Tution fees for privately sponsored students shall be $3,825,000$ Uganda Shillings per year for Ugandans and $3,350$ US dollars per year for International students.

4 Regulations

4.1 Course Assessments

- Each Course will be assessed on the basis of 100 total marks with proportions as follows:
  Course Work - 40; and
  Examination - 60.
- A minimum of two Course Assignments/Tests shall be required per Course.
- Course work shall consist of tests, group assignments and presentations in each semester. In the second year, assessment shall also include the evaluation of individual research projects for both Plan A and B.

4.2 Grading of Courses

a) Each Course will be graded out of a maximum of 100 marks and assigned an appropriate letter grade and a grade point as follows:

Marks	Letter Grade	Grade Point	Interpretation
90-100	A+	5.0	Exceptional
80- 89	A	5.0	Excellent
75- 79	B+	4.5	Very good
70- 74	B	4.0	Good
65- 69	C+	3.5	Fairly good
60- 64	C	3.0	Pass
55- 59	D+	2.5	Marginal Fail
50- 54	D	2.0	Clear Fail
45- 49	E+	1.5	Bad Fail
40- 44	E-	1.0	Qualified Fail
0 - 39	F	0.0	Qualified Fail

b) The following additional letters will be used, where appropriate: -

W	-	Withdraw from Course;
I	-	Incomplete;
AU	-	Audited Course Only;
P	-	Pass;
F	-	Failure.

4.3 Minimum Pass Mark

A minimum pass grade for each course shall be 3.0 grade points.

4.4 Calculation of Cumulative Grade Point Average (CGPA)

The CGPA shall be calculated as follows: -

$$\text{CGPA} = \frac{\sum_{i=1}^{n}(GP_i \times CU_i)}{\sum_{i=1}^{n} CU_i},$$

where GP_i is the Grade Point score of a particular course i; CU_i is the number of Credit Units of course i; and n is the number of courses so far done.

4.5 Progression

Progression through the programme shall be assessed in three ways:

4.5.1 Normal Progress

This occurs when a student passes each course taken with a minimum Grade Point of 3.0.

4.5.2 Probationary

This is a warning stage and occurs if either the cumulative grade point average (CGPA) is less than 3.0 and/ or the student has failed a core course. Probation is waved when these conditions cease to hold.

4.5.3 Discontinuation

When a student accumulates three consecutive probations based on the CGPA or the same core course(s), he/she shall be discontinued.

4.5.4 Re-taking a Course

A Student may re-take any course when it is offered again in order to pass if the student had failed the course. A Student may take a substitute elective, where the Student does not wish to re-take a failed elective.

4.6 Weighting System

The weighting unit is the Credit Unit (CU). The Credit Unit 15 is contact hours per semester. A contact hour is equal to (i) one lecture hour, (ii) two practical hours or (iii) two tutorial hours

4.7 Post Graduate Diploma Project

Students are required to demonstrate their ability to independently formulate a detailed Project Proposal, as well as develop and demonstrate their Project thoroughly.

a) A candidate shall be allowed to formally start on the Project during the second semester.

b) A candidate shall submit a Project Proposal to the Faculty of Computing and Information Technology Higher Degrees Committee during the second semester.

c)The candidate shall execute the Project during the recess term.

d)The candidate shall submit the Project Report by the end of recess term.

4.7.1 Passing of a Project

To pass the Project, the candidate shall satisfy the examiners in a written report and viva voce independently.

4.7.2 Revised Project Report

A candidate, who fails to satisfy the examiners, shall re-submit a Revised Project Report in accordance with the standing University guidelines for the project examinations.

4.8 Minimum Graduation Load

To qualify for the award of the Post Graduate Diploma of Master of Data Communications and Software Engineering , a full-time candidate is required to obtain a minimum of 29 credit units for courses passed including all the compulsory courses; and the Post graduate diploma's Project Report (5 credit units) within a period stipulated by the School of Graduate Studies, usually not exceeding five (5) years from the date of registration.

5 Program Structure

The Post Graduate Diploma in Data Communications and Software Engineering degree programme shall be for both the day and evening programmes. The programme shall normally extend over a period of one year consisting of two semesters of 17 weeks. A full-time student shall not carry less than 15 credit units for semester I, 14 credit units for semester II and not more than 25 credit units per semester. The proposed programme requires a minimum of 29 credit units.

5.1 Option I: Communication Networks

CODE	COURSE TITLE	CU	LH	PH	CH
Semester I (5 Courses)					
4 Core					
MCN 7100	Computer Networks	3	30	30	45
MCN 7103	System and Network Security	3	30	30	45
MCN 7104	Mobile Communications	3	45	-	
MIT 7116	Research Methodology	3	30	30	45
1 Elective					
MCN 7106	Mobile Software and Content development	3	30	30	45
MCN 7101	Principles of Mobile Computing	3	45	-	45
MCN 7107	Communications Systems	3	45	-	45
MCS 7116	Graph Theory	3	45	-	45
Total Credit Units=15					
Semester II (5 Courses)					
4 Core					
MCN 7200	Advanced Internetworking Protocols	3	30	30	45
MCN 7201	Fiber Optic Networks	3	30	30	45
MCN 7202	Mobile and Wireless Networks	3	30	30	45
MCS 7226	Seminar Series	2		60	30
1 Elective					
MCN 7208	Network Performance Evaluation	3	30	30	45
MCN 7204	Mobile Applications Programming	3	30	30	45
MCN 7203	Wireless Security	3	30	30	45
MIT 7218	Legal and Ethical Aspects of Computing	3	30	30	45
Total Credit Units=14					
Recess					
Core					
DCN 6301	PGD Project in Communication Networks	5		300	300
Total Credit Units = 5					

5.2 Option II: Mobile Computing and Application Software Development

CODE	COURSE TITLE	CU	LH	PH	CH
Semester I (5 Courses)					
4 Core					
MCN 7101	Principles of Mobile Computing	3	45	-	45
MCN 7106	Mobile Software and Content Development	3	30	30	45
MCN 7104	Mobile Communications	3	45	-	45
MIT 7116	Research Methodology	3	30	30	45
1 Elective					
MCN 7102	Software Engineering	3	30	30	45
MCN 7100	Computer Networks	3	30	30	45
MCN 7108	Software Architecture	3	30	30	45
MCN 7109	Requirements Engineering	3	45	-	45
MCN 7107	Communications Systems	3	45	-	45
Total Credit Units=15					
Semester II (5 Courses)					
4 Core					
MCN 7204	Mobile Applications Programming	3	30	30	45
MCN 7205	Secure Software Architecture and Design	3	30	30	45
MCN 7202	Mobile and Wireless Networks	3	30	30	45
MCS 7226	Seminar Series	2		60	30
1 Elective					
MCN 7207	Software Design Process and Metrics	3	45		45
MCN 7203	Wireless Security	3	30	30	45
MCN 7201	Fiber Optic Networks	3	30	30	45
MIT 7218	Legal and Ethical Aspects of Computing	3	30	30	45
Total Credit Units=14					
Recess					
Core					
DCN 6302	PGD Project in Mobile Computing and Application Software Development	5		300	300
Total Credit Units = 5					

5.3 Option III: Software Engineering

CODE	COURSE TITLE	CU	LH	PH	CH
Semester I (5 Courses)					
4 Core					
MCN 7105	Structure and Interpretation of Computer programs	3	30	30	45
MCN 7102	Software Engineering	3	30	30	45
MCN 7109	Requirements Engineering	3	45	-	45
MIT 7116	Research Methodology	3	30	30	45
1 Elective					
MCN 7108	Software Architecture	3	30	30	45
MCN 7100	Computer Networks	3	30	30	45
MCN 7101	Principles of Mobile Computing	3	45	-	45
MCN 7103	System and Network Security	3	30	30	45
MCN 7106	Mobile Software and Content Development	3	30	30	45
Total Credit Units = 15					
Semester II (5 Courses)					
4 Core					
MCN 7207	Software Design Process and Metrics	3	45	-	45
MCN 8109	Formal Methods in Software Engineering	3	45	-	45
MCN 7205	Secure Software Architecture and Design	3	45	-	45
MCS 7226	Seminar Series	2		60	30
1 Elective					
MCN 7206	Service Oriented Architectures	3	30	30	45
MCN 7204	Mobile Applications Programming	3	30	30	45
MCS 7218	Theoretical Computing	3	45	-	45
MIT 7218	Legal and Ethical Aspects of Computing	3	30	40	45
Total Credit Units = 14					
Recess					
Core					
DCN 6303	PGD Project in Software Engineering	5		300	300
Total Credit Units = 5					

6 Detailed Course Description

6.1 MCN 7100 Computer Networks

Course Description

This is an introductory course in computer networks and communication. Areas covered in the course will include Formatting and transmission of digital information over various media; Open Systems Interconnection Reference Model; Functions and specification of data link layer; Data link layer protocols; Networking and internetworking principles; Internet routing, congestion control and operation. Local area networks: Topologies, medium access under contention, basic queuing principles, fundamental performance evaluation.

Aims

This course provides a broad overview of computer networking, covering application layer, transport layer, network layer, and link layers. It covers basic concepts in computer networking as well as the prominent Internet protocols.

Learning Outcomes

A successful learner from the course shall obtain a knowledge and understanding of computer communication network concepts that is very instrumental in building the foundation of the whole program. Completing students are expected to be very conversant with the computer network models and structure in terms of theoretical concepts of network protocols and components.

Teaching and Learning Pattern

This course will be delivered in class only. In addition, students shall be assigned with research coursework where they shall choose an area in networking and conduct independent research on. Students shall be expected to write a preview or summary of the area they have chosen and make presentation of the findings to the class. The aim of the research course work here is to cement the scope of knowledge of networking concepts.

Indicative Content

Overview of computer networks :

- Packet switching, delay and loss concepts, physical media, protocol layering, Internet peering structure.
- Application layer : Web, E-mail, DNS, FTP, P2P
- Transport layer : Principles of reliable transport : UDP and TCP, principles of congestion control
- Network layer and routing : Link-state routing theory, distance-vector routing theory, hierarchical routing, IPv4, addressing and CIDR, RIP
- Link layer : Error detection and correction techniques, multiple access protocols, LAN addressing and ARP, Ethernet.

Assessment method

- (Assignments, Tests, Group Research course work) 40%
- Final Examination 60%

Reading materials/ Indicative Sources

Text book:

Computer Networking: A Top-Down Approach, by James F. Kurose, Keith W. Ross Morgan Kaufmann, 2000.

Reference materials (International journals)

- IEEE/ACM Transaction on Networking, IEEE Communication Magazine,IEEE Network Magazine,
- IEEE Journal on Selected Areas in Communications, IEEE Transaction on Communications,International Conferences in Networking: ACM SIGCOM, IEEE INFOCOM, ICNP.

6.2 MCN 7101 Principles of Mobile Computing

Aims

The objective of the course is to equip students on the fundamentals of mobile computing and the design mobile services. Learn the issues in mobile computing and communications from the hardware and software perspective. Understand the mobile IP stack and mobile web access, technologies and services.

Indicative Content

Review of Mobile Computing fundamentals. Fundamentals of Mobile Terminal Hardware set-up: Radio, DSP, Memory and CPU components. The division into access & application parts. Base Station side radio interface standards. The Mobile IP stack and mobile web-browsing. The WAP-protocol & Location Information. Principles of Multimedia Messaging (SMS, MMS) and web services.

Teaching and Learning Patterns

- Lectures, seminars and laboratory exercises

Assessment:

- (Assignments, tests and Semester) 40%
- final examinations 60%

Recommended References:

- Mobile computing principles, R. BFar, Cambridge University Press,2005.
- Smart Phones & Next Generation Mobile Computing, P.Zheng, Morgan Kaufmann, 2006.
- Mobile Internet Architecture, Nokia, IT Press-2001, ISBN 951-826-499-6.

6.3 MCN 7102 Software Engineering

Course Description

Even when a software engineer is working in a specific phase of the software engineering process, it is paramount to have a good understanding of the activities in the other phases. Therefore, in this course is about problems we face when constructing large software systems.

Aims

The course aims at giving the student an understanding and practical experience of he software engineering process. They will be introduced to various methodologies that are applicable during the software design process. The will learn the use and application of these methodologies by examining how they can be supported by the Java language.

Learning Outcomes:

At the end of the course, students will

- Outline, select and apply the fundamental principles of software engineering
- have acquired a strong grounding in the process and tools used in engineering systems

Teaching and Learning Patterns:
The teaching method shall mainly be based on lectures. A medium size project shall be given to students in groups or individuals. The students are expected to walkthrough the engineering process using the different projects.

Indicative Content
The development of software-intensive systems;

- software quality factors; software engineering principles;
- system life-cycle models; requirements definition and analysis; behavioral specification;
- software design; implementation; software testing techniques;
- verification and validation; system evolution; software project management.

Asessment

- Test ,Project (40%)
- Final written exam (60%)

Reading materials
Required:

- Barbara Liskov. Program Development in Java: Abstraction, Specification, and Object-Oriented Design. Addison Wesley, 2001.
- Roger S. Pressman. Software Engineering: A practitioner's approach (7th ed). 2008. McGraw Hill

Recommended:

- David Flanagan. Java in a Nutshell, 5th Edition. O'Reilly, 2005.
- Joshua Bloch. Effective Java: Programming Language Guide, 1st Edition. Addison Wesley, 2001.
- Ian Sommerville. Software Engineering: (8th Edition)
- Mark Van Harmelen (Ed), Stephanie Wilson (Author) Object Modeling and User Interface Design: Designing Interactive Systems . Addison Wesley, 2001.
- Martin Fowler. UML Distilled: A Brief Guide to the Standard Object Modeling Language (3rd Ed) 2003. Addison-Wesley Object Technology Series.

6.4 MCN 7103 System and Network Security

Course Description
The course covers theory and practice of computer security, focusing in particular on the security aspects of the computer systems, Web and Internet. It introduces network and system security threats, then surveys cryptographic tools used to provide security, such as shared key encryption (DES, 3DES, RC-4/5/6, etc.); public key encryption, key exchange, and digital signature (Diffie-Hellmann, RSA, DSS, etc.). It then reviews how these tools are utilized in the internet protocols and applications such as Kerberos, SSL, IPSEC, TLS, PGP, S/MIME, SET, and others. System security issues, such as viruses, intrusion, firewalls, and others will also be covered.

Aims

System and network security is becoming increasing important in networking. Malicious users such as hackers tend to keep above times and continuously compete against existing security measures. The objective of the course is to introduce students to security threats and the methods to tackle them. The course shall focus on systems security for desktop and host computing devices as well as network security issues, which will equip student with fundamental techniques required for IT managers and system administrators.

Teaching and Learning Pattern

Teaching delivery shall be based on conventional in-class interaction between lecturers and students. The teaching shall follow the content of the suggested text book in addition to other teaching materials such as papers where possible. Students are expected to learn through lectures and different assessment exercises which shall include quizzes, research coursework, and project. Research course work will be based on identifying a security problem that a student or a group of students will independently research on and present at the class. A project on the other hand may require some programming skills where students to implement various security mechanisms such as firewalls in real systems.

Indicative Content

- Introduction to computer and network security: threats, attacks techniques, vulnerability sources and classification, social and ethical issues
- Host security: virus, worms, zombies, etc.
- Cryptography: Privacy and authentication techniques/protocols and systems
- Basic Firewalls: concept, filtering, statefull vs. stateless, FW proxy and design issues
- Advanced Firewall Issues: policy management (anomaly discovery), distributed firewall, firewall performance, defense-in-depth
- IPSec/VPN and NAT: network design and policy definition and verification
- Intrusion Detection Concepts , Intrusion Detection Systems
- Network Security Design
- Server security, SSL

Assessment

- Quiz, Project, Research coursework,(40%)
- Final Examination (60%)

Reading materials/ Indicative sources

Text Books

- Cryptography and Network Security: Principles and Practice, Third Edition, by William Stallings (2000)
- Fundamentals of Network Security" by J. Canavan; Artech House (2003)

Reference books:

- Eric Rescorla, SSL and TLS: Designing and Building Secure Systems, Addison Wesley Professional 2000
- 2.Bruce Schneier, Applied Cryptography: Protocols, Algorithms, and Source Code in C, 2nd Edition, John Wiley & Sons 1995

6.5 MCN 7104 Mobile Communications

Course Objective:

The objective of the course is to teach students the principles of the technology of wireless communications, radio frequency planning, special protocols and mobile networking. Trends on next generation cellular systems and services will be discussed based on service oriented telecom architectures.

Indicative Content

- Introduction to the technology and underlying principles of wireless communications.
- Wireless communication spectrum and channel modeling.
- Mobility, Cell-planning & Handoff.
- Introduction to Wireless Intelligent Networking and Prepaid systems.
- Standards for Mobile/Wireless Communication.
- Mobile/wireless Networking Fundamentals.
- Special Features and protocols in Mobile/Wireless Networking.
- Trends in Next Generation Mobile Wireless Communications.

Teaching and Learning

- Lectures, seminars and take-home exercises

Assessment:

- Assignment, tests (40%)
- Semester final examinations (60%)

Reading Materials/ Indicative Sources:

- Wireless Communications & Networks, William Stallings, 2nd Ed., Prentice Hall publishers-2001.
- Wireless Communications Principles & Practices, T.S. Rappaport, 2nd edition -2007.

- Wireless & Mobile Network Architectures, Yi-Bing Lin & I.Chlamtac, Wiley publishers-2006.
- UMTS Networks, Architecture, Mobility & Services. H. Karanen, et.al, Wiley Publishers-2005.

6.6 MCN 7105 Structure and Interpretation of computer programs

Course Description

The course provides a survey of techniques and principles in the underlying design and implementation of systems. The course focuses on symbolic computation and less on numerical examples from the calculus and number theory. Effective software engineers need to know efficient techniques that serve as building blocks in the design an implementation of software systems. Today, most systems require a collection of skills to provide an efficient implementation. Therefore this course enriches through broadening rather than acceleration. The programming language used has a simple syntax and an intuitive semantic model, allowing a focus on concepts. Throughout, the focus is on understanding computational tools by building them, rather than covering many language features

Aims

The aim of the course is to equip students with the knowledge to understand and design software systems.

Learning outcomes

- Strong understanding of basic concepts in computer science (including some material on lists and trees.
- Ability to write programs from scratch in the programming language Scheme while understanding the meaning of what is being written.
- Proper attention to design and testing.

Teaching and Learning The course is structured around a strong textbook and associated instructional development environment, though lectures offer elaboration on ideas, different examples, and additional material. Short assignments during this course are interspersed with a substantial programming project using object-oriented techniques, such as an adventure game.

Indicative Content

- The fundamentals of Lisp computation: names and values, evaluation, function definition and evaluation, and predicates.
- Higher-order functions, including the use of functions as parameters. Introduce the definition of functions with LAMBDA, and the use of functions that return functions as values.
- Function definition and application, making decisions (conditional expressions), working with aggregated data (structures), working with unbounded data (lists and recursion), information hiding (local definitions), functional abstraction (functions as values), mutation (changing name-value bindings), and encapsulation (making objects).

- Data abstraction and techniques for implementing "abstraction barriers. Use of scheme pairs to implement lists, trees, and other data structures. Cover advanced data abstraction techniques: tagged data, data-directed programming, and message-passing.
- State and assignment: The use of state and local assignment to write efficient programs; introduce the idea of object-oriented programming, assignment, and the environment model of evaluation that is needed to understand how local state is maintained in Scheme.
- Introduction to mutable data, concurrency; streams, model time-varying state information within the functional programming approach
- Metalinguistic abstraction: The creation of new programming languages, as a still more powerful abstraction technique. Two major examples are presented: Lisp and a logic programming language the course follows the fourth chapter of the text.

Assessment

- Test, Project (40%)
- Final Examination (60%)

Reading Materials/Indicative sources

- Structure and Interpretation of Computer Programs by Abelson and Sussman (second edition, MIT Press, 1996)

6.7 MCN 7106 Mobile Software & Content Development

Aims

The objective of the course is to teach students on the principles of mobile software architecture, operating system platforms and software development tools for mobile software, content and service development.

Indicative Content

Introduction to Mobile Operating System Platforms (OSPs): Symbian, Android, Linux & Microsoft mobile. User Interface, Menu system, and Applications. Software set-up in modern Mobile Terminals. Overview of Mobile Multimedia Codecs. Fundamentals of Mobile Content & Mobile web content design. Widgets, W3C Standards, Device Recognition & dotMobi. The .mobi top level domain (TLD) initiative for mobile optimized web-site creation.

Teaching and Learning

- Lectures, seminars and laboratory exercises

Assessment:

- Assignment, Lab. Tests, Project (40%)
- Semester final examinations (60%)

Reading Materials/ Indicative sources

- Smart Phones & Next Generation Mobile Computing, P.Zheng, Morgan Kaufmann, 2006
- Mobile computing principles, R. BFar, Cambridge University Press,2005.
- http://dev.mobi. Developers guide, content developer tools.
- http://code.google.com, Android an open handset alliance project.
- Mobile Internet Architecture, Nokia IT Press-2001, ISBN 951-826-499-6.

6.8 MCN 7107 Communications Systems

Course Description

This course is about representation of signals in terms of Fourier Series and Fourier Transformations. The students must be able to go back and forth in time and frequency domains and represent signals in both domains. They should comprehend continuous time signals, sampled signals, discrete-time signals and digital signals both in time and in frequency domains. Introduction to Signals and Systems, Fourier Series and Fourier Transform. Building blocks of communication systems. Signal types, vector spaces, generalized functions. Hilbert transform and analytical signals. Linear and angular modulation methods, frequency division multiplexing. GM/SM applications, stereo TV. Sampling, quantization, PCM, DPCM, DM, TDM, pulse transmission: PAM,PDM PWM. Baseband data transmission: Nyquist pulse shaping; Bandpass data transmission and digital modulation techniques: ASK,PSK,FSK, QAM.

Aims

In this course, the communication systems will be studied from a systems point of view, emphasizing mathematical descriptions, representations, and processing of electrical signals that characterize such systems.

At the end of this course, students will be able to

- Find frequency representation of deterministic signals and LTI systems,
- Design filters with a given amplitude and phase response,
- Design analog modulators and demodulators from a system point of view,
- Design digital modulators and demodulators from a system point of view

Teaching and Learning

Lectures and students presentations. Students will also learn through reading research papers and implementing course projects .

Indicative Content

- Re-visiting basic calculus
- Review of Signals and Systems
- Introduction of Fourier Series and Fourier Transformation, Generalized Orthogonal Transformation Analysis and Transmission of Signalsand Design of Filters

- Amplitude (Linear) Modulation
- Angle (Exponential) Modulation
- Sampling, Quantization, Pulse Amplitude and Pulse Digital Modulation
- Signalling Schemes

Assessment

- Assignments, test (40%),
- Final Examination (60%)

Recommended Reading/ Indicative Sources:
Text Book:

- Modern Analog and Digital Communication Systems, by B.P.Lathi , Oxford University Press,1998 (3/e)

Reference Texts:

- M. Schwartz, Information, Transmission, Modulation and Noise,McGraw Hill, 1990 (4/e).
- Schwartz, Bennette, Stein, Communication Systems and Techniques,
- S. Haykin, Introduction to Analog and Digital Communications, John Wiley and Sons, 1988.
- S. Haykin, Digital Communication, John Wiley and Sons, 1989.

Prerequisite:
A-level Mathematics

6.9 MCS 7108 Software Architecture

Course Description
Very little software is actually written from scratch. Instead, software projects usually rely on existing libraries, frameworks, and components. Such building blocks must be carefully integrated to ensure that the resulting applications are robust and maintainable. The necessity to integrate, reuse, and maintain large collections of software components has led to important challenges for computer scientists and engineers which, in turn, resulted in the elaboration of various component models and integration mechanisms..

Aims
To equip students with issues of large-scale software development usually referred to as "software architecture", including architectural design and documentation, component models and technologies, software product lines, frameworks, and aspect-oriented programming

Learning Outcomes

- To understand the factors and issues that come into play in the development of large-scale software systems.
- To understand the concepts, terminology, and notation of various component models.
- To understand a variety of integration mechanisms used to build large scale systems, and to apply the mechanisms in a concrete situation.
- To be able to clearly document non-trivial software architectures.
- To evaluate and discuss the properties of different software architectures.
- To know about a number of innovative approaches to software architecture as proposed by the research community.

Teaching and Learning

The class will be conducted on face to face, in class lecture. The lectures should include examples of software architectures of varying sizes. Students should develop their own architectures

Indicative Content

- Introduction: What is software architecture, Software design levels, and architectural views, current and emerging status of software architecture?
- Architectural Styles: pipes and filters, object oriented, event-based, layered systems, repositories, interpreters, process control, other familiar architectures like client-server.
- Architectural design guidance: Design spaces and rules, user interface design guidance, domain specific design guidance.
- Formal models and specifications: the value of architecture formalism, formalizing the architecture for a specific system, examples of formal notations
- Linguistic Issues: Requirements for architecture description languages, notations for components connectors- constraints, tools for architecture descriptions

Assessment

- Test, Project, Research coursework (40%),
- Final examination (60%)

Reading Material/Indicative sources

- L. Bass, P. Clements, R. Kazman. Software Architecture in Practice, Second Edition. Addison Wesley Professional, 2003
- M. McBride. The Software Architect. Communications of the ACM, 50(5):75-81, May 2007
- P. Clements et al. Documenting Software Architectures: Views and Beyond. Addison Wesley Professional, 2003

6.10 MCS 7109 Requirements Engineering

Course Description

Establishing firm and precise requirements is an essential component of successful software development. This course covers a range of methods from the hard semi-formal approaches to softer methods, and some innovative techniques. Practical guidance is also included

Aims

At the end of the course the student will have a breadth of knowledge about the range of requirements methods, tools, and techniques. They will gain an appreciation of at least two methods, and obtain practical guidance on elicitation techniques.

Learning outcomes

- To be able to clearly document non-trivial requirements
- To evaluate and formulate the user requirements in systems.

Teaching and learning patterns

The class will be conducted on face to face, in class lecture

Indicative Content

- Covers the principles, tools, and techniques for requirements elicitation, specification, and analysis.
- Focus on understanding the role of requirements in system development and maintenance, and the difficulties of specifying requirements for real systems, and effective methods tools and techniques.
- This course covers the principles, tools, and techniques used to establish a software specification that captures correctly and completely the requirements of a software system under development and the expectations of the potential user.
- System and Software System Engineering, Software Requirements Concepts, Requirements Elicitation, Software Requirements Analysis, Software Requirements Specifications, Software Requirements Tools, Software Requirements Verification, Software Requirements Engineering Management, Developing a Successful Software Requirement

Assessment

- Test, Project, Research coursework, (40%)
- Final Examination (60%)

Reading Material/Indicative sources

- Requirements Engineering: Processes and Techniques (Worldwide Series in Computer Science) by Gerald Kotonya and Ian Sommerville (Aug 24, 1998)
- Software Requirements Engineering, 2nd Edition by Richard H. Thayer and Merlin Dorfman 1999
- Geri Schneider and Jason P. Winters. Applying Use Cases: A Practical Guide. 1998. Addison- Wesley.

6.11 MIT 7116 Research Methodology

Course Description

In this course, guidance will be given to students on how to identify a research problem. Instructions will be provided which will enable students to perform effective literature reviews. Students will be presented with various research paradigms and models of methodology and assist with designing an appropriate method for their research. Students will be trained in the analysis and presentation of results, exposition of processes and methods used and conclusions drawn. Guidelines outlining the preparation and writing of a research dissertation and or a project will be provided at the conclusion of the course.

Aims

The aims of the course are: To provide students with a firm foundation/underpinnings of research from which they can undertake a research problem

To provide students with a number of separate, but related practical skills associated with the research process

Learning outcomes

At the end of this course unit, the students will be able to identity the aims of the research, selection of appropriate methodological approach, selection of implementation methods, data collection and analysis techniques and its interpretation, and how all this fits within the literature. In other words, the students will produce a research proposal as a blue print for the whole research dissertation and or project.

Teaching and Learning Pattern

Lectures will be given through out the semester. Group work and discussions to perform literature reviews will be done to enable understanding and application of concepts. This will involve identification and reading material which includes journal papers to be distributed to students a week in advance. The lecturer addresses questions to the students to encourage them to think about and understand the material. The students will identify researchable problems from which they will apply the concepts taught in class with an aim of producing research/project proposals by the end of the semester. The students will be required to build on their proposals on a weekly basis in line with the new concepts that will be taught. The students will make presentations of their draft proposal for critique and feedback from both the students and the lecturer.

Indicative Content

The course will cover the following topics:

- Definition of Research Methodology

- Research Paradigms in Computing and Information Systems
- Research Planning and Management
- Types of Research Methods
- Scientific writing including abstracts; identifying research problems, research objectives and questions; Interpretation of technical literature (literature reviews); Selection of overall methodological approach; Selection of suitable data collection and analysis techniques; Interpretation and conclusion of the research; and Presentation of research findings
- Research Ethics and plagiarism

Assessment Method

Assessment will categorized as foolows:

- Progressive assessment 40%
  - Group work(literature reviews) 20%
  - Presentation(skills) 10%
  - Theory and application (concepts) 10%
- Final written Exam 60%
  - Individual work(scientific writing and research paper) 40%
  - Theory and application (concepts) 20%

Reference books

- Practical Research: Planning and Design (March 2004): Paul D. Leedy, Jeanne E. Ormrod, Jeanne Ellis Ormrod, Paperback, Prentice Hall
- Graduate research: A guide for Students in the sciences (May 1998): Robert V. Smith, Paperback, University of Washington
- Research Methods: A process of Inquiry ((May 2006)): Anthony M. Graziano, Michael L. Raulin, Hardcover, Prentice Hall
- Introduction to qualitative research methods: A guidebook and resource (1998): Taylor, Steven J.; Bogdan, Robert, Hoboken, (3rd Ed.) NJ, US: John Wiley & Sons Inc.

6.12 MCN 7200 Advanced Internetworking Protocols

Course Description

This course assumes the basic knowledge regarding the Internet and its protocols. It offers advanced level treatment of data transport and switching concepts; TCP/IP protocol stack with detailed analysis. It also looks at architectures of network components mainly routers and switches and their types regarding queues location. Quality of service mechanisms; packet scheduling and active queue management mechanisms. LAN and core network technologies.

Aims

The goal of this course is to take a broader view of networking issues and solutions. The main objective is to strengthen the student's understanding of fundamental concepts, requirements and design tradeoffs, particularly as related to congestion control, routing, scheduling, and overlay and wireless architectures. More importantly, the course covers the basic knowledge needed to design current and future networks capable of providing ubiquitous high-quality support in heterogeneous environments.

Teaching and Learning Pattern

This course shall adopt interactive teaching that shall emphasize on allowing students to use analytical thinking to required to get in depth understanding of advanced network protocols. Teaching patterns shall include class sessions, laboratory sessions, reading assignments of related research papers. Network and system laboratory of the department shall facilitate hands-on; simulations and test-bed experiments in an isolated setting . These may include configuring a network, a routing protocol, doing traffic measurements, testing a new protocol, etc. in addition to simulations. The course shall provide an overview of discrete-event simulation and ns-2, and MATLAB programming that shall be important to conduct laboratory and some research course work.

Indicative Content

- Review of Architectural trends : Layering and end-to-end principle
- Internet routing : OSPF, Interdomain routing and BGP, Multicast routing, interconnection Principles
- End-to-end transport : Fundamentals of transport protocols (conn mgmt, error control, congestion and flow control), TCP congestion control algorithms, TCP throughput modelling and TPC-friendlyness, TCP over wireless links, Recent extensions and open issues in TCP, Reliable Multicast
- Switches: Switch architectures, output queued switches, input queued switches, Virtual output Queues, scheduling in switches. Internet routers : HW architectures and packet processing Router hardware architectures, Longest-match prefix algorithms and IP lookups, Flow classifications algorithms, Active Queue Management (AQM) and RED, Traffic limiting/shaping algorithms.
- Virtualization : VLANs, Intro to ATM first, IP over ATM, LAN Emulation, MPLS Quality of Service : IntServ, Diffserv, Traffic Engineering Signalling SS7, RSVP, Q.2931

Assessment

- Assignments, Laboratory Projects (ns2, C++, Matlab), Research Project: (Research paper review plus presentation) (40%)
- Final Examination (60%)

Reading Material /Indicative sources

There is simply no single textbook that either covers all the material in this course or covers them in a reasonably detailed level. Some lecture slides and notes will be made available on-line, and supplemented with research some papers, Internet RFCs and drafts. In case we use portions of a textbook, the textbook will be placed on reserve in the Science & Engineering Library.

6.13 MCN 7201 Introduction to Fiber Optic Networks

Course Description

This course will introduce principles of optical fiber communications. The course shall provide students with important issues that affect how optical networks are made, their limitations, and potentialities, and how optical networks fit in with more classical forms of communication networks.

Aims

Many developing countries are witnessing an increase in roll-out of fiber-optic networks. This will have tremendous increase in Internet access bandwidth in the region, which will in turn lead to much lower cost. The goal of this course is to equip our students with fundamental theoretical concepts of fiber optical networks so that they can contribute to the emerging job market.

Learning Outcomes

Students taking this course shall be conversant with fundamental issues on fiber optic communication and networks. These issues include basic theoretical principles of optics , components, and designing an optical network. Additionally, through research course, students shall learn methods conducting research, writing the results, and presenting the findings.

Teaching and Learning Pattern

This course shall mainly be delivered through student lecturer classes and some of the chapters of the recommended text book. Students shall also be expected to expand their learning through assignments and research course work. Through research course work, students shall be asked to identify a topic related to optical networking that they shall conduct research on through reading related published papers. Students shall be asked to write a conference paper style report of their research and they will present their research at the end of the course.

Indicative Content

- Principles of Optical transmission
- Overview of optical communication technologies
- Fiber Optic Transmitters and Receivers
- Modulation and Multiplexing Techniques: TDM, WDM, OTDM
- Propagation in Optical Fibers
- Wavelength Routing Networks, wavelength division multiplexing
- Wavelength routing and allocation algorithms: fixed vs agile wavelength
- assignment, wavelength conversion, dynamic wavelength switching

- Optical Core Networks Technology Trends
- Optoelectronic Devices
- Optical Components , Optical Amplification, Optical Transmitters
- Optical Switches, Routers, Cross-Connects and Processors, optical packet switching.
- Wavelength Division Multiplexing/Dense Wavelength Division Multiplexing
- Optical Networks and the Optical Layer
- The All-Optical Network
- IP, ATM, DWDM and the Future of SONET/SDH

Assessment Method

- Assignments, Test, Research course work, (40%)
- Final Examination (60%)

Reading materials/ Indicative Sources
Text book:

- Optical Networks: A Practical Perspective, Second Edition, by Rajiv Ramaswami, Kumar Sivarajan, Kumar N. Sivarajan

References

- Optical Fiber Communication Systems, by Kazovsky, S. Benedetto, A. Willner
- Optical Networking Crash Course, by Steven Shepard
- Journals such as IEEE/ACM Transactions on Networking,
- IEEE Journal on Selected Areas in Communications,
- IEEE Communications Magazine,
- IEEE/OSA Journal of Lightwave Technology
- Optical Switching and Networking - Elsevier
- Journal of Optical Networking
- IEEE Infocom

Pre-requisite:
There will no be pre-requisite to this course

6.14 MCN 7202 Wireless and Mobile Networking

Course Description

This course shall provide fundamental to advanced concepts of wireless and mobile networks and the underlying technologies It shall cover Medium access control mechanisms for wireless communications, wireless communication standards particularly WiFi and WiMAX technologies. Cellular networks, wireless Internet, pervasive networks such as ad-hoc networks and sensor networks and their protocols , etc.

Aims

Wireless and mobile communications is very popular in developing countries due to the lack of fixed infrastructure. Wireless and mobile networking technologies there fore have direct relevance to out communities. The challenge to practitioners and researchers of these technologies is that they have been undergoing rapid changes and new technologies have been constantly emerging. The main goal of this course is to provide students with fundamental principles on existing and emerging wireless and mobile networking technologies.

Learning outcomes:

The course shall offer an in-depth understanding of networking technologies and protocols of wireless and mobile networks. Upon successful completion of the course, students shall be able to fill the existing gap of experts in job market in the area mobile and wireless networks. In addition, the course shall provide students with foundation in the sufficient to undertake further research in the field.

Teaching and Learning Patterns:

Teaching method shall mainly include lectures. In addition, students shall learn through take-home exercises and research course work. The later shall also provide to students opportunities to learn and practice some transferrable skills such as presentations and working in groups. Some assignments might be tuned to require students to learn simulation tools such as network simulator (ns-2) to implement their course projects.

Indicative Content

- Introduction of Wireless and Mobile Communications
- Fundamentals: Radio Channel Model; Modulation; Fading Mitigation; Intersymbol Interference, Mitigation Error Control
- Medium Access Control Protocols; Centralized Systems: CDMA, FDMA, TDMA, Polling, Distributed Systems: Aloha and Reservation Aloha, PRMA, CSMA, RTS-CTS
- Standards: Wifi - IEEE 802.11, WiMAX - IEEE 802.16
- Cellular Networks: 2G and 2.5G Systems: GSM and GPRS, 3G Systems: IMT-2000, 3G++ Systems: 3GIP, 3GPP
- Wireless Internet: Mobile IP, Wireless TCP, Wireless QOS Issues
- 4G Systems: IP-based Mobile Telecommunications
- Advances in Mobile IP (AAA, etc.), Micro-mobility Protocols, Cellular IP

- Pervasive Networking- Personal Area Networks, Bluetooth and Home RF, Ad Hoc Networks
- Routing: DRS, AODV, PAR, QOS,
- Wireless sensor networks: overview, applications and architecture; auto-organization techniques; data gathering mechanisms; reliable transport protocols; etc.

Assessment:

- Assignments, test , research course work/ project (40%),
- Final Examination (60%)

Recommended Reading/ Indicative Sources:
Text book:

- Wireless Communications and Networks, by William Stallings

Recommended References:

- Journals and Conferences on Mobile and Wireless:
- ACM Mobicom, IEEE Infocom, IEEE Journal on Vehicular Technologies, etc

6.15 MCN 7203 Wireless Security Fundamentals

Description
The adaption of Mobile and Wireless communications technologies, in military, commercial and personal use has grown exponentially. But the mobile and wireless nature of these devices raise new and important security challenges not usually present in highly structured and static environments. Thus, the purpose of this course is to give students a full understanding of what mobile and wireless communication technologies are, how they work, how people find them and exploit them, and how they can be secured. This course is based on real world examples, solutions, and deployments. In general the course will address the the taxonomy of Mobile/wireless security, fundamentals of digital security including wireless Authentication and authorization schemes, privacy, threat analysis and security protocol security functionality and assurance issues.

Teaching and Learning
Lectures and students presentations. Students will also learn through reading research papers and implementing course projects .

Indicative Content
The course will cover: Wireless and mobile computing Security Threat analysis and threat modeling; attack classifications; Explore wireless Network Architecture and Design; Fundamental of Security Management; encryption algorithms for some mobile and wireless communications e. g., WEP, WAP, A5 etc; Wireless Intrusion detection and Policy; Overview of security software and protocols for wireless and mobile communications; understanding of organizational issues and practices that affect security of service; Overview of implementation of the best and latest security techniques and mechanisms for mobile and wireless communications. Implementation of WEP, WPA, WPA2, 802.11i and 802.1x

Specific Subjects:

- Understanding security goal formulation; including Identification, Authentication, authorization; reliability; confidentiality; integrity; non-repudiation etc
- Protection, Integrity Protection, Provision of Service
- Types of Wireless Networks ; System Architectures
- Introduction to threat modeling and Wireless Security Threats ; Eavesdropping; Jamming; Injection/Replay; Rouge Clients; Roaming issues ; social engineering; brute force attacks; etc
- Information Leakage at all Levels ; Physical Security; Security applied at Protocol and Application Layers ; Encryption in Wireless Mobile Devices ; Device, Network and User; Mutual Authentication; Application of Biometric Approaches
- Security Protocols used in Wireless Devices ; 802.1x ; 802.11; A5; IS-95 ; Mobile IP and IPSEC; Application Layer Security; TSL; WPA Algorithms; WPA Pre-Shared Key; WPA RADIUS; WPA2 (Wi-Fi Protected Access 2) Security; WPA and WPA2; IEEE 802.11i (RSN) Enhanced Wireless Security; TKIP ; AES; EAP-TLS; EAP-TTLS
- Attacks on Protocols in Wireless Mobile Environments
- Advanced Security Measures
  - Wireless security policy
  - Authentication & encryption
  - Wireless DMZ and VLANs
  - Audits
  - Authenticated DHCP
  - Traffic patterns
  - Wireless LAN Auditing Tools
  - Discovery tools
  - Password crackers
  - Share enumerators
  - Network management and control
  - Wireless protocol analyzers
  - Manufacturer defaults
  - Password sniffers
  - Antennas and WLAN equipment
  - OS fingerprinting and port scanning
  - Application sniffers
  - Networking utilities
  - Network discovery and management
  - Hijacking users
  - Jamming tools
  - WEP crackers

- Operating system defaults
- Security Issues and Architectural Approaches in Dynamic Wireless
- Student Project Reports

Assessment:

- Tests, research course work (40%),
- final examination (60%)

Reading materials/ Indicative Sources

Text books:

No textbook currently exists for this course. We plan to use the following books as reference and take advantage of the growing number of technical papers and reports in this field:

- Wireless Security, Merritt Maxim, by David Pollino, McGraw Hill
- Wireless Security Essentials, by Russel Dean Vines, John Wiley

References

Relevant international journals and conferences

6.16 MCN 7204 Mobile Applications Programming

Aims

The objective of the course is to give students a practical introduction to mobile applications software programming and development tools. The course will contain 50

Indicative Content

The dimension of Mobility. Principles of Mobile Applications Programming. Introduction to programming languages for programmable mobile phones: J2ME (MiDP), C++ (Symbian), PYTHON. The mobile applications and Services echo system. Characterization of Innovative Mobile Services and design of an application software to meet a desired criteria.

Teaching and Learning:

- Lectures, seminars and laboratory exercises

Assessment:

- Assignment, lab exercises, Course Project, (40%) and
- Semester final examinations (60%)

Recommended Reading/ Indicative Sources:

- Mobile Internet Architecture, Nokia IT Press-2001, ISBN 951-826-499-6.
- Mobile computing principles, R. BFar, Cambridge University Press,2005.

Pre-requisite
MCN 7104 Principles of Mobile Computing

6.17 MCN 7205 Secure Software Architecture and Design

Course Description
Capability in the design of systems that meet security goals is an increasingly important skill. This course explores how cost-effective solutions to security needs can be achieved by following well-established architectural practices and detailed security principles. Central to these considerations is meeting the requirements with established solutions, and striking a balance between security and other system requirements.

Aims
The goal of the course is to equip students with necessary knowledge to design software systems that can stand most security risks.

Learning Outcomes:
At the end of the course, students will

- know the strengths and weaknesses of different security design techniques
- be able to specify a security solution to fulfill specific design requirements

Teaching and Learning Patterns
The teaching method shall mainly be based on lectures. In addition, assignments such as reading and course projects shall help students to help a better understanding in security and design requirements for secure systems. Furthermore, class presentations and group work will help students acquire some transferable skills.

Indicative Content

- Managing Security: Enterprise business strategies; Promoting security; Information security policy; Defining Properties of Secure Software , How to Influence the Security Properties of Software, How to Assert and Specify Desired Security Properties
- Security Requirements: Motivation for security requirements; Security requirements artifacts; Specifying security requirements
- Requirements Engineering for Secure Software: Misuse and Abuse Cases, The SQUARE Process Model, SQUARE Sample Outputs Requirements Elicitation, Requirements Prioritization,
- Secure Software Architecture and Design: Software Security Practices for Architecture and Design: Architectural Risk Analysis, Software Security Knowledge for Architecture and Design: Security Principles, Security Guidelines, and Attack Patterns
- Security Design Process: Business continuity; Principles of security design; AEGIS design methodology;
- Security Architectures: Security design patterns; Platform and channel security components; Enterprise security architectures;

- Designing Access Control : Security and access control; Access control policy; Security policy models;
- Designing Secure Systems: Security standards; Security decision-making; Design principles; Architecture principles; Security vs other architectural goals, Code Analysis , Coding Practices , Software Security Testing , Security Testing Considerations Throughout the SDLC
- Security and Complexity: System Assembly Challenges ; Security Failures, Functional and Attacker Perspectives for Security Analysis: Two Examples System Complexity Drivers and Security , Deep Technical Problem Complexity

Assessment

- Test, Research coursework (40%),
- Final Examination (60%)

Reading Material/Indicative sources

Software Security Engineering: A Guide for Project Managers. By Julia H. Allen, Sean Barnum, Robert J. Ellison, Gary McGraw, Nancy R. Mead , Published May 1, 2008 by Addison-Wesley Professional. Part of the SEI Series in Software Engineering series

6.18 MCN 7206 Service Oriented Architectures

Course Description

Service Oriented Architecture (SOA) is a fairly new concept motivated by in explosive increase in services that are increasingly required to interoperate. This course provide fundamental concepts of SOA, requirements for building services, types of services such as Web services and SOA engineering as way of building dynamic, autonomous systems.

Aims

The course aims at giving the student an understanding of the strengths and weaknesses of a service-based architecture, informed by an ability to implement and deploy simple web services using a suitable development platform. They will also learn to define and design applications as combinations of services, and be able to discuss the emergent properties of those compositions; and to understand the research context and potential future directions for these technologies.

Learning Outcomes

At the end of the course, students will

- know the fundamental principle of service-oriented systems
- be able design and implement service-oriented systems

Teaching and Learning Patterns

The teaching method shall mainly be based on lectures. In addition, assignments such as reading and course projects shall help students to help a better understanding in the design of service-oriented systems. Furthermore, class presentations and group work will help students acquire some transferable skills.

Indicative Content

- Software components: Modularity; reuse; contracts; component-oriented programming; services. Web-services. XML; HTTP; SOAP; WSDL; UDDI.
- Representational state transfer: Architectural styles of the web; REST; resource-oriented architecture. Composition Workflow; activity diagrams; BPMN; BPEL.
- Objects : OO middleware; CORBA; objects versus services.
- Software architecture: Client-server; layers; pipes and filters; EDA; repositories; peer-to-peer; Grid Computing.
- Semantic Web: Knowledge representation; Resource Description Framework; Web Ontology Language; Semantic Frameworks.
- Service qualities: Transactions; performance; security.
- Engineering SOA: Organization; lifecycle; versioning; governance.

Reading Material/Indicative sources

- Building Web Services with Java: Making Sense of XML, SOAP, WSDL, and UDDI (2nd Edition) by Steve Graham, Doug Davis, Simeon Simeonov, and Glen Daniels (Jul 8, 2004)
- Web Services: Principles and Technology by Michael Papazoglou (Sep 23, 2007) SOA Principles of Service Design (Jul 28, 2007) by Thomas Erl

Assessment

- Test, Project, (40%)
- Final Examination (60%)

Pre-requisite

The course assumes basic knowledge in XML schema and XML namespaces. Practical exercises entail a fair amount of Java programming, usually by extending and adapting supplied skeleton code; familiarity with OO programming will be helpful. The design discussion assumes a basic reading knowledge of UML

6.19 MCN 7207 Software Design Process and Metrics

Course Description

Software engineers may work in groups or be required to report or measure the activities on each phase of the software engineering process. This course is a step by step description of the software metrics. It includes introduction to foundations of measurement theory, models of software engineering measurement, software products metrics, software process metrics and measuring management.

Aims

The course aims at giving the student an understanding and practical experience of the design metrics. The will learn and use different metrics to measure the productivity of different software systems.

Learning Outcomes

At the end of the course, students will

- Outline, select and apply various techniques of measuring design metrics.
- have acquired a strong grounding in different techniques of measuring software metrics.

Teaching and Learning Patterns

The teaching method shall mainly be based on lectures. A medium size project shall be given to students in groups or individuals. The students are expected to walkthrough the different software metrics.

Indicative Content

- Recap of SW Engineering. Goal-question-metric (GQM). Balanced Score Card (BSC).
- Requirements Metrics. Design Patterns. Design Metrics. Best Practices in Coding, Code & Test Metrics. Maintenance Metrics. Analysis Tools. Customer Satisfaction Metrics & Process Improvement Metrics. Project Management Metrics &.Human Resources & Training Metrics
- Development Quality Metrics &Quality Audit Metrics. Customer Care Metrics and Miscellaneous Metrics.

Assessment

- Test, project (40%)
- Final Examination (60%)

Reading Materials

Text Book

- Software Metrics: A Rigorous and Practical Approach, (2nd ed.) (638p.), N.E. Fenton and S.L. Pfleeger, PWS Publishing, 1998. ISBN 0-534-95425-1.

References

- Metrics and Models in Software Quality Engineering, Stephen H. Kan, 2nd ed. (560 p.), Addison-Wesley Professional (2002). ISBN: 0201729156.
- Software Engineering Measurement, John C. Munson, Auerbach Publications, 2003 (443 pages) ISBN:0849315034

6.20 MCN 7208 Network Performance Evaluation

Course Description

This course unit shall cover areas in probability theory, random processes, Markov Chains (discrete and continuous), queuing theory (M/M, M/G queues), scheduling policies; preemptive, non-preemptive, priority scheduling, sized based scheduling. Analysis of networks of queues, mean value analysis (MVA), simulation models, network measurement techniques , and workload characterization.

Aims

Networked systems are highly dynamic in nature. They transport traffic that constitute highly varying workloads due to multitude of applications they support. Understanding the nature of networked systems is therefore crucial in analyzing and evaluating their performances and very important in designing these systems at different workload characteristics. The goal of this course is provide the fundamental and essential techniques for analyzing networked systems. Furthermore, students will learn some techniques for network simulation, measurements and modeling of traffic and user behaviors.

Learning Outcomes

Students completing this course will obtain in-depth theoretical understanding of analytical techniques that are used to analyze the performance of communication networks. Successful completion of students in this course unit will enable them to deploy modeling techniques to characterize various features that emerge in communication networks such as traffic workload, user characterization, measurements, etc. In general, successful learners of this course will obtain research skills that are very important in conducting research and in better comprehending published research results in computer communications areas.

Teaching and Learning Patter

n The content of this course shall be offered through contact hours between the lecturer and students. In addition to offered lecturer, students shall also learn through course assignments, reading assignments, and research course work. Some of the course work shall involve some numerical analysis and programming using MATLAB to simulate and prove some of the theory learnt in the class. Students are expected to get better knowledge of the concepts through these kinds of course work. Students shall also learn through other assessments mainly test and the final examination.

Indicative Content

- Probability theory: Probability measures, sample space, events, probability mass function, cumulative distribution
- Stochastic theory: probability density function, cumulative distribution function, moments
- Random processes: Poisson, Counting, birth death,
- Markov Chains: homogeneous discrete and continuous time chains
- Queuing Theory: M/M/1, M/M/K, M/M/1/K, M/G/1 etc
- Scheduling Policies: Preemptive, non-preemptive, priority scheduling, size based policies

- Workload Characterization: fundamentals of modeling techniques for traffic and user behaviors,
- Measurements and simulations

Reading materials/ Indicative Sources

Text books:

There is no single book that covers all content for the course, following text books are

Recommended

- Queueing Systems. Volume 1: Theory , by Leonard Kleinrock
- Computer Applications, Volume 2, Queueing Systems by Leonard Kleinrock
- Data Networks, by Bertsekas and Gallegar

References

Conferences and Journals: ACM SIGMETRICS, ACM Performance Evaluation, ACM SIGCOMM, IEEE INFOCOM, etc

Assessment

- Assignments, Test, Research course work,
- Final Examination

6.21 MIT 7218 Legal and Ethical Aspects of Computing

Course Description

The course focuses on issues that involve computer impact on society and related concerns. The students will be taught issues on: Transitional data flow; copyright protection; Information as a source of economic power; rights to access computer systems; computer crime; data privacy; establishing national priorities in the technical and social aspects of computing; current and anticipated uses of computer prediction. The course will also examine and evaluate the meaning of ethics and professional conduct including the protection of personal ethical concerns. The students will also be exposed to the status of the regulation and emerging markets.

Aims

This course aims at providing students with: A good grounding in social, legal, ethical and management issues affecting their probable role as researchers and or working computer scientists, practitioners or engineers in Computing and Information Technology-related disciplines.

The basic background to develop their professional role in the workplace, beyond simply performing technical tasks assigned to them.

Learning outcomes

Upon successful completion of this course, the students will: Apply the ethical concepts relevant to resolving moral issues in business, industry, and other relevant areas of concern; Articulate and defend with good reasons his/her own ethical point of view pertaining to specific problem areas in business, industry, and related areas; Analyze business plans, working procedures and policies in terms of current legislative and case law; Evaluate proposed and actual changes in the law for their effect on their working and personal environments in terms of rights, liabilities and responsibilities; Present compelling arguments about the social impact of new technological developments; and In addition, students should be able to maintain and develop their awareness of the social, legal and ethical framework in which they find themselves, through knowledge of the underlying mechanisms of change in these areas.

Teaching and Learning Pattern

The course will primarily be taught by external seminar speakers (i.e. professionals in the field of IT and Law related disciplines) and directed reading (from internet resources and text books as seen in the reading list). Also interactive lectures i.e. presenting a topic to the class and giving a starting point from which the students can give their own ideas will be used in learning this course. Strong encouragement will be given for students to continue these discussions outside lectures both in person and using online discussion tools such as MUELE (Makerere University Elearning). Current IT-related legislation and case law will be taught by direct lectures, supported by directed reading. Assignments with strong formative aspects (requiring self-directed research on a topic) will support each of the sections of the course.

Indicative Content

The course will cover the following topics: Nature of ethics, ethical development, responsibilities and basic ethical directions Ethical principles, values, and their foundations Specific computing and information technology related business, industry, and engineering ethical issues Social impact of technological change: Internet communications; medical technologies; bio-engineering; education; entertainment; industry, commerce and working practices; globalization; public misunderstanding of science; environmental impact of high technology National and international legal frameworks; specific legislation and case law involving IT issues Domain Names; IP law; Data Protection; Computer misuse; Software Licensing, Transitional data flow; copyright protection; Information as a source of economic power; rights to access computer systems; computer crime; data privacy; establishing national priorities in the technical and social aspects of computing

Assessment Method

Assessment will be made up of coursework (40%) and a final written exam (60%). Coursework will entail four parts:

A portfolio or similar on social issues (10%); An essay on a legal question (10%); Individual questions from the external speakers requiring short answers (10%); In-depth concise online discussions on legal and social issues (10%)

Reference books

- Computer Ethics: Integrating Across the Curriculum by Marion Ben-Jacob, Mercy College, ISBN-13: 9780763778095, ISBN-10: 0763778095, Cd-rom, 2010
- Pandoras Box: Social and Professional Issues of the Information Age by Andrew A. Adams and Rachel McCrindle (Paperback - 14 Dec 2007)

- Engineering Ethics by Charles B. Fleddermann, 1st edition Prentice Hall, 1999. ISBN 13: 9780137842247
- Engineering, Business and Professional Ethics by Moodley, Krisen, Elsevier Science & Technology 2007, ISBN-13: 9780750667418

6.22 MCS 7226: Seminar Series

Course Description

The course helps students to strengthen their ability to do guided research, make a report on technical issues and present these issues in a scientific set up. While lecturers will give the students guidelines on the topics to research on, they will not formally teach them in class. However, what is expected out of the students will be explicitly given to them and examined.

Aims

The aims of the course are:

- To develop the students ability to search for and internalize scientific academic material
- To develop the students skills in technical writing
- To develop the student's presentation skills.

Teaching and Learning Pattern

Students will be given broad areas of study together with research questions to address by the beginning of the second semester. Each student will be given a senior staff from whom they can get advice and guidance whenever necessary. The student will then be required to address one research problem and make a write up on it. The student will then be required to present his work to the staff and his/her peers. As part of the course, the student will also be obliged to attend all (weekly) research talks in the faculty (for the entire second semester).

Indicative Content

The content is both in terms of skill and technical content.

- Technical content: This depends on the problem addressed. The student is expected to show understanding and comprehension of the subject matter.
- Skill content: a student is expected to show ability to comprehend scientific literature, correctly make a technical report and competently prepare and make an academic presentation.

Assessment Method

Assessment will be made up of 4 parts:

- Attendance of weekly research talks (Semester 2) 10%
- Report write up 50%
- Presentation 20%
- Knowledge of subject matter 20%

Reference books

The textbooks and articles will depend on the problem being addressed.

7 Resources and Infrastructure

7.1 Library

In addition to the library that has some of the boos required for the revised and proposed course units, the faculty has its own library with books specifically for students in the faculty. The faculty library already has a number of relevant text books for existing and new course units. Additionally, the university has free access to the online IEEE publications portal that supports full text access to the worlds highest quality technical literature in ICT fields. All IEEE journals and conference proceedings that make up more than 1,700,000 documents in total. This is the invaluable source of teaching materials for the proposed courses.

In addition, the faculty is maintaining a digital library with a list of e-books for different courses in the Faculty. The digital library has a number of books that are relevant to some of the course units. More e-books shall be added to the library to cater for new courses.

7.2 Lecture Space

The Faculty of Computing and Information Technology has recently started using its new building with abundant space that can accommodate up to 10, 000 students at once. The building is composed of lecture halls of varying sizes. The proposed programs shall require lecture halls that can accommodate not more that 50 students at once.

7.3 Computer Labs

The Facultys new building is equipped with state of the art computer laboratories of different for students in addition to the computer laboratories in the old faculty laboratories. The Faculty has 6 existing computer laboratories that can accommodate 100 students at a time. The faculty is opening 5 new computer laboratories in the new building each is capable of serving up to 600 students. Some of these labs are already fully installed and ready for use.

7.4 Research Labs

Two specialized laboratories have been established for the program. These are Networks and Systems laboratory and Mobile Computing laboratory. The new laboratories have received some of the high-end equipments from Hewlett Packard (HP) and programmable mobile phones from Nokia & Nokia Siemens Networks, respectively. In addition, Google has awarded the Department of Networks a grant to establish the revised program, particularly the proposed Mobile Computing option. The grant will be also used to more specialized tools to facilitate teaching and research of the program. The network and systems lab is equipped with around 30 PCs, access points, routers, switches, spectrum analyzers, training PC, fiber-optic training tool, in addition to specialized software. The Mobile Computing lab is equipped with around 30 PCs, 30 programmable phones and accessories, specialized software, etc.

7.5 Field attachments

MSc programs in the Faculty of Computing and IT dont require field attachments. Due to the already ongoing initiatives between the department of Networks and private and public sectors, we have opportunities for students field work. These kind of opportunities however, shall provide students with practical problems to solve for their MSc theses and projects.

7.6 Human Resources

See Appendix A

7.7 Student Support

Students shall be allocated personal supervisors after their first semesters. The Head of the Department shall be their supervisor by default in their first semester. The supervisors role in the first semesters (i.e., before commencing their projects/theses) shall include guiding the students on the program and encouraging them towards better academic as well as future career paths. Supervisors shall help students identifying relevant electives. Students may be assigned different supervisors

The Faculty of Computing and Information Technology has registrar office that has been supporting new and foreign students. Decision to admit or reject transferring students from other options or institutions shall be taken by the registrars office with the consultation with the head of department.

7.8 Fees and Funding

Tution fees for privately sponsored students shall be $3,825,000$ Uganda Shillings per year for Ugandans and $3,350$ US Dollars per year for non Ugandans.

8 Quality Assurance

To ensure the quality and relevance of the revised program, various state holders were consulted. These include students, local private and public sector and some international institutions. Students were consulted through questionnaire during their final examination in the last semester of 2007/2008 academic year . The response collected from students indicated lack of research assessments and insufficient hands-on and transferable skills. The revised assessment methods are aimed to deliver these learning outcomes. Local institutions consulted include Uganda Communication Commission (UCC), DICTS, Ministry of ICT, and Faculty of Technology. We received constructive comments from DICTS and UCC, which we have implemented. In addition, through the first satellite workshop organized by the faculty of Computing and IT in 2008, a series of consultation with local Telecommunications providers and International companies such as Google, Nokia, Gramen foundation, etc were conducted regarding an option on Mobile Computing and Software Application Development. It was decided on the need to have such a program and Nokia. A paper of the proposed mobile computing and software development option was presented in Brasil during W3C conference by professor Fisseha of the Faculty of Computing and IT. The initiative received a very positive feedback.

The faculty has a QA committee that monitors the teaching delivery and follows up students feedback and complaints. The faculty QA committee collects data itself from class rooms. In addition, it continuously collects some information from head of departments and students. In its monthly meetings, the committee draws action plans that are followed at different levels; at

departmental and faculty management level. In most cases the follow-up of action plans was very effective.

The monitoring of course delivery has proved very efficient way in sustaining quality of teaching delivery in the faculty. It disclosed some irresponsible teaching practices that the faculty dealt with in time.

Appendix A: Staff

No	Name (Highest Qualification)	Rank	Dept
1	Venanius Baryamureeba (Ph. D)	Professor	CS/Dean
2	Irina Ya Zlotnikova (Ph. D)	Professor	IT
3	Idris Rai (Ph. D)	Ass. Professor	NW
4	Patrick J Ogao (Ph. D)	Ass. Professor	IS
5	Jose G. Quenum (Ph. D)	Senior Lecturer	CS
6	Jude T Lubega (Ph. D)	Lecturer	IT
7	Martin Bagaya (Ph. D)	Lecturer	IS
8	Josephine Nabukenya(Ph. D)	Lecturer	IT
9	Agnes R Ssemwanga (Ph. D)	Lecturer	IS
10	Benjamin Kanagwa (Ph. D)	Lecturer	NW
11	John Quinn (Ph. D)	Lecturer	CS
12	John Ngubiri (Ph. D)	Lecturer	CS
13	Tonny E Bulega(Ph. D)	Lecturer	NW

Appendix B: Load Distribution

Staff	Specialisation	Old	Ld	New	Ld	Old	Ld	New	Ld
I. A. Rai (PhD, Ass Professor)	Communication Networks	MCS 8107, MCS 7105	6	MCN 7101, MCN 7106, MCN 8107	9	MCS 7200, 7211	6	MCN 7205, MCN 7204	6
F. Mekuria (PhD, Professor)	Mobile Computing and Communications	MCS 8108, MCS 7118	6	MCN 7104, MCN 7107, MCN 7108	9	MCS 7208, 7211	6	MCN 7202, MCN 7208	6
T. E. Bulega (PhD, Lecturer)	Telecom. and Information Systems			MCN 7100, MCN 7103, MCN 8100	9			MCN 7203, MCN 7201	6
B. Kanagwa (PhD, Lecturer)	Software enginering, formal methods, service-Oriented architectures	MCS 7201	3	MCN 7105, MCN 7102, MCN 8108	9	MCS 7212	3	MCN 7206, MCN 7205	6
V. Baryamureeba (PhD, Professor)	Programing, Theoretical computing	MCS 9100	3	MCS 9100	3	MCS 9200	3	MCS 9200	3
J.G.Quenum (PhD, S. Lecturer)	Theoretical computing, Compiler Theory, Distributed Systems	MCS 7117 MCS 8102 MCS 8101	9	MCS 9102 MCN 7105 MCN 7118	9	MCS 7215 MCS 7218 MCS 9202	9	MCN 7207 MCS 9202	6
J. Quinn (PhD, Lecturer)	Image processing, Mathematical Computing, Image processing, Pattern Recognition	MCS 7116 MCS 8104 MCS 7101	9	CSC 2109 MCS 9101	9	MCS 7216 MCS 7217 MCS 9201	9	MCS 7217 MCS 7224 MCS 9201	9
J. Ngubiri (PhD, Lecturer)	Programing, Disributed Systems, Mathematical Computing, Database Systems, Algorithms	MCS 7115 CSC 3100	9	MIT 7116 CSC 2111 MCS 7109	9	MCS 7202 CSC 1201	9	MCS 7202 MCS 7220	6