UNIVERSITY OF BOTSWANA
FACULTY OF SCIENCE
DEPARTMENT OF COMPUTER SCIENCE

Type of Proposal: Minor Review

Revised Curriculum
for
MSc (Computer Science)
MSc(Computer Information Systems)

Approval	Date
Departmental Board	February 14, 2008
Faculty Board	October 28, 2009
Faculty Executive	November 11, 2009

Proposed Date of Implementation: August 2010

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1. Introduction

1.1. Preamble

The Department of Computer Science has undertaken a review of its Master of Science degree programmes. This is in response to

a) the experience gained in the implementation of the programme so far,
b) informal input from students who have been on the programme,
c) the report of the External Reviewer(Prof. S. Seidman),
d) input from a Fulbright Scholar who visited the department(Dr. S. Kouborov),
e) the Report of the Maitlamo project (Botswana ICT Policy development project 2005),
f) the perceived changes in the national Human Resources needs as contained in the Botswana Human Development Report 2005 (BHDR 2005),
g) global trends in the field of computing as reported in the ACM/IEEE-CS/AIS/AITP Computing Curricula report 2005 (CC2005) and the MSIS2000 curricula standard,
h) Vision 2016 with the ICT human resources development implications,
i) Shaping our future strategy document of the University of Botswana

Based on the report of a comprehensive SWOT analysis of the programme carried out by the External Reviewer and the input from the various sources cited above, for now, the review exercise does not involve a major overhauling of the programme that would require changes in the original aims, objectives, rationale, focus and general structure of the programme. Rather, the changes resulting from the review exercise essentially involve:

- Addition, deletion or changes in course title or content
- Shifting of courses from one semester to another
- Minor regulatory changes to realign the implementation strategy

Hence, based on University Guideline on Programme Review, the review exercise undertaken belongs to the category of minor review.

The rest of this document provides specific rationale for the review exercise, the revised Departmental regulation, including the current and proposed courses mapping for transition students, as well as a table linking the programme review rationale with specific changes.

1.2. Programme Review Rationale

The department has gathered experience in offering the programme for the past 4 academic years and useful observations and comments have been obtained from both staff and students who have been involved in the programme implementation. An External Reviewer conducted a comprehensive SWOT analysis of the programme with specific recommendations for improvement. A Fulbright scholar visited the department for one academic year and made very useful observations about the programme and some suggestions for improvement on its

offering. The department has availed itself the computing curricula trend as documented in the ACM/IEEE/AIS/AITP Computing Curricula 2005 (CC2005) report and the MSIS 2000 Masters in IS curriculum standard. Also availed was the Botswana Human Development Report 2005 (BHDR 2005) which has clear implications for the computing technology human resources development. Further considered is the report of the Maitlamo project spelling out ICT policy/strategy for Botswana and the ICT vision 2016, both of which have clear implications for computing education and training in the country.

Drawing input from all these sources, the department established as rationale for the programme review exercises the following needs:

R1: To broaden the core courses so as to give students more adequate theoretical and practical orientation and an exposure to the most central body of knowledge in Computer Science and Information Systems;

R2: To minimize unnecessary overlap between courses and programmes;

R3: To enhance the breadth and depth of the courses to reach the target graduate profile better;

R4: To optimize the curricula by eliminating unnecessary duplications;

R5: To strengthen the structural cohesion of the programme to take advantage of related knowledge clusters;

R6: To rationalize the range of optional courses which seem to be too many for the number of students being enrolled in the programme;

R7: To reflect relevant development trends in computing curricular provisioning.

1.3. Graduate Profile

In line with the mission of the department, the graduates of these programmes will have enhanced capacity for the following:

a) conduct research and advance knowledge in computing,
b) serve as technical managers of computing technology resources and projects,
c) serve as large-scale systems integrators,
d) demonstrate intellectual competency and transferable knowledge and skills, and articulate them effectively, and
e) demonstrate analytical, critical and strategic thinking skills, and devise new ways to use computing technologies.

2. The Revised Departmental Regulations

2.1. General Provisions

Subject to the provisions of General Academic Regulations 40.0, the following Departmental Regulations shall apply

2.2. Programmes and Titles of Programmes

The Department of Computer Science offers an MSc programme with two specialisation areas - Computer Science and Computer Information Systems leading to the award of

- MSc (Computer Science) and
- MSc (Computer Information Systems)

2.3. Entrance Qualifications and Admissions

Subject to the provisions of General Academic Regulation 41.3, to be admitted into the Master's degree programme, an applicant shall normally have any one of the following:

a) Completed either the single major or combined major/minor degree programme with major in Computer Science or Information Systems or related degree offered at this University or equivalent institution.

b) Obtained a Bachelors degree from this University or any other recognized institution in Mathematics, Science or Engineering, PLUS a postgraduate diploma in Computer Science or Information Systems or equivalent qualification from a recognized institution considered appropriate by the department.

c) Application for admission into the programme shall be in accordance with General Regulation 41.4.

d) Registration for the programme shall be subject to General regulation 41.6.

2.4. Programme Structure

Subject to the General Regulation 41.5, the following regulations shall apply:

2.4.1. Programme Offering Mode, Duration and Workload

a) The Master's programme shall be offered on both full-time and part-time basis.

b) Subject to the General Regulation 41.1, the Programme shall be offered in the Coursework and Dissertation mode.

c) The minimum duration for the Master's programme shall be subject to the General Regulation 41.5.1.

d) The coursework component shall be drawn from core, optional and approved Additional Optional courses as specified under Regulation 2.4.3.

e) Selection of optional courses shall be from either of the two streams of specialization, which are, CS (Computer Science) stream and CIS (Computer Information Systems) stream, as specified under Regulation 2.4.3. Additional streams of specialization may be added in future depending on departmental capabilities and national needs. Additional optional non-computing courses can be taken as prescribed under Regulation 2.4.3.

f) Subject to relevant General Academic Regulations, students who select and pass the prescribed minimum number of credits of core and optional courses from any of the Computer Science (CS) and Computer Information Systems (CIS) specialization areas shall be awarded the MSc degree with the title MSc (Computer Science) and MSc (Computer Information Systems) respectively.

2.4.2. Core and Optional Courses

Semester I

MSc (Computer Science) Specialization Courses	**Type**	**Credits**
Core Courses		
CSI602 Software Engineering	Core	3
CSI691 Data Warehousing	Core	3
CSI604 Operating Systems	Core	3
Optional Courses		
CSI613 Machine Learning	Optional	3
CSI633 Web Engineering	Optional	3
CSI617 Agent-Oriented Systems	Optional	3
CSI636 Topics in Computing	Optional	3
Other relevant Masters level courses as may be deemed necessary		
MSc (Computer Information Systems) Specialization Courses		
Core Courses		
CSI603 Information Systems Engineering	Core	3
CSI691 Data Warehousing	Core	3
CSI621 Information Systems Policy and Strategy	Core	3
Optional Courses		
CSI636 Topics in Computing	Optional	3
FIN620 Business Finance	Optional	3
MGT743 Strategic Management	Optional	3
MKT660 Principles of Marketing	Optional	3
Other relevant Masters level courses as may be deemed necessary		

Semester II

MSc (Computer Science) Specialization Courses	**Type**	**Credits**
Core Courses		
CSI601 Computer Networking and Communications	Core	3
CSI615 Algorithms and Data Structures	Core	3
CSI695 Computing Research Methods	Core	3
Optional Courses		
CSI618 Grid Computing Systems	Optional	3
CSI631 Multimedia Computing Systems	Optional	3
CSI612 Aspect-oriented Software Development	Optional	3
CS607 Information Retrieval	Optional	3
Other relevant Masters level courses as may be deemed necessary		

MSc (Computer Information Systems) Specialization Courses		
Core Courses		
CSI601 Computer Networking and Communications	Core	3
CSI623 Project and Change Management	Core	3
CSI695 Computing Research Methods	Core	3
Optional Courses		
CSI627 Decision Support Systems	Optional	3
CS607 Information Retrieval	Optional	3
MPA602 Public Policy and Administration	Optional	3
MPA711 Managing Negotiations, Contracts and Conflicts	Optional	3
Other relevant Masters level courses as may be deemed necessary		

Semester III

MSc (Computer Science) Specialization Courses	**Type**	**Credits**
Core Courses		
CSI700 Supervised Research and Dissertation	Core	12
MSc (Information Systems) Specialization Courses	**Type**	**Credits**
Core Courses		
CSI700 Supervised Research and Dissertation	Core	12

Semester IV

MSc (Computer Science) Specialization Courses	**Type**	**Credits**
Core Courses		
CSI700 Supervised Research and Dissertation	Core	12
MSc (Information Systems) Specialization Courses		
Core Courses		
CSI700 Supervised Research and Dissertation	Core	12

2.4.3. Additional Optional Courses

Subject to the General regulation 40.18, with the approval of the departmental Board, additional core/optional course(s) can be introduced from within the field of Computing or selected from other relevant Master's level programmes in the university, as may be prescribed by the department from time to time, and such additional course(s) shall be advertised in the departmental hand book prior to the commencement of the semester during which this will take effect.

2.4.4. Audited Courses

Students can audit any undergraduate or postgraduate course as may be considered necessary. Such audited course shall not count as part of normal course work in respect of credit earning.

2.4.5. Workload Distribution

Subject to the General Academic Regulation 41.6, student workload distribution shall be as follows:

	MSc (Computer Science) Specialization Courses	**MSc (Information Systems) Specialization Courses**	**No of Credits**
Semester I			
Core	CSI602	CSI603	3
	CSI691	CSI691	3
	CSI604	CSI621	3
Optional	3 - 6 Credits from CS Stream	3 - 6 Credits from CIS Stream	3-6
Semester I Total			**12-15**
Semester II			
Core	CSI601	CSI601	3
	CSI615	CSI623	3
	CSI695	CSI695	3
Optional	3 - 6 Credits from CS Stream	3 - 6 Credits from CIS Stream	3-6
Semester II Total			**12-15**
Semester III			
Core	CSI700	CSI700	12
Optional	Max 3 Credits	Max 3 Credits	0-3
Semester III Total			**12-15**
Semester IV			
Core	CSI700	CSI700	12

Optional	Max 3 Credits	Max 3 Credits	0-3
Semester IV Total			**12-15**
Total Required Credits			**48-60**

2.4.6. Optional Courses Availability

The department reserves the right to offer any optional course in any academic session.

2.5. Assessment

2.5.1. Assessment of course work shall be in accordance with the provisions of the General Regulation 41.7

2.5.2. The ratio of CA to Examination for course work shall be as provided for each course.

2.5.3. Assessment procedure for dissertation work shall be as per General Academic Regulation 41.11.

2.6. Dissertation

2.6.1. A student shall be allowed to register for the dissertation course only if he/she has passed all core courses or has not failed more than one core course with score not less than 50.

2.6.2. Selection of research dissertation topic and written proposal shall be subject to evaluation by a Supervising Committee comprising the proposed Supervisor, Co-supervisor and the CS Graduate Studies Coordinator, who shall write report and recommend the proposal for defence before the department, and pass on for approval by the graduate studies board who shall in turn give final approval.

2.6.3. Supervision of dissertation shall be in accordance with the provisions of the General Academic Regulation 41.9.

2.6.4. Examination of Dissertation shall be in accordance with the provisions of the General Academic Regulation 41.11.

2.7. Progression

Progression shall be as provided in the General Academic Regulation 41.8

2.8. Notification of results and award

Notification of results and award shall be as provided in the General Academic Regulation 41.12.

3. Mapping of Courses

The following table provides the mapping between revised programme and current programme for transition students plus change rationale.

Courses in Revised Programme	**Courses in Current Programme**	**Change Rationale**
CSI601 Computer Networking and Communications	CSI601 Computer Networking and Communications	No change
CSI602 Object-oriented Software Engineering	CSI602 Software Engineering	Re-titling
CSI603 Information Systems Engineering	CSI603 Information Systems Engineering	No change
CSI604 Operating Systems	New	R1, R3
CSI607 Information Retrieval	New	R3, R7
CSI615 Algorithms and Data Structures	CSI615 Complexity and Computability	Refocusing. R2
CSI691 Data Warehousing	CSI691 Database Systems Engineering	Re-titling, R7
CSI695 Computing Research Methods	CSI695 Computing Research Methods	No change
CSI613 Machine Learning	CSI613 Intelligent Interfaces and Systems CSI 617Knowledge-Based Systems Engineering	R4, R5
CSI633 Web Engineering	CSI633 Web Engineering CSI626 Web-Based Information Systems	R4, R5
CSI 627 Decision Support Systems	CSI 627Decision Support Systems	No change
CSI617 Agent-Oriented Systems	New	R3, R7
CSI636 Topics in Computing	CSI636 Current Topics in Computing Science CSI628 Current Topics in Information Systems	R4, R5
CSI621 Information Systems Policy and Strategy	CSI621 Information Systems in Development	Re-titling, R7
FIN620 Business Finance	Available as option from MBA programme	R3
MGT743 Strategic Management	Available as option from MBA programme	R3
MKT660 Principles of Marketing	Available as option from MBA programme	R3
CSI618 Grid Computing Systems	CSI 618 Distributed Computing Systems CSI 619 Parallel Computing Systems	R3, R4, R5, R6, R7
CSI631 Multimedia Computing Systems	CSI 631 Multimedia Computing Systems	No change

CSI612 Aspect-oriented Software Development	CSI 612 Software Development Methods	Re-focusing R2, R7
CSI623 Project and Change Management	CSI 623 Information Systems Project Management	Re-focusing R3, R6, R7
MPA602 Public Policy and Administration	Available as option from MPA programme	R3
MPA711 Managing Negotiations, Contracts and Conflicts	Available as option from MPA programme	R3
CSI700 Supervised Research and Dissertation	CSI700 Supervised Research and Dissertation	No change
Deleted	CSI 692Object Oriented Systems	R4, R5, R6, R7
Deleted	CSI 694 Independent Study	R4, R5, R6
Deleted	CSI 611Programming Language Theory and Implementation	R6
Deleted	CSI614 Numerical Computation	R6, R7
Deleted	CSI616 Computer Modelling and Simulation	R6, R7
Deleted	CSI622 Information Systems Development Methodologies	R3, R6, R7
Deleted	CSI632 Computer Animation and Visualization	R2, R6, R7
Deleted	CSI634 Pattern Recognition	R6, R7
Deleted	CSI635 Linguistics Computing	R6
Deleted	CSI693 Social Computing	R2, R6
Deleted	CSI624 Information Systems Management	R3, R6
Deleted	CSI625 Knowledge Resources Management	R6
Deleted	CSI701 Research Essay	Found unsuitable for the field of Computing

4. Resources

4.1. Human Resource

The following table shows the human resource situation in the department including the establishments allocated for the different positions.

Academic Year	**2007/2008**	**2008/2009**	**2009/2010**	**2010/1011**
Professor	(2) 0	0	1	1
Associate Prof.	(2)1	1	2	2
Senior Lecturer	(12) 6	3	6	8
Lecturer	(16) 16	16	16	16
Total Academic	**(32) 23**	**20**	**25**	**27**
Technical Staff				
Chief Technician	1	1	1	1
Senior Technician	(2) 1	2	2	2
Technician	(5) 3	5	5	5
Total Technical Staff	(8) 5	8	8	8
Secretarial Staff				
Administrator	0	1	1	1
Personal Assistant	1	1	1	1
Secretary	1	1	1	1
Total Secretarial Staff	**2**	**3**	**3**	**3**

4.2. Physical

The following table shows the laboratory resources available for the MSc program. There are two dedicated laboratories for the MSc programme with the following equipments.

Laboratory	**No. of machines**	**Model/make**	**Processor**	**Memory**
Lab 232/111	8	HP COMPAQ	PENTIUM (R) 4 CPU 3.00GHZ	512 MB RAM
Lab 232/112	30 THIN CLIENTS (25 CONNECTED)	HP T5720 AMD NX	AMD Geode NX 1500 1 GHZ	512 MB RAM

5. Inputs and Outputs

5.1. Expected MSc Intake and Outputs

	2007/2008	**2008/2009**	**2009/2010**	**2010/2011**	**2011/2012**
Intake	7	11	10	11	11
Output	2	4	6	6	6

6. Course Descriptions

Code	CSI601
Title	Computer Networking and Communications
Credits	3
Type	Core
Semester in which the course is taught (1 or 2)	2
Pre-requisites (if any)	None
Co-Requisites (if any)	None

Aims and Learning Objectives

The aim of this course is to discuss network architectures, routing, forwarding, naming, and addressing. It will also cover emerging network technologies and performance evaluation issues.

Learning Outcomes
On successful completion of the course, students should be able to:

- design, implement, and evaluate a protocol of their choice;
- demonstrate knowledge of emerging communications technologies and their potential applications;
- critique research papers on network architectures;
- conduct an open-ended research or development project

Course Synopsis
Overview of addressing, routing, TCP/IP, naming, and congestion control; Routing security and traffic engineering; Multi-path routing; Network measurement operations and research (quality of service); Addressing (anycast, flat labels, and network services); Active networks and their programmability.

Course delivery
3 lecture hours

Modes of assessment
CA and Examination

Reading (and other resources) list

1. A. S. Tanenbaum, Computer Networks, 4th edition, Prentice-Hall, 2002
2. W. Stallings, Local and Metropolitan Area Networks, 6th eEdition, Prentice Hall, 2000
3. Keshav, An Engineering Approach to Computer Networking: ATM networks, the Internet and the Telephone network, Addison-Wesley, 1998
4. e-resources

Code	CSI602
Title	Object-oriented Software Engineering
Credits	3
Type	Core
Semester in which the course is taught (1 or 2)	1
Pre-requisites (if any)	None
Co-Requisites (if any)	None

Aims and Objectives

The aim of this course is to impart advanced software engineering design concepts and principles underlying modern software development with a special emphasis on OO design patterns and frameworks.

Learning Outcomes
At the end of the course, students should be able to:

- Explain object-oriented design concepts and approaches
- Choose appropriate architectural views and styles for a given project
- Explain the rationale and benefits of object-oriented design patterns
- Apply design patterns to the construction and development of software
- Integrate application frameworks and component-based software
- Identify research issues related to OO technology and design patterns

Course Synopsis
Overview of software engineering; software engineering challenges; software life cycle revisited; requirement engineering; software architecture and styles; Object-oriented Design; Introduction to Design Patterns; In-depth studies of individual design patterns covering the whole set of GoF's (Gang-of-Four) design patterns and any additional related patterns applying design patterns to the design and construction of reliable and reusable software; Overview of frameworks; Component-based Software Engineering; Software testing and maintenance.

Course Delivery

3 lecture hours

Modes of assessment
CA and Examination

Reading (and other resources) list

1. Eric J. Braude, Software Design: From Programming to Architecture**,** Wiley, 2004.
2. W. Pree, Design Patterns for Object-Oriented Software Development, Addison-Wesley, 1998
3. L.A. Maciaszek and B.L. Liong, Practical Software Engineering, Addison-Wesley, 2005
4. e-Resources

Code	CSI603
Title	Information Systems Engineering
Credits	3
Type	Core
Semester	1
Pre-requisites (if any)	None
Co-Requisites (if any)	None

Aims and Learning Objectives

Students look at the role of information systems in an integrated view of the organization from both the external and internal perspective. Students are encouraged to understand the issues from the perspective of senior IS managers.

Learning Outcomes

At the end of the course, students should be able to

- Discuss business processes that are necessary to run a corporation and their relationships with legacy systems and other functional applications
- Describe the concept of ERP and how it is implemented in business processes
- Discuss the different roles that IS can have in the enterprise
- Identify the characteristics of successful IS organizations
- Make intelligent choices about computer architectures and platforms with appropriate emphasis on both organizational integration and flexibility
- Demonstrate knowledge of the strategies of major hardware and software vendors with regard to technologies and standards.

Course Synopsis

Integrating the Enterprise; Organizational needs for integration and flexibility; Overview of a typical "business architecture", ERP functions/applications; Enterprise Information Systems Architectural (ISA): frameworks, models, and concepts; Integrating the IS Function; IS key business processes, Organizational structure for IS, Managing emerging technologies, Integrating IS Technology; current and emerging architectures and technologies, computer platforms and information architectures, Software component architectures interoperability and standardization. Case Studies

Modes of assessment
CA and Examination

Delivery Mode

3 lecture hours

Reading (and other resources) list

1. Brian P. Bloomfield, Rod Coombs, David Knights, and Dale Littler, Information Technology and Organizations: Strategies, Networks and Integration, Oxford University Press, 2000.
2. Fong, Joseph, Information Systems Reengineering and Integration, 2nd edition, Springer, 2006
3. e-resources

Code	CSI604
Title	Advanced Operating Systems
Credits	3
Type	Core
Semester in which the course is taught (1 or 2)	1
Pre-requisites (if any)	None
Co-Requisites (if any)	

Aims and Learning Objectives

This aim of this course is to provide students with knowledge in advanced topics in operating systems design and implementation and exposure to recent developments in operating systems research.

Learning Objectives

At the end of this course, students should be able to:

- Apply the principles and concepts in operating systems design and implementation, in particular, design and development of scheduling, process management, memory management, security, and other sub-systems critical to operating system performance, reliability and security.
- Suggest alternate designs to various critical operating system components incorporating ideas from research, with understanding of advantages and disadvantages of such approaches.
- Perform performance analysis of operating systems using simulation and analytical methods.

Course Synopsis

Operating systems (OS) design and implementation covering design issues, virtualization, multiprocessing, process management, multithreading, scheduling, synchronization, hardware support, memory management, storage and file systems, inter-process communication, protection and security, fault tolerance, and recovery; Performance evaluation of OS.

Course Delivery
3 lecture hours

Modes of assessment
CA and Examination

Reading (and other resources) list

1. A.S. Tanenbaum. Modern Operating Systems, 3rd Edition. Prentice Hall, 2008
2. D.P. Bovet and M. Cesati. Understanding the Linux Kernel, 3rd Edition. O'Reilly. 2005
3. A. Silberschatz, P.B. Galvin, and G. Gagne. Operating System Concepts, 8th Edition. Wiley & Sons, 2008

Code	CSI607
Title	Information Retrieval
Credits	3
Type	optional
Semester in which course is taught (1 or 2)	2
Pre-requisites (if any)	none
Co-requisites (if any)	none

Aims and Learning Objectives

This course introduces students to techniques for designing and building information retrieval systems. It will focus more on the algorithms for performing efficient text-based searches.

Learning Outcomes
After completion of the course, students should be able to

- explain information storage and retrieval concepts;
- describe issues specific to efficient information retrieval;
- select the appropriate search strategy for an application;
- design and implement a medium size information retrieval system;
- evaluate performance of an information retrieval system

Course Synopsis

Goals and history of information retrieval; Boolean and vector space retrieval models; Text representation and indexing techniques; Evaluation of information retrieval; Web search; Web crawling and indexes; Link analysis; Text/web clustering and classification; Text mining; XML retrieval; Relevance and query expansion.

Course Delivery
3 hours lectures

Modes of Assessment
CA and Final Examination

Reading (and other resources) List

1. Manning D., Raghavan P., and Schutze, "*Introduction to Information Retrieval*", Cambridge University Press, 2008.
2. e-resources

Code	CSI 612
Title	Aspect-Oriented Software Development
Credits	3
Type	Optional
Semester	2
Pre-requisites(if any)	None
Co-Requisites (if any)	None

Aims and Objectives

This course aims to introduce students to the new dimension of software development, aspect-orientation with an emphasis on the analysis, design, and implementation of aspect-oriented systems and formal foundations of aspect-oriented systems development.

Learning Outcomes

After completing the course, students should be able to:

- explain the basic concepts of aspect-orientation
- apply a particular analysis and design technique and its related tools
- write programs using one of the aspect-oriented programming languages
- describe aspect orientation's philosophy to software development
- identify research issues associated to aspect-oriented software development

Course Synopsis

Overview of aspect orientation: separation of concerns, crosscutting concerns, modularization, aspects, join points, pointcuts, advice, and aspectual composition; Aspect-oriented analysis and design; Aspect-oriented programming; Aspect-oriented applications**;** AOSD and other paradigms.

Course Delivery:

3 Lecture hours

Modes of assessment:

CA and Examination

Reading (and other resources) list

1. Siobhán Clarke, Elisa Baniassad, Aspect-Oriented Analysis and Design. The Theme Approach*,* Addison-Wesley, 2005.
2. Robert Filman, Tzilla Elad, Siobhán Clarke, Mehmet Aksit, Aspect-Oriented Software Development, Addison-Wesley, 2004.
3. E-Resources

Code	CS613
Title	Machine Learning
Credits	3
Type	Optional
Semester	1
Pre-requisites (if any)	None
Co-Requisites (if any)	None

Aims and Objectives

The course will explain how to build systems that learn and adapt using real-world applications through the concepts of advanced search, machine learning, and neural networks. It will also provide an understanding of when such AI approaches become appropriate for a given problem.

Learning Outcomes
At the end of the course, students should be able to:

- Explain the differences among the three main styles of learning: supervised, reinforcement, and unsupervised
- Describe decision trees, neural networks, and belief networks providing examples of when each strategy is superior.
- Design and implement a solution to a problem using machine learning techniques

Course Synopsis

Advanced search, advanced knowledge representation and reasoning (Structured representation, Uncertainty, Knowledge representation for diagnosis, qualitative representation), Machine learning and Neural Networks

Course Delivery
3 lecture hours

Mode of Assessment
CA and Examination

Reading (and other resources) list

1. Grigoris Antoniou, John Slaney, Advanced Topics in Artificial Intelligence, 1st edition, Springer, , 1998
2. Michael Negnevitsky, Artificial Intelligence: A Guide to Intelligent Systems, 2nd edition, Addison-Wesley, 2004
3. David M. Skapura, Building Neural Networks: algorithms, Addison-Wesley, 1996
4. David E. Goldberg, Genetic Algorithms in search, optimization and machine learning, Addison-Wesley, 1989

Code	CSI615
Title	Algorithms and Data Structures
Credits	3
Type	Core
Semester in which course is taught (1 or 2)	2
Pre-requisites (if any)	none
Co-requisites (if any)	none

Aims and Learning Objectives

This course will discuss advanced data structures and algorithms. It will emphasize on algorithms that are applied in several areas of computing.

Learning Outcomes
After completion of the course, students should be able to:

- use the potential method to provide an amortized analysis of a data structure, given the potential function;
- design and implement a dynamic programming solution to a problem;
- select and use appropriate data structures and algorithms to solve a problem;
- explain the use of randomization in the design of algorithms;
- describe important algorithms and data structures used in areas such as cryptography, computational geometry, bio-informatics, combinatorial optimization and others.

Course Synopsis

Amortized analysis; Randomized algorithms; Dynamic programming; Advanced data structures: Fibonacci heaps, splay trees, tries and suffix trees, etc. Graph matching theory and its applications; Applications in selected areas such as cryptography(private and public key cryptography, digital signatures), computational geometry (line segments and convex hulls), Linear and Integer programming, and bio-informatics.

Course Delivery
3 lecture hours

Modes of Assessment
CA and Final Examination

Reading (and other resources) List

1. T. Cormen, C. Leiserson, R. Rivest, and C. Stein, "*Introduction to Algorithms*", 2nd Edition, MIT Press, 2001
2. L. A. Wolsey, "*Integer Programming*", John Wiley & Sons, Inc., 1998
3. V. Chvatal, "*Linear Programming*", W. H. Freeman, 1983
4. D. R. Stinson, "*Cryptography : theory and practice*", 3rd edition, CRC Press, Inc., 2005
5. E. Lawler, "*Combinatorial Optimization : networks and matroids*", Dover Publications, Inc., 2001
6. N. Jones and P. Pevzner, "*An Introduction to Bioinformatics Algorithms*", MIT Press, 2004

Code	CSI617
Title	Agent-Oriented Systems
Credits	3
Type	optional
Semester in which the course is taught (1 or 2)	1
Pre-requisites (if any)	
Co-Requisites (if any)	None

Aims and Objectives

The course aims to introduce students to the concept of an agent and multi-agent system, and issues related to the design and implementation of agents and multi-agent systems. It also introduces the main issues related to the design of intelligent agents.

Learning Outcomes
After completing the course, students should be able to:

- describe the notion of an agent, and the characteristics of applications that lend themselves to an agent-oriented solution
- explain the key issues and approaches associated with the development of agents
- discuss the key issues in designing societies of agents that can effectively cooperate in order to solve problems
- develop agent-based systems using a contemporary agent development platform

Course Synopsis

Introduction to agents: agents and objects, agents and distributed systems, typical application areas for agent systems; Intelligent Agents: architectures for agents and the design of intelligent agents; Multi-Agent Systems: types of interactions, interaction languages and protocols, applications of agent systems.

Course Delivery:

3 Lecture hours

Modes of assessment:
CA and Examination

Reading (and other resources) list

1. M. Wooldridge, An Introduction to Multi-Agent Systems. John Wiley & Sons, 2002.
2. G. Weiss, editor. Multi-Agent Systems. The MIT Press, 1999
3. J. Ferber. Multi-Agent Systems. Addison-Wesley, 1999
4. E-Resources

Code	CSI 618
Title	Grid Computing Systems
Credits	3
Type	Core
Semester	2
Pre-requisites	None
Co- requisites	None

Aims and learning objectives:

The aim of this course is to introduce students to advanced topics in distributed computing systems with particular emphasis on the service-oriented distributed computing systems such as the Grid computing Systems.

Learning Outcomes

At the end of the course, students should be able to:

- discuss service-oriented computing architectural issues,
- Develop and implement models of grid computing systems,
- Design structured application systems to work in a grid environment,
- Develop and implement middleware support required for grid computing environment

Course Synopsis:

Distributed high-performance computing concept; Principles and practice of Service-oriented systems, The Open Grid Services Architecture, Grid computing model; Grid market place: Grid taxonomy, fabric, middleware, serverware, e-service provider, Grid protocols: security, resource management, data: Grid software environments and tools; Creating and Managing Grid Services; Managing grid environments; Grid systems and applications development tools; current trends in grid computing.

Course Delivery
3 lecture hours

Mode of Assessment:
CA and Examination

Reading (and other resources) list

1) Fran Berman, Geoffrey C. Fox, Anthony J.G. Hey (Editors): Grid Computing - Making the Global Infrastructure a Reality, Wiley, 2003
2) Ian Foster, Carl Kesselman (Editors): The Grid: Blueprint for a New Computing Infrastructure, 2nd Edition (Grid 2), Morgan Kaufmann, Elsevier, 2004
3) Ahmar Abbas: Grid Computing: A Practical Guide to Technology and Applications, Charles River Media, 2004
4) e-Resources

Code	CSI621
Title	Information Systems Policy and Strategy
Credits	3
Type	Core
Semester	1
Pre-requisites (if any)	None
Co-Requisites (if any)	None

Aims and Learning Objectives:

The aim of the course is for the Students to acquire knowledge and skills in IS policy and strategy formulation towards exploitation of the potentials of organisational, national and global Information Systems (IS) technologies in socio-economic development.

Learning outcomes

At the end of the course, students should be able to:

- Describe the operational, contextual and strategic issues of IS
- Describe IS capabilities for competitive advantage
- Formulate an IS policy and strategy
- Align IS policy and strategy with organisational and national gaols/ objectives

Course Synopsis:

IS and business, competition, aligning IT strategy, IS planning, outsourcing vs. insourcing, inter-organizational systems, Frameworks for IS policy and strategy formulation and implementation; Evaluating success of an IS policy and strategy; IS personnel structure and leadership, case studies in organizational, national and global IS strategy and policy.

Course Delivery
3 lecture hours

Modes of assessment:
CA and Examination

Reading (and other resources) list

1. John Ward, Peppard Joe, Strategic Planning for Information Systems, 3rd edition, Wiley Information Systems Series, 2002.
2. Anita Cassidy, A Practical Guide to Information Systems Strategic Planning, 2nd Edition, Auerbach Publications, 2005.
3. E-Resources and National Policy documents

Code	CSI 623
Title	Project and Change Management
Credits	3
Type	Core
Semester	2
Pre-requisites (if any)	None
Co-Requisites (if any)	None

Aims and Learning Objectives:

The aim of the course is for students to acquire knowledge and skills in information systems project and change management, using both conventional and computer-based tools and techniques.

Learning outcomes

At the end of the course, students should be able to:

- discuss project and change management concepts and principles
- carryout requirements definition, estimation; quantitative IS project and scheduling methods
- analyze and Implement IS project organization
- carryout Risk management; Management of change and expectations
- apply tools and techniques in IS project management
- apply relevant management principles and techniques in IS project management

Course Synopsis

Project lifecycle, Project stakeholders, over view of project planning, reporting and control, The role of IT in organizational change, the role of IS specialists as change agents, Envision change and the change process, Diagnose and conceptualize change, IS implementation challenges, group/team dynamics, and leadership in the change process, Manage organizational politics, The limitations of projects as organizational change initiatives, Organizational influences on project success, issues associated to the success of IT projects.

Course Delivery

3 lecture hours

Modes of assessment:

CA and Examination

Reading (and other resources) list

1) Lewis James P, Fundamentals of Project Management: Developing Core Competencies to Help Outperform the Competition, 2001
2) James Cadle, Donald Yeates, Project Management for Information Systems, 5th Edition, Prentice Hall, 2007
3) Olson David L., Introduction to Information Systems Project Management; McGraw-Hill, 2001
4) Lewis James P. The Project Manager's Desk Reference: 2nd Edition, McGraw-Hill, 1999
5) Esther Cameron, Mike Green, Making Sense of Change Management: A Complete Guide to the Models, Tools & Techniques of Organizational Change, Kogan Page Publishers, 2004

Code	CSI627
Title	Decision Support Systems
Credits	3
Type	Optional
Semester in which the course is taught	2
Pre-requisites (if any)	None
Co-Requisites (if any)	None

Aims and Learning Objectives

The course presents up-to-date business intelligence solutions successful for integration of managerial decision-making and business information systems. Students will learn be exposed to the latest trends and progress in computer technology designed to support managerial decision-making.

Learning Outcomes

At the end of the course, students should be able to

- Discuss the needs of decision makers and be able to apply techniques and tools to support various phases of decision making process.
- Produce a simulated DSS through a development project.
- Apply data mining and warehousing techniques to a typical decision problem.

Course Synopsis

Business Decision Making; Decision Analysis and Models; DSS Optimization, DSS Development and Implementation Strategy; Data Mining and Warehousing with DSS; Decision under Risk and Uncertainty; Practical DSS project

Course Delivery
3 lecture hours

Modes of assessment
CA and Examination

Reading (and other resources) list

1. Turban Efraim, Aaronson Jay, Ting-Peng Liang, Ramesh Shada, Decision Support Systems and Business Intelligent Systems, Person Prentice hall, 8th Edition, 2007.
2. Panos M. Parlos, Multi-criteria Decision Making: A Comparative Study, Kluiwer Academic Publishers, 2000.
3. Theodor J. Stewart, Thomas Hann, Tomas Gal, Multicriteria Decision Making: Advances in MCDM Models, Algorithms, Theory and Application, Vol. 21 , 1999

Code	CSI 631
Title	Multimedia Computing Systems
Credits	3
Type	Optional
Semester	2
Pre-requisites	None
Co-Requisites	None

Aims and Learning Objectives

The aim of the course is equip students with advanced knowledge and skills in the theory and practice of Multimedia Computing Systems.

Learning Objectives

At the end of the course, students should be able to:

- discuss principles and concepts of multimedia computing systems
- Develop systems for running multimedia applications
- Develop practical skills for designing multimedia computing systems
- Use multimedia computing systems development tools

Course Synopsis

Multimedia data representation; data compression; media conversion and synchronization; multimedia storage and retrieval; authoring techniques; audio and video editing; 2-D and 3-D animation; distributed multimedia.

Course Delivery
3 lecture hours

Modes of assessment:
CA and Examination

Reading (and other resources) list

1. R. Steinmetz, K. Nahrstedt, Media Coding and Content Processing, Prentice Hall, 2002
2. e-resources

Code	CSI633
Title	Web Engineering
Credits	3
Type	Optional
Semester in which the course is taught	1
Pre-requisites (if any)	None
Co-Requisites (if any)	None

Aims and Learning Objectives

This course will equip students with the techniques and technologies used to produce high quality, reliable and usable web applications. It introduces systematic approaches utilized in software engineering which are adapted to provide software solutions for the internet.

Learning Outcomes

At the end of the course, students should be able to

- Apply software engineering techniques to analyze and design web applications
- Construct appropriate problem specific architecture for a web application
- Apply evaluation metrics for ensuring the proper operability, maintenance and security of web applications.
- Discuss emerging technologies and their potential application in web engineering

Course Synopsis

Web Engineering concepts and principles; Requirements and Design; architectures; Web Development Strategies, Tools and Applications; Web scripting; Integrated Web Application Development Environments; Web system quality; metrics, scalability, accessibility, cost estimation, performance measurement; Web content management; Security; Development Project.

Course Delivery
3 lecture hours

Modes of assessment
CA and Examination

Reading (and other resources) list

1. Kappel, G., Proll, B. Reich, S. and Retschitzegger, W., Web Engineering, 1st edition, Wiley & Sons, 2006
2. Xue Bai, Michael Ekedahl, Joyce Farrell, Don Gosselin, Diane Zak, The Web Warrior Guide to Web Programming, Thompson Publishing, 2003
3. e-resources

Code	CSI636
Title	Topics in Computing
Credits	3
Type	Optional
Semester	1
Pre-requisites (if any)	None
Co-Requisites (if any)	None

Aims and Learning Objectives

The aim of the course is to provide avenue for students to learn special and advanced topics or current issues in Computing

Learning Outcomes

At the end of the course, students should be able to:

- Acquire selected computer science/information systems knowledge and skills specified as per the course topics

Course Synopsis

Selected advanced/current topics in Computing

Course Delivery
3 lecture hours

Modes of assessment:
CA and/or Examination

Reading (and other resources) list:

1) According to the topic selection
2) e-Resources

Code	CSI691
Title	Data Warehousing
Credits	3
Type	Core
Semester	1
Pre-requisites (if any)	None
Co-Requisites (if any)	None

Aims and Learning Objectives:

The aim of the course is to introduce the main concepts and techniques of data warehousing and data mining and their applications.

Learning Outcomes
At the end of the course, students should be able to:

- Explain the main concepts and benefits associated with data warehousing
- Describe the processes, architecture and main components of a data warehouse
- Identify the issues associated with the integration of a data warehouse
- Design and build a Data Warehouse
- Explain the key features of OLAP applications
- Demonstrate the effective use of OLAP extensions of SQL
- Explain the concepts associated with data mining
- Describe different data mining algorithms
- Apply different data mining techniques to practical problems
- Identify research issues related to data warehousing and data mining

Course Synopsis:

Evolution of data warehousing and data mining; Data warehousing: concepts, architecture, data flows; Data warehousing technologies; data warehouse design: Integration and Meta-data warehousing issues; Developing and managing data marts; Distributed Data warehousing; OLAP and data warehousing; OLAP tools; Knowledge discovery and data mining.

Course Delivery
3 lecture hours

Modes of assessment:
CA and Examination

Reading (and other resources) list

1) W. H. Inmon. Building the Data Warehouse, 4th edition, Wiley; 2005
2) M. Kantardzic, Data Mining: Concepts, Models, Methods, and Algorithms, Wiley, 2003
3) e-resources

Code	CSI695
Title	Computing Research Methods
Credits	3
Type	Core
Semester	2
Pre-requisites (if any)	None
Co-Requisites (if any)	None

Aims and Learning Objectives:

The course aims at providing students with preparatory background for their first dissertation in the field of computing, equipping them with knowledge and skills required for undertaking research; conveying the culture and nature of research; and introducing them to necessary tools and techniques for executing computing research work.

Learning outcomes
At the end of this course, students should be able to:

- describe the process of research and development in computing;
- Use research tools and methods of research;
- Critique research articles;
- Give a professional presentation
- Write research articles.

Course Synopsis

This course introduces research methods in computer science and information systems. It explains the skills needed to successfully complete a research project in the field of computing, exposes students to ways of thinking about research, and teaches general skills for writing and experimentation. Topics include: the process of research, writing a research proposal, empirical/experimental research design and result analysis; writing and web skills; research and business presentations; research management, tools for experiments, and reading and assessing the literature.

Course Delivery
3 lecture hours

Mode of Assessment:
CA and/or Examination

Reading (and other resources) list

1. J. Zobel, Writing for Computer Science: The Art of Effective Communication, Springer-verlag, 2004.
2. P. D. Leedy, Practical Research: Planning and Design, 7th edition, Prentice Hall, 2001.
3. M. Graziano and M. L. Raulin, Research Methods, 5th edition, Pearson, 2004.
4. C.W. Dawson, The Essence of Computing Projects: A Student's Guide, Prentice Hall, 2000.

Code	CSI700
Title	Supervised Research and Dissertation
Credits	24
Type	Core
Semester	3 and 4
Pre-requisites (if any)	Completed second semester
Co-Requisites (if any)	None

Aims and Learning Objectives

The aim of this course is for the individual students to carry out independent research.

Learning Outcomes
At the end of the course, students should be able to:

- Carry out supervised research and dissertation
- Produce a publishable quality dissertation

Course Synopsis

Approved research topics

Course Delivery
Independent research

Modes of assessment:
By Internal/External Assessment

Reading (and other resources) list