**Haramaya University**

**VICE-PRESIDENT FOR ACADEMIC AFFAIRS**

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**Syllabi for Masters programs**

**Compiled By THE OFFICE OF ACADEMIC ProgramS Directorate**

**May 2020**

**Haramaya University**

**College of Computing and Informatics**

**Department of Computer Sciences**

**Program Name: Master of Science in Computer Science**

1. **Course Breakdown by Semester**

**Year I – Semester I**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Course Coode** | **Course Title** | **Cr Hr.** | **LecHr(s)** | **PracHr(s)** |
| CoSc501 | Design and Analysis of Algorithm | 3 |  |  |
| CoSc511 | Selected Topics in Computer Science | 3 |  |  |
| CoSc531 | Object-Oriented Software Development | 3 |  |  |
| CoSc541 | Distributed Systems | 3 |  |  |
| **Total** | | **12** |  |  |

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Course Coode** | **Course Title** | **Cr Hr.** | **LecHr(s)** | **PracHr(s)** |
| CoSc651 | Computer Security and Privacy | 2 |  |  |
| CoSc672 | Seminar in Computer Science | 1 |  |  |
| CoSc6X | Elective II | 3 |  |  |
| CoSc6X | Elective II | 3 |  |  |
| CoSc674 | Project (Proposal writing) | 0 |  |  |
| **Total** | | **9** |  |  |

**Year I - Semester Semester – II**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Course Coode** | **Course Title** | **Cr Hr.** | **LecHr(s)** | **PracHr(s)** |
| CoSc521 | Embedded Systems | 3 |  |  |
| CoSc571 | Research Methods in CS | 3 |  |  |
| CoSc561 | Artificial Intelligence | 3 |  |  |
| CoSc58X | Elective I | 3 |  |  |
| **Total** | | **12** |  |  |

*Semester-I* **ear II - Semester-II**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Course Coode** | **Course Title** | **Cr Hr.** | **LecHr(s)** | **PracHr(s)** |
| CoSc673 | Project | 3 |  |  |
| **Total** | | **3** |  |  |

1. **Course Description**

**Course Title:** Design and Analysis of Algorithm

**Course Code:** CoSc501

**Credit Hours:** 3

**Prerequisite(s):** None

**Course Description:** This course provides a comprehensive introduction to the modern study of computer algorithms. It discusses engineering issues in algorithm design, as well as mathematical aspects.

**Learning Outcomes:** On successful completion of the course students will be able to:

 Analyze a given algorithm.

 Compare and contrast different algorithms for the application of a given problem.

 Implement a given algorithm.

**Course Content:**

**Chapter One: Introduction to algorithms**

 Algorithms

 Analyzing algorithms

 Designing algorithms

**Chapter Two: Mathematical foundations**

 Growth of functions

 Summations

 Recurrences

 Sets and Graphs

 Counting and or probability

**Chapter Three: Sorting and order statistics**

 Heap sort

 Quick sort

 Sorting in linear time

 Median and order statistic

**Chapter Four: Data structures**

 Elementary data structures

 Hash tables

 Binary search trees

 Red black trees

 Augmenting data structures

**Chapter Five: Advanced design and analysis techniques**

 Dynamic programming

 Greedy algorithms

 Amortized analysis

**Chapter Six: Advanced data structures**

 B-Trees

 Binomial heaps

 Fibonacci heaps

 Data structures for disjoint sets

**Chapter Seven: Graph Algorithms**

 Elementary graph algorithms

 Minimum spanning trees

 Single source shortest paths

 All-pairs shortest paths

 Maximum flow

**Teaching Strategy:**This course will be offered through lectures, class discussions, laboratory work, programming and reading assignment.

**Method of Assessment**

This course is assessed by the project work, the assignments and a written examination. Both the project and assignment will be presented in the class, defended/demonstrated by the students and feedbacks will be given to them by the instructor and by other peer students in the class.

**Percentage Contribution to the Assessment**

 Project work: 20%

 Assignments: 20%

 Written Examinations: 60%

**Course Requirement:**

 Students are required to attend all lectures and lab sessions

 Students should group themselves into a group of (the number of students per project) for the project work and identify their own project titles for the projects work on project titles forwarded by the course instructor.

 Students will be required to submit a report of the project and should demonstrate the project to the instructor.

 Assignments will be given by the instructor.

 Students are expected to write a report on their assignment and will be required to present their work in the class. During such presentations of the Assignments, students will be required to respond to the questions that may be raised by their classmates and by their Instructor.

 Students should submit the report of every assignment according to the deadline and should make their presentations based on a schedule that will be set at the beginning of the assignment.

 Students should sit for the written examination.

**Reading Material:**

1. Thomas H.. Cormen, Charles Eric Leiserson, Ronald L. Rivest, and Clifford Stein.

Introduction to algorithms. Vol. 6. Cambridge: MIT press, 2001.

2. Vazirani, Vijay V. Approximation algorithms. Springer Science & Business Media, 2013.

3. Preparata, Franco P., and Michael Shamos. Computational geometry: an introduction.

Springer Science & Business Media, 2012.

4. "Self-adjusting Binary Search Trees." Journal of the AC*M* 32, no. 3 (July, 1985): 652-686.

ISSN: 0004-5411.

**Course Title: Selected Topics in Computer Science**

**Course Code: CoSc511**

**Credit Hours: 3**

**Prerequisite(s): None**

**Course Description:**

The motivation for this course lies in the interest in providing a broad viewpoint on Computer Science by surveying recent developments, major results, and hot topics in today’s leading- edge research in Computer Science. The main focus of this course is on topics of current interest in Computer Science.

**Learning Outcomes:**

On successful completion of the course students will be able to critically discuss current research topics in Computer Science.

**Course Content:**

The course will cover topics such as pervasive and grid computing, temporal data warehouse, aspect-oriented programming, open source software engineering, mobile computing, web engineering, Web Services, Big Data Analytics, etc.

**Teaching Strategy:**

 Student-centered, block teaching

 Self and collaborative learning

 Presentations and discussions of specific assignments

**Method of Assessment:**

This course is assessed by class room activities, a project and an examination. The project can be research paper presentation or a practical work.

**Percentage Contribution to the Assessment**

 Classroom activities: 10%

 Project: 40 – 50%

 Examination: 40 – 50%

**Course Requirements**

 Every student should attend all lectures.

 Students should submit every assignment according to the deadline.

 Students should present/demonstrate their assignments.

 Students should sit for the written examination.

**Reading Materials:**

Vary depending on the selected topics.

**Course Title:** Embedded Systems

**Course Code:** CoSc521

**Credit Hours:** 3

**Prerequisite(s):** None

**Course Description:** The course provides comprehensive overview of embedded systems, their characteristics and design constraints with particular emphasis on the software aspects. It also covers specific constraints imposed by real-time requirements, such as task scheduling, task synchronization, inter-task communication mechanisms, and memory management.

**Learning Outcomes**

On successful completion of the course students will be able to:

 Identify and evaluate processors and technologies for embedded systems development

 Critically understand the design issues associated with embedded software

 Discuss the software process for the development of real-time embedded systems and contrast it with development for a standard application.

 Specify architectural patterns for embedded systems.

 Discuss synchronization and communication in embedded systems

 Discuss concurrency and use of threads

 Discuss real time scheduling issues

 Implement a simple application on a Real Time Embedded System

**Course Content:**

**Chapter One: Embedded Software Development Overview**

 Introduction

 Embedded Software Development

**Chapter Two: The Embedded Platform**

 Embedded Systems Architecture

 Interrupts, Interfacing and Device Drivers

 Embedded Software Architectures

**Chapter Three: Real-Time Operating Systems (RTOS)**

 Review of Operating Systems Basics

 Task Scheduling

 Concurrency, Synchronization and Inter-process Communication

 Memory Management

**Chapter Four: Embedded Systems Programming**

 Models of Computation

 Testing and Debugging Embedded Systems

**Teaching Strategy:**

 Student-centered, block teaching

 Self and collaborative learning

 Presentations and discussions of specific assignments

**Method of Assessment:** This course is assessed by written exams, lab assignments, reports and presentations of assignments.

 **Assessment Breakdown:**

o Assignments: 10 – 20 %

o Laboratory work: 20 – 35%

o Written exams: 50

**Course Requirements:**

 Every student should attend all lectures.

 Students should group themselves into a group of (the number of students per project) for the project work and identify their own project titles for the projects work on project titles forwarded by the course instructor.

 Students should submit every assignment according to the deadline.

 Students should present/demonstrate their assignments.

 Students should sit for the written examination.

**Reading Materials**

1. An Embedded Software Primer, David E. Simon, Addison-Wesley Professional,2014

2. Laplante, P. A. (2004). Real-time systems design and analysis (p. xxi). New York:Wiley.

3. MicroC/OS-II, The real-time kernel, 2nd edition, CPM Books, 2002.

**Course Title:** Object-Oriented Software Development

**Course Code:** CoSc521

**Credit Hours:** 3

**Prerequisite(s):** None

**Course Description:** The course is about building large and complex software systems using object oriented approaches and techniques.

**Learning Outcomes:**

On successful completion of the course students will be able to:

 Describe objects, classes and OO approaches

 Construct modeling diagrams using UML

 Prepare developmental documents: RAD, SDD, ODD, TPD and UMD

 Develop and test software systems

 Develop team work spirit

**Course Content:**

**1. Overview**

 Software crisis

 Design approaches

 OO Software development activities

**2. Unified Modeling Language(UML)**

 Modeling concepts

 Modeling diagrams: use case, class, sequence, state chart , activity

**3. Requirements Elicitation**

 An overview of requirements elicitation

 Requirements elicitation activities: identifying actors, scenarios, use cases, objects

**4. Requirements Analysis**

 Analysis concepts

 Analysis activities: identifying entity, boundary and control objects, mapping use cases to objects

**5. System Design**

 System design concepts

 System Design activities: identifying subsystems, defining persistent data stores and access control, mapping subsystems to components

**6. Object Design**

 Design concepts

 Object design activities

**7. Implementation and Testing**

**Teaching Strategy:**

 Student-centered, block teaching

 Self and collaborative learning

 Presentations and discussions of specific assignments

**Method of Assessment:**

This course is assessed by a project and an examination. The project is a group work and assessed in 5 phases:

* + Phase 1: Requirements elicitation and analysis- students will produce requirements analysis document (RAD) of their project.
  + Phase 2: System and OO Design- students will produce system design document (SDD) including OO design of their project.
  + Phase 3: Implementation- students will implement their design.
  + Phase 4: Test plan document- students will produce test plan document (TPD) to test their system.
  + Phase 5: User manual- students will produce a user manual (UMD) for their system. Each phase will be demonstrated and defended by the students and feedbacks will be given to them by the instructor.

**Percentage Contribution to the Assessment:**

 Written examination: 25%

 Project: 75%

**Course Requirements:**

 Every student should attend all lectures.

 Students should group themselves into a group of (the number of students per project)

for the project work and identify their own project titles on the first day of the class.

 Students should submit every assignment according to the deadline.

 Students should present/demonstrate their assignments.

 Students should sit for the written examination.

**Reading Materials**

* + - * Gady Booch, Object-Oriented Analysis and Design with Applications, Addison- Wesley.
      * Waman S.Jawadekar, Software Engineering: Principles and Practice, tata MacGraw- Hill.
      * David William Brown, Object-Oriented Analysis, John Wiley.
      * Scott W.Ambler, The Object Primer, Cambridge University Press.

**Course Title: Research Methods in Computer Science**

**Course Code:** CoSc571

**Credit Hours:** 3

**Prerequisite(s):** None

**Course Description:** Research Methodology in Computer Science is designed to provide the knowledge of research methods and professionally research proposals / paper writings in computer science domain, its importance in real life and in organizations, especially in global techno-economic and competitive environment.

**Learning Outcomes:**

On successful completion of the course students will be able to

 Define the research in computer science and its allied scientific domains and dimensions

 Explain the different scientific steps in research methodology,

 Explain the Philosophy of computer research, its logical perceptions and integrated components

 Develop the notion of how to do high quality scientific research in computer science

 Acquire sound understanding of research steps in techno-economic domain to make research more relevant and market oriented.

 Acquire the advanced knowledge of latest practices in doing research

 Develop the research oriented environment amongst the budding technocrats and equip them with ethical aspects of research designs and dissemination

mechanism in Computer Science.

**Course Content:**

**1. Over view of Research**

 Introduction

 What is Computer Science Research?

 Dialectics of Research

 Models of Argument

 Proofs by Demonstration

 Empiricism

 Mathematical Proof

 Hermeneutics

 Research and its scope in computer science domain

 Technological value of research

 Types of research studies

**2. Tools of Research**

 The library and its resources as a tool of research

 The computer and its software as tool of research

 The human mind as a tool of research

**3. The Research Process in computer science**

 Identification and selection of a Research topic/problem

 Stating the research problem

 Evaluating the research problem

 Further dimensions of the research problems

 Ordering the topics in a research proposal

 Developing the hypothesis

 Determining research design

 Design sample and collect data

 Analyze and interpret the data

 Prepare the scientific research proposal report

**4. Review of the literature**

 Understanding the role of the review of literature

 Sources and strategies for locating related literature

 Evaluating, Organizing and documenting the information collected

 Evaluating, Organizing and documenting the information collected

 Different Levels of information

 Information sources

* + - Indexes and bibliographies
    - Dictionaries
    - Encyclopedias
    - Handbooks
    - Directories

 Searching bibliographic database

 Using search engines and online archives for searching the information on WWW

**5. Planning and writing the research proposal**

 Planning a general approach

 Planning data collection

 Linking data collection in research methodology

**6. Research methodology**

 Qualitative

 Quantitative

 Statistical techniques for analyzing quantitative data

**7. Research Design**

 What is research design?

 Essentials of research design

 Classification of research designs

* + - Action Research
    - Design research
    - Constructive research
    - Exploratory research
    - Secondary data analysis
    - Experience surveys
    - Focus groups
    - Two-stage designs
    - Descriptive studies
    - Experimentation

**8. Writing the research report**

 The preparatory or preliminary papers

* + - Letter of transmittal
    - The title page
    - Acknowledgements
    - Table of contents
    - List of tables
    - List of figures
    - Abbreviations or glossary of technical words used in the report
    - Abstractor summary of the entire report

 The body of the research report:

* + - Introduction
    - Literature review
    - Methodology
    - Findings (Results and Discussions)
    - Summary and
    - Conclusions and recommendations

 The Appended section:

* + - Appendix
    - Bibliography
    - Individual citation
    - Summary:
    - For books:
    - For Magazines, Journal Articles and Newspapers:

 Further Rules:

**Teaching Strategy:** The course will be offered through lectures, class discussions, Laboratory work, reading assignment.

**Method of Assessment:** The course will be assessed by writing assignment papers and written, oral examination.

**Assessment Breakdown:**

 Assignment: 60%

 Written exam 40%

**Course Requirement:** Students are required to attend lectures, lab sessions, seminars, discussions individually or in groups. Examination and assignments are compulsory. **Reading Material:**

* + - * Christian W. Dawson: Projects in Computing and Information Systems (A Student’s Guide). Addison Wesley, 2005.
      * Justin Zobel: Writing for Computer Science. Springer, 2004.
      * Paul D. Leedy, Jeanne Ellis Ormrod: Practical Research Planning and Design, 8th edition, Pearson, 2005
      * Miller, Casey, and Kate Swift, The Handbook of Nonexist Writing, Harper and Row.

**Course Title:** Distributed Systems

**Course Code:** CoSc541

**Credit Hours:** 3

**Prerequisites:** None

**Course Description:** This course is intended to introduce to students the current developments in distributed systems, their construction, issues that are involved in building reliable distributed systems, and possible applications of distributed systems.

**Learning Outcomes:**

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

 Understand issues in developing distributed systems

 Explain how communication is handled in distributed systems

 Realize issues and difficulties in clock synchronization over several machines

 Learn the different methods that are used in handling consistency and replication and how fault tolerant systems are built

**Course Content**

**1. Introduction**

 Introduction and Definition

 Goals of a Distributed System

 Types of Distributed Systems

**2. Architectures**

 Architectural Styles

 System Architectures

**3. Processes**

 Threads and their Implementation

 Anatomy of Clients

 Servers and Design Issues

 Code Migration

**4. Communication**

 Network Protocols and Standard

 Remote Procedure Call

 Message-Oriented Communication

 Stream-Oriented Communication

 Multicast Communication

**5. Naming**

 Names, Identifiers, and Addresses

 Flat Naming

 Structured Naming

 Attribute-Based Naming

**6. Synchronization**

 Clock Synchronization

 Logical Clocks

 Mutual Exclusion

 Election algorithms

7. **Consistency and Replication**

 Reasons for Replication

 Data-Centric Consistency Models

 Client-Centric Consistency Models

 Replica Management

 Consistency Protocols

**8. Fault Tolerance**

 Introduction to Fault Tolerance

 Process Resilience

 Reliable Client-Server Communication

 Reliable Group Communication

 Distributed Commit

 Recovery

**Teaching Strategy:**

 Modular, student-centered class lectures and lab work

 Independent and group learning

 Presentations and discussions of specific assignments

**Method of Assessment:**

- Written exams, lab assignments, reports and presentations of assignments.

**Course Requirements:**

Students are required to attend all lectures and lab sessions, do their reading and lab assignments individually or in groups as the case may be and submit on time, make presentations of assignments, read all reading materials provided and/or referred, and sit for all exams.

**Reading Materials:**

* + - * S. Tanenbaum and Maarten van Steen, Distributed Systems, Principles and Paradigms, Prentice Hall, 2nd edition, 2006.
      * Coulouris, J. Dollimore, and T. Kindberg, Distributed Systems, Concepts and Design, Addison Wesley, 4th edition, 2005.
      * S. Mullender, Distributed Systems Concept and Design, 5nd edition, Pearson.

**Course Title:** Computer Security and Privacy

**Course Code:** CoSc651

**Credit Hours:** 2

**Prerequisite(s**): None

**Course Description:** The course is about fundamentals of computer security, privacy, the importance of security for computer systems, protection schemes and policy, network security concepts and mechanisms, public and private key encryption techniques, network layers security, computer forensics, legal and policy issues, viruses and worms, web security, programming security.

**Learning Outcomes:**

 On successful completion of the course students will be able to:

 Describe elements of computer security and privacy

 Investigate the degree of vulnerability of a computing environment to security threats

 Identify computer security threats in a computing environment and prepare the necessary counter measures for protection

 Deploy security techniques like encryption, cryptography, access control, firewall, etc.

 Develop computer security and privacy policies, procedures and guidelines for a computing environment.

 Develop team work spirit and communication skills

**Course Content:**

1. Fundamentals of computer security & privacy

o Overview, history, vulnerabilities, countermeasures, physical security

2. Computer security threats

o Viruses, Worms, Trojan horses, Crackers, Spy-wares …

3. Security Techniques

o Encryption, cryptography, access control, firewall, …

4. Network security concepts and mechanisms

o Software security mechanisms, programming techniques

5. Secure system planning and administration

- Analysing risks, planning, policies and procedures

6. Computer forensics

7. Legal, ethical and policy issues

**Teaching Strategy:**

* + - * Student-centered, block teaching
      * Self and collaborative learning
      * Presentations and discussions of specific assignments

**Method of Assessment:**

This course is assessed by a group project, individual assignments, and examination. Each group project will be presented in the class, defended/demonstrated by the students and feedbacks will be given to them by the instructor and by other peer students in the class.

**Percentage Contribution to the Assessment:**

* + - * Written examination (final): 50%
      * Group project: 30%
      * Individual Assignment: 20%

**Course Requirements:**

 Every student should attend all lectures.

 Students should group themselves into 3 for the project work and identify their own project titles from the list of categories of topics that will be provided by the instructor.

 Students should submit every assignment and project work according to the deadline.

 Students should present/demonstrate their work.

 Students should sit for the written examination.

**Reading Materials:**

* + - * C. Easttom, Computer Security Fundamentals, Prentice Hall, May 2005.
      * W. Stallings, Network Security Essentials, 2nd edition, Prentice Hall, 2003.
      * L. Fennelly, Effective Physical Security, Butterworth-heinemann, 2003.
      * E. Michael, Physical Security for IT, Digital Pr, 2004.
      * M. Bishop, Computer Security: Art and Science, Addison-Wesley, 2002.
      * S. Bosworth and M. E. Kabay, Computer Security Handbook, 4th edition, Willey, 2002.
      * S. A. Thomas, SSL and TLS Essentials: Securing the Web, Wiley, 2000.
      * R. J. Anderson, Security Engineering, Ross Anderson, John Wiley & Sons Inc., 2008.

**Course Title:** Artificial Intelligence

**Course Code:** CoSc561

**Credit Hours:** 3

**Prerequisite(s):** None

**Course Description:** This course aims to provide advanced background on Artificial Intelligence. It provides the basic concepts of AI to apply it to a pattern recognition and Natural Language Processing problem.

**Learning Outcomes:**At the end of this course, students will be able to

 Understand the scope of Artificial Intelligence.

 Understand the application areas of Artificial Intelligence.

 Explain Artificial Intelligence as representation and search problem.

 Explain Connectionist theory in terms of Artificial Intelligence domain.

**Course Content:**

1. Introduction to Artificial Intelligence (AI): Roots and Scope of AI, Definition, Turing

Test, Application Areas of AI

2. AI as Representation and Search: Predicate Calculus, Structures and Strategies for State Space Search, Heuristic Search, Control and Implementation of State Space Search

3. Representation and Inference: Knowledge Representation, Strong Methods for Problem

Solving, Reasoning in Uncertain Situations

4. Machine Learning:

 Symbol-Based: Framework for Symbol Based Learning, Version Space Search, ID3 Algorithm, Un-supervised learning, Reinforcement Learning

 Connectionist: Perceptron Learning, Backpropagation Learning, Competitive

Learning, Hebbian Coincidence Learning, Attractor Networks

5. Advanced Topics of AI Problem Solving:

 Automated Reasoning: Weak Methods in Theorem Proving, GPS and Difference

Table, Resolution for Theorem Proving, Automated reasoning with PROLOG

 Understanding Natural Language: Role of Knowledge, Symbolic Analysis, Syntax, ATN Parsers, Stochastic Tools for Language Analysis, Natural Language Applications

**Teaching Strategy:** This course will be offered through lectures, presentations, class discussions, laboratory work and Group project work. Students present their assignments, and get feedbacks.

**Method of Assessment:** This course is assessed by written exams, lab assignments, reports and presentations of assignments.

 **Assessment Breakdown:**

o Assignments: 20 – 30%

o Written examination: 35 – 50%

o Practical Project: 35 – 50%

**Course Requirement:**

 Every student should attend all lectures.

 Students should group themselves for the project work.

 Students should submit every assignment according to the deadline.

 Students should present/demonstrate their assignments.

 Students should sit for the written examination.

**Reading Material:**

* + - * "Artificial Intelligence Structures and Strategies for Complex Problem Solving", George F. Luger, 4th Edition, Pearson Education , 2003.
      * "Artificial Intelligence", Knight, Tata McGraw Hill
      * "Artificial Intelligence a Modern Approach" Russell & Norvig, second edition, Pearson Education, 2003.

**Course Title: Seminar in Computer Science**

**Course Code:** CoSc672

**Credit Hours:** 1

**Prerequisite(s):**None

**Course Description:** This course is intended to provide a skill in reviewing recently published works and prepare review report in a selected area of Computer Science.

**Learning Outcomes:** On successful completion of the course students will be able to critically review and discuss computer science articles.

**Course Content:**

 Students critically and scientifically evaluate published works in current research issues and results in selected areas of Computer Science.

**Teaching Strategy:**

 The instructor will decide on the area of emphasis and will avail published research papers to the students. Students, in groups or individually, critically and scientifically review published papers, prepare well-written reports and present their findings in a class.

Method of Assessment:

 This course is assessed by class room activities, written report and presentation.

**Percentage Contribution to the Assessment:**

 Class Room Activities: 10%

 Review report: 60%

 Presentation: 30% Course Requirements:

 Every student should attend all seminar classes.

 Students should submit their review report according to the deadline.

 Students should present their paper reviews.

**Reading Materials:**

 Vary depending on the seminar topics.

**Course Title:** Natural Language Processing

**Course Code:** CoSc581

**Credit Hours**: 3

**Prerequisite(s):** None

**Course Description:** This course is an introduction to natural language processing - the study of human language from a computational perspective and designed to get students up to speed of with the current research in the area. It covers morphology, syntactic, semantic and pragmatic processing models, emphasizing statistical or corpus-based methods and algorithms. It also covers applications of these methods and models in syntactic parsing, information extraction, statistical machine translation, dialogue systems, and summarization.

**Learning Outcomes:** On successful completion of the course students will be able to explain and apply fundamental algorithms and techniques in the area of natural language processing (NLP). In particular, students will:

 describe major trends and systems in Natural Language Processing;

 define: morphology; syntax; semantics; pragmatic processing; and give appropriate examples to illustrate their definitions;

 describe approaches to syntax and semantics in NLP;

 describe approaches to pragmatic, generation, dialogue and summarization within NLP;

 describe current corpus-based methods to NLP;

 describe statistical techniques as applied within NLP;

 describe an application of natural language processing (for instance machine translation, information retrieval) and show the place of syntactic, semantic and pragmatic processing.

**Course Content:**

1. Natural Language Processing: Background and Overview

2. Lexical semantics and word-sense disambiguation

3. Morphology

4. Parsing and Syntax

5. Semantic analysis

6. Pragmatic Processing

7. Natural Language Generation/Summarization

8. Statistical/corpus-based NLP

9. Information extraction

10. Machine Translation

**Teaching Strategy:**

 Student-centered, block teaching

 Self and collaborative learning

 Presentations and discussions of specific assignments

**Method of Assessment:**

 This course is assessed by a project and an examination.

**Percentage Contribution to the Assessment:**

 Written examination: 50%

 Practical Project: 50%

**Course Requirements:**

 Every student should attend all lectures.

 Students should group themselves for the project work.

 Students should submit every assignment according to the deadline.

 Students should present/demonstrate their assignments.

 Students should sit for the written examination.

**Reading Materials:**

* + - * Jurafsky, David, and James H. Martin. Speech and Language Processing: An -Introduction to Natural Language Processing, Computational Linguistics and Speech Recognition. Upper Saddle River, NJ: Prentice-Hall, 2000.
      * Dale, R., Moisl, H., & Somers, H. (Eds.). (2000). Handbook of natural language processing. CRC Press.
      * Indurkhya, N., & Damerau, F. J. (Eds.). (2010). Handbook of natural language processing (Vol. 2). CRC Press.

**Course Title:** Software Architecture and Design Pattern

**Course Code:** CoSc582

**Credit Hours: 3**

**Prerequisite(s):** None

**Course Description:** Software architecture has emerged as the central theme over which all large scale software is built. It is the algorithmic counterpart for large scale software. This course deals with problem of identifying the concept of architecture and other topics covered are Architecture Documentation, Architecture Evaluation, and Product Lines Enterprise Architecture.

**Learning Outcomes:** The learning objectives for the course are the following:

 Develop and evaluate software architectures

 Select and use appropriate architectural styles

 Select and use appropriate software design patterns

 Express the specifications and design of an application using UML

 Specify parts of the design using a formal design language (OCL)

 Ability to design and apply existing software patterns

 Ability to use the software design tool in an integrated environment

**COURSE CONTENT**

1**. Introduction to Software Architecture**

1.1 Roles and Team,

1.2 Viewpoint Considerations of the Software Architect & Terminology

1.3 Software Architecture Principles

1.4 System Structures

Workshop: Patterns and Anti-Patterns Research Assignment

2**. The 4+1 View of Software Architecture**

2.1 Examples of Software Architecture

2.2 Architecture Design

2.2.1 Quality attributes

2.2.2 Attribute Driven Design

2.3 Documenting Software Architecture Stakeholders, Views, Viewsets, View-based documentation

**3 Architecture Description Languages**

3.1 Architecture Evaluation

3.2 Product line architectures

3.3 Enterprise Architecture

3.4 Architecture Knowledge Management

`

4. **Architectural Process, Methods and Artifacts**

4.1 Modeling

4.2 Applying Design Patterns

4.3 Code Quality Analysis

4.4 Design Patterns Selection and Application

**5 Architecture Centric Software Development Methodology**

5.1 Software Architecture Governance

5.2 Working with other Architects

5.3 SDLC - What it means to the Software Architect

5.4 Professional Growth and Mentoring

6**. Software Design Patterns From GoF**

6.1 Creational Patterns

6.2 Structural Patterns

6.3 Behavioral Patterns

6.4 Software Architectural Patterns

6.5 Layer, Pipe and Filters and Black Board

**7. Software Construction**

7.1 Application Development and Visualization

7.2 Programming Patterns

7.3 Software Construction

7.4 Technology Platforms

**Teaching Strategy:**

 Student-centered, block teaching

 Self and collaborative learning

 Presentations and discussions of specific assignments

**Method of Assessment:** This course is assessed by written exams, lab assignments, reports and presentations of assignments.

 **Assessment Breakdown:**

o Assignments: 10 – 20 %

o Laboratory work: 20 – 35%

o Written exams: 50

**Course Requirements:**

 Every student should attend all lectures.

 Students should group themselves into 3 for the project work and identify their own project titles from the list of categories of topics that will be provided by the instructor.

 Students should submit every assignment and project work according to the deadline.

 Students should present/demonstrate their work.

 Students should sit for the written examination.

**Reading Materials:**

* + - * Design Patterns: Elements of Reusable Object-Oriented Software, Erich Gamma, Richard Helm, Ralph Johnson, and John Vlissides, Addison-Wesley.
      * Software Architecture in Practice, Len Bass, Paul Clements, Rick Kazman.
      * Documenting Software Architectures: Views and Beyond Paul
      * Object-Oriented Design with Applications (Second Edition) by Grady Booch.
      * UML Distilled – Third Edition by Martine Fowler, Addison Wesley

**Course Title: Mobile Computing**

Course Code: CoSc586

Credit Hours: 3

**Prerequisite(s):** None

**Course Description:** This course will introduce students to mobile computing and mobile application development. Mobile computing will be discussed from three perspectives: mobile technology, application development, and user interaction. The course will first overview various mobile computing applications, technologies and wireless communication. Next, students will learn about common paradigms in mobile computing such as low power computing, computing in an environment with limited resources, fault tolerance, and persistence. Students will be introduced to and use mobile application frameworks and development environments to reinforce concepts covered in lectures. User interface and user experience will be discussed and application development guidelines from various vendors will be discussed and analyzed. Lastly, the course will look at some current research in mobile computing. Students will be expected to learn at least one mobile application development framework and use it to implement their assignments and course project.

**Course Contents:**

1. **Introduction**:

 Basic Concepts in Mobile Computing and mobility impact on Computing

 Medium Access Control: Motivation for Specialized MAC - SDMA - FDMA - TDMA - CDMA - Comparison of Access mechanisms - Tele communications: GSM - DECT - TETRA - UMTS - IMT - 200 - Satellite Systems: Basics - Routing

- Localization - Handover - Broadcast Systems: Overview - Cyclic Repetition of

Data - Digital Audio Broadcasting - Digital Video Broadcasting.

2. **Wireless Networks**:

 Wireless LAN: Infrared Vs Radio Transmission - Infrastructure Networks - Ad hoc Networks - IEEE 802.11 - HIPERLAN - Bluetooth - Wireless ATM: Working Group - Services - Reference Model - Functions - Radio Access Layer - Handover

- Location Management - Addressing Mobile Quality of Service - Access Point

Control Protocol.

3. **Mobile Network Layer**:

 Mobile IP: Goals - Assumptions and Requirement - Entities - IP packet Delivery - Agent Advertisement and Discovery - Registration - Tunneling and Encapsulation

- Optimization - Reverse Tunneling - IPv6 - DHCP - Ad hoc Networks.

4. **Mobile Transport Layer**:

 Traditional TCP - Indirect TCP - Snooping TCP - Mobile TCP - Fast retransmit/ Fast Recovery – Transmission / Timeout Freezing - Selective Retransmission -

Transaction Oriented TCP.

5. **WAP:**

 Architecture - Datagram Protocol - Transport Layer Security - Transaction Protocol

- Session Protocol - Application Environment - Wireless Telephony Application.

**6. Ad Hoc Network Architecture and Capacity**

 Mobile Ad Hoc Routing

**7. OS Mobility Support, Mobile OS case study**

 Software design for Mobile devices, e.g., Android and iOS platforms.

**8. IEEE Standards (**[**802.11 a/b/g/n)**](http://en.wikipedia.org/wiki/IEEE_802.11) **used for WLAN & Wi-Fi**

**Teaching Strategy:**

 Student-centered, block teaching

 Self and collaborative learning

 Presentations and discussions of specific assignments

**Method of Assessment:** This course is assessed by written exams, lab assignments, reports and presentations of assignments.

 **Assessment Breakdown:**

o Assignments: 10 – 20 %

o Laboratory work: 20 – 35%

o Written exams: 50

**Course Requirements:**

 Every student should attend all lectures.

 Students should group themselves into 3 for the project work and identify their own project titles from the list of categories of topics that will be provided by the instructor.

 Students should submit every assignment and project work according to the deadline.

 Students should present/demonstrate their work.

 Students should sit for the written examination.

**Reading Materials:**

1. J. Chiller, **“Mobile Communication”**, Addison Wesley, 2000.

2. William Stallings, **“Wireless Communication and Networks”**, PHI/ Pearson Education,

2003.

3. Singhal **“WAP-Wireless Application Protocol**”, Pearson Education, 2003.

4. Asoke K Talukder, Roopa R Yavagal, **“Mobile computing”,** TMG, 2006.

5. Mark Grayson, Kevin Shatzkamer, and Klaas Wierenga, **Building the Mobile Internet,**

Cisco Press; February 2011, ISBN-13: 978-1587142437. .

6. Shane Conder and Lauren Darcey, Androidâ„¢ **Wireless Application Development,**

Second Edition Addison-Wesley Professional, December 2010 ISBN-13: 978-0-321-

74301-5;

**Course Title:** Computer Vision and Image Processing

**Course Code:** CoSc684

**Credit Hours: 3**

**Prerequisite(s):** None

**Course Description:** This course is designed to give students all the fundamentals in 2-D digital image processing with emphasis in image processing techniques, image filtering design and applications.

**Learning Outcomes:** On successful completion of this course, students will:

 Have a clear understanding of the principals the Digital Image Processing terminology used to describe features of images.

 Have a good understanding of the mathematical foundations for digital manipulation of images; image acquisition; preprocessing; segmentation; Fourier domain processing, compression and analysis.

 Be able to write programs using Matlab language for digital manipulation of images; image acquisition; preprocessing; segmentation; Fourier domain processing; and compression.

 Have knowledge of the Digital Image Processing Systems.

 Be able to understand the documentation for, and make use of, the MATLAB library and

MATLAB Digital Image Processing Toolbox (IPT).

 Learn and understand the Image Enhancement in the Spatial Domain.

 Learn and understand the Image Enhancement in the Frequency Domain.

 Understand the Image Restoration, Compression, Segmentation, Recognition, Representation and Description.

**Course Content:**

1. **Introduction**

 Elements of visual perception

 Image sensing and acquisition

 Image sampling and quantization

 Linear and nonlinear representation

 Digital image representation

2. **Image Enhancement**

 Enhancement in spatial domain

i. Grey level transformation ii. Histogram processing

iii. Smoothing and sharpening Spatial filters

 Enhancement in frequency domain i. Fourier transform

ii. Smoothing and sharpening frequency domain filtering iii. Homomorphism filtering

3. **Morphological Image processing**

 Dilation and Erosion

 Morphological algorithms

4. **Image segmentation**

 Detection of discontinuities

 Boundary detection

 Thresholding

5. **Object recognition**

 Patterns and pattern classes

 Decision Theoretic Methods

 Structural Methods

**6. OCR Identification**

**Teaching Strategy:** The course will be delivered in the form of lectures, demonstration, seminars, student presentations, group discussions, and individual and group project works. **Assessment Method:** The evaluation shall be based on both formative and summative assessment which includes:

 **Lecture:**

**i.** Quizzes / Test / Assignments / others 20 %

**ii.** Mid Examination 20%

**iii.** Final Examination 30%

 **Practice:**

**i.** Project 30%

**Course requirement:**

 Students should:

 Attend lectures and lab session

 Work in team on group work

 Participate in group discussion

 Discusses with the instructor on topics of interest for project work.

 Deliver and presents project work.

 Attend quiz, midterm and final examination.

**Reading Materials:**

* + - * Gonzalez, R. C. and Woods, R. E. 2002/2008, Digital Image Processing, 2nd/3rd ed., Prentice Hall
      * Sonka, M., Hlavac, V., Boyle, R. Image Processing, Analysis and Machine Vision (2nd edition), PWS Publishing, or (3rd edition) Thompson Engineering, 2007
      * Gonzalez, R. C., Woods, R. E., and Eddins, S. L. [2009]. Digital Image Processing Using MATLAB, 2nd ed., Gatesmark Publishing, Knoxville, TN.
      * Anil K. Jain 2001, Fundamentals of digital image processing (2nd Edition), Prentice-Hall, NJ
      * Willian K. Pratt [2001], Digital Image Processing (3rd Edition), , John Wiley & Sons, NY
      * Burger, Willhelm and Burge, Mark J. [2008]. Digital Image Processing: An Algorithmic Introduction Using Java, Springer

**Course Title:** Cryptography and Network Security

**Course Code:** CoSc684

**Credit Hours:** 3

**Prerequisite(s):** None

**Course Description:** This course focuses on the mathematical concepts and techniques behind the state-of-the-art information encryption and network security technologies. Also covered are the security threats and their possible countermeasures, secure protocols, and other network security related schemes (authentication, key management, etc.).

**Course Content:**

**1. Introduction:** What is Security? Threats (eavesdropping, tampering, impersonation, repudiation, denial of service, illegal access), Mechanisms (confidentiality, integrity, auditing, authentication, access control). **Cryptography:** terms, outline, symmetric cryptography, asymmetric cryptography, integrity, digital signatures, authentication, hash algorithms

**2. Secret Key Cryptography:** Block encryption, transformations, substitutions, permutations, decryption

DES: overview, DES rounds, S-Boxes

IDEA: overview, comparison with DES, key expansion, IDEA rounds

Skipjack: history, overview

Uses of Secret Key Cryptography: ECB, CBC, FOB, CF, Multiple encryption DES

**3. Hash Functions and Message Digests:** length of hash, uses, algorithms (MD2, MD4, MD5, SHS)

MD2: algorithm (padding, checksum, passes)

MD4&5: algorithm (padding, stages, digest computation) SHS: overview, padding, stages

**4. Public Key Cryptography:** algorithms, examples, modular arithmetic (addition, multiplication, inverse, exponentiation)

RSA: generating keys, encryption and decryption

Other Algorithms: PKCS, Diffie-Hellman, El-Gamal signatures, DSS, Zero-Knowledge

Signatures

**5. Authentication:** Password Based, Cryptographic Authentication, Passwords: in distributed systems, on-line vs off-line guessing, storing

Cryptographic Authentication: passwords & keys, protocols, KDCs, Certification

Authorities, CAs vs. KDCs, Certification Revocation, Inter-domain, groups, delegation

Authentication of People: Verification techniques, passwords, length of passwords, password distribution, smart cards, biometrics

**6. Public Key Infrastructure:** what is PKI, certificates, directories, cross-certification of domains in PKI, X.500 directories and X.509 certificates

**7. Security Policy:** What is security policy, high and low level policy, user issues

**8. Security Handshake Pitfalls:** protocol problems, assumptions, shared secret protocols, public key protocols, mutual authentication, reflection attacks, use of timestamps, nonces and sequence numbers, session keys, one- and two-way public key based authentication

**9. Example System: Kerberos:** purpose, authentication, server and ticket granting server, keys and tickets, use of AS and TGS, replicated servers

Kerberos V4: names, inter-realm authentication, key version numbers

Kerberos V5: names, realms, delegation, forwarding and proxies, ticket lifetimes, revoking tickets, multiple realms

**10. Access Control:** principles, subjects and objects, review of access control matrix, access control lists and capabilities

Lattice Based Access Control: information flow policies, military lattice, Bell-La

Padula model, Chinese Wall lattice

Role-Based Access Control: users, roles & permissions, relation to organizational structure, role inheritance, active vs allowed roles, permission conflict, positive and negative permissions, attributes, expressing RBAC policies, managing RBAC

**11. Network Security:** IP security, Firewalls, Intrusion Detection

**12. Security for electronic commerce:** SSL, SET.

**Method of Assessment:** This course is assessed by Written exams, lab assignments, reports and presentations of assignments.

 **Assessment Breakdown:**

 Assignments: 30 – 50%

 written exam: 50 – 70%

**Course Requirement:**

 Every student should attend all lectures.

 Students should group themselves into 3 for the project work and identify their own project titles from the list of categories of topics that will be provided by the instructor.

 Students should submit every assignment and project work according to the deadline.

 Students should present/demonstrate their work.

 Students should sit for the written examination.

**Reading Material:**

* + - * Kaufman, C., Perlman, R., & Speciner, M., .Network Security, Private Communication in a Public world, 2nd ed., Prentice Hall PTR., 2002
      * Stallings, W., .Cryptography and Network Security: Principles and Practice, 3rd ed., Prentice Hall PTR., 2003
      * Stallings, W., Network Security Essentials: Applications and Standards, Prentice Hall, 2000
      * Kruse, W.G. & Heiser, J.G., Computer Forensics: Incident Response Essentials, Addison Wesley, 2002

**Course Title:** Machine Learning and Intelligent Systems

**Course Code:** CoSc684

**Credit Hours: 3**

**Prerequisite(s):** None

**Course Description:** Machine Learning and mining of massive datasets are rapidly growing fields of data analysis. For many years data analysis and statistical community has been developing algorithms and methods for discovering patterns in datasets. Besides theoretical knowledge successful research in the areas depends on confided usage of common methods, algorithms and tools along with skills for developing new ones. The focus of this course is to introduce students to methods and modern programming tools and frameworks aimed for data analysis. Special attention is given to methods for handling massive datasets.

**Learning Outcomes:** On the successful completion of the course the students will be able to:

 acquire knowledge about a wide range of machine learning algorithms, understanding their differences and connections;

 understand complexity of Machine Learning algorithms and their limitations;

 understand modern notions in data analysis oriented computing;

 capable of confidently applying common Machine Learning algorithms in practice and implementing their own;

**Course Content:**

**1. Introduction to methods for Machine Learning**

 Introduction to methods for Machine Learning

 Overview of modern technologies,

 Problem examples and basic tasks.

**2. Elementary Machine Learning Algorithms**

 Inferring Rudimentary Rules

 Statistical Modeling

 Divide-and-Conquer: Constructing Decision Trees

 Covering Algorithms: Constructing Rules

 Mining Association Rules

 Linear Models

**3. Real Machine Learning Schemes**

 Decision Trees

 Classification Rules

 Association Rules

 Extending Linear Models

 Instance-Based Learning

 Numeric Prediction with Local Linear Models

 Bayesian Networks

 Clustering

 Semi supervised Learning, Multi-Instance Learning

**4. Ensemble Learning**

 Combining Multiple Models

 Bagging

 Randomization

 Boosting

 Additive Regression

 Interpretable Ensembles

 Stacking

**5. Introduction to the Weka Machine Learning Software**

 Evaluating Machine Learning Results

**Teaching Method:** The course will be delivered in the form of lectures, demonstration, student presentations, group discussions, and individual and group project works.

**Assessment Method:**

The evaluation shall be based on both formative and summative assessment which include:

 **Lecture:**

* Quizzes / Test / Assignments / others 20%
* Mid Examination 20%
* Final Examination 40%

 **Practice**

 Project 20 % **Course Requirements:** Student should:

Attend lectures, lab session and presentation, work in team on group work, participate in group discussion, discusses with the instructor on topics of interest for project work, delivers and presents project work, seminars, and final examination.

**Reading Materials:**

* + - * Witten, E. Frank, M. Hall. Data Mining: Practical Machine Learning Tools and Techniques, 2011, 3rd Edition, Morgan Kaufmann Publishers
      * Jure Leskovec, Anand Rajaraman, and Jeffrey David Ullman. Mining of massive datasets. Cambridge University Press, 2014.
      * Peter Flach Machine Learning: The Art and Science of Algorithms that Make Sense of Data, Cambridge University Press, 2012
      * Christopher M Bishop. Pattern recognition and machine learning. Springer, 2006
      * Trevor J.. Hastie, Robert John Tibshirani, and Jerome H Friedman. The elements of statistical learning: data mining, inference, and prediction. Springer, 2009

**Course Title:** Thesis

**Course Code:** CoSc673

**Credit Hours:** 6 credit hours

**Prerequisite(s):** Completion of the two-semester core courses

**Course Description:** This course is intended to provide a practical skill in carrying out research and documenting and presenting the findings in a selected area of Computer Science.

**Learning Outcomes:** At the end of this course, students will be able to

 know how to read and understand published papers and other materials related to the thesis title

 understand and apply issues related to research in Computer Science

 write technical reports in the form of journal and workshop papers and thesis

 present and defend research findings

**Course Content:**

 The student investigates an original work including a study of its possible implications, its potential applications, and its relationship to previous related works reported in the literature. Contributions and results from this investigation are synthesized and compiled into a thesis presenting the new idea and presented to an examining committee, to be organized by the Department, and any interested audience.

**Teaching Strategy:**

 Individual investigation of significant areas of Computer Science; Guided study and research working closely with a faculty member.

**Method of Assessment:** The assessment is based on two aspects: content of the thesis and defense in front of an examination committee. Issues that will be considered for the content of the thesis are

 Problem formulation and methodology

 Prototype or data presentation and interpretation

 Literature coverage

 Format and overall organization

The defense considers presentation skills and response to questions.

**Course Requirements:**

A student intending to take this course must select a topic and submit a proposal to the

Department, approved by his/her adviser, and defend the proposal for a final approval by the

Department. After approval, a student is required to fully engage himself/herself in the research by seeking advice from his/her advisor(s).

**Reading Materials:**

 Articles published in journals and conference proceedings related to the area of the title of the thesis, books, reading materials from the Web, etc.

**Course Title:** Project

**Course Code:** CoSc674

**Credit Hours:** 3

**Prerequisite(s):** Completion of the two-semester core courses

**Course Description:** This project is intended to provide a practical skill in carrying out project, documenting and presenting the results in particular local problem areas.

**Learning Outcomes:** At the end of this course, students will be able to

 know how to read and understand published papers and other materials related to the project title

 write technical reports in the form of journal and workshop papers and project

 present and defend project results

**Course Content:**

 Through the project the student crystallizes the concepts, techniques and methodologies encountered throughout the curriculum. Problems pursued under this framework may be predominantly analytical, involving exploration and extension of theoretical structures, or may pivot around the design/development of solutions for particular applications drawn from areas throughout the University and/or community. Contributions and results from this undertaking are compiled into a project report.

**Teaching Strategy:**

 Individual implementation of a substantive project involving one or more application areas; Guided study and project working closely with a faculty member.

**Method of Assessment:** The assessment is based on two aspects: content of the project and defense in front of an examination committee. Issues that will be considered for the content of the project are

 Problem formulation and methodology

 Prototype or data presentation and interpretation

 Literature coverage

 Format and overall organization

The defense considers presentation skills and response to questions.

**Course Requirements:**

 A student intending to take this course must select a topic and submit a proposal to the

Department, approved by his/her adviser, and defend the proposal for a final approval by the Department. After approval, the student is required to fully engage himself/herself in the project by seeking advice from his/her advisor(s).

**Reading Materials**

 Articles published in journals and conference proceedings related to the area of the title of the project, books, reading materials from the Web.

**Department: Information Science**

**Name of the Program**

1. **Course Breakdown By Semester**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Topics/Areas** | **Code** | | **Core Courses** | **Cr.**  **hrs** |
| **Year I, Semester I** | | | | |
| **Fundamentals** | INFO 511 | | Foundations of Information Science | 3 |
| **Management** | INFO 561 | | Management of Information Services and  Systems | 3 |
| **Information Processing and**  **Retrieval** | INFO 531 | | Information Storage and Retrieval (advanced level) | 3 |
| **Electronic communication/communication** | INFO 532 | | Scholarly Communication | 3 |
| **Total Cr. hrs** | | | | **12** |
|  | | | |  |
| **Year I, Semester II** | | | | |
| **Digital libraries** | INFO 551 | Digital Libraries (Advanced level) | | 3 |

|  |  |  |  |
| --- | --- | --- | --- |
| **Policy** | INFO 571 | Information policy and Strategies | 3 |
| **Research methodology** | INFO 581 | Research Methods in Information Science | 3 |
| **Information/knowledge** | INFO 533 | Knowledge Management | 3 |
| **Seminar** | INFO 582 | Seminar on current topics in information Science | 1 |
| **Total Cr. hrs** | | | **13** |
| **Year II, Semester I** | | | |
| **Thesis** | INFO 611 | Master Thesis | 6 |

**Remedial Courses**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Code** | **List of Remedial courses** | **Cr. hr** | **Lec. hrs.** | **Lab. hrs** |
| INFO 331 | Information Organization and Development I | 3 | 2 | 1 |
| INFO 331 | Information Organization and Development II | 3 | 2 | 1 |
| INFO 361 | Collection Development and Management | 3 | 3 |  |
| INFO 352 | Human Information and Communication Behavior | 3 | 3 |  |
| COMP | Data Structure and Algorithms | 3 | 2 | 1 |

*\*N.B. 1 Lab hour = 3 contact hours*

**b) Course Description**

**INFO 511: Foundations of Information Science (3 cr.) Course Objectives**

* + - * To examine the evolution of information science; information representation, organization and management; search and retrieval; human information seeking and interaction; organizational behavior and communication; policy, ethics and scholarly communications.
* To explain the current information environment to students of Information Science
* To identify and discuss major topics and issues in information science that are current in Ethiopia and which will continue to affect the profession for years to come.
* To identify opportunities for leadership, advocacy, and partnership.
* To place information science in a larger social, economic and political context
* To examine the qualities of a “professional” as well as the ethics and values
  + - * and how these shape policy of the library profession.
* To help in beginning the process of developing informed choices as to their educational program, and career planning through review of the wide range and rich environment options open to information professionals.
* Explain information life-cycle management (ILM)

**Course Description:**

An introduction to the historical, current, and potential roles of information professionals in modern society. This course will provide an understanding of the institutional infrastructure which is necessary for all information professionals. It will also provide the major concepts, processes and systems, actors, and operations in the life cycle of information.

**Course content:**

* The Information Infrastructure: Libraries in context
* Information Science: A service perspective
* Redefining the Library: The Impacts and Implications of Technological Change
* Information policy: Stakeholders and Agendas
* Information policy as Library Policy: Intellectual Freedom
* Information Organization: Issues and Techniques
* Ethics and Standards: Professional practices in Library and Information Science
* The Library as Institution: An organizational view.
* Information life-cycle management (ILM)
* Emerging trends in information science

**Learning outcome**

After completing this course, students will able to:

* grasp the role of information centers and libraries today.
* Review the growth of information technologies, especially those that have affected the organization and delivery of information in libraries.
* Grasp the ethical aspects of Information science, the relationship between information provider and information seeker

**Assessment:** Individual and group assignments, exam.

**Readings:**

* Joseph Michael Reagle Jr., 2010, Good Faith Collaboration: The Culture of Wikipedia (History and Foundation of Information Science). London: The MIT press Cambridge, Massachusetts.
* Julian Warner, Nov 30, 2009, (Human Information Retrieval (History and Foundation of Information Science)). London: The MIT Press; 1 edition
*  Rubin, R.E 2004, Foundations of Library Information Science. New York: Neal-Schuman.
* Sandy Dolnick, 2001. [Foundations in Library and Information Science: Fundraising for Nonprofit Institutions Vol 19 (Foundations in Library and Information Science) E](http://www.amazon.com/Foundations-Library-Information-Science-Institutions/dp/0892323876/ref=sr_1_7?s=books&ie=UTF8&qid=1294231876&sr=1-7)merald Group Publishing Limited.
* [Leonhardt.](http://www.amazon.com/s/ref=ntt_athr_dp_sr_1?_encoding=UTF8&sort=relevancerank&search-alias=books&field-author=LEONHARDT) 1996. Foundations in Library and Information Science. Emerald Group Publishing Limited.
*  [Sue K. Norman a](http://www.amazon.com/s/ref=ntt_athr_dp_sr_2?_encoding=UTF8&sort=relevancerank&search-alias=books&field-author=Sue%20K.%20Norman)nd [Steven Vincent.](http://www.amazon.com/s/ref=ntt_athr_dp_sr_1?_encoding=UTF8&sort=relevancerank&search-alias=books&field-author=Steven%20Vincent) 1999, All That Glitters": Prospecting for Information in the Changing Library World (Foundations in Library and Information Sciences) (Author), (Author) JAI Press.
* [Richard Rubin.](http://www.amazon.com/Richard-Rubin/e/B001K8S8X2/ref=ntt_athr_dp_pel_1) 2010. Foundations of Library and Information Science, 3 ed., Neal-Schuman Publishers.
* [Arlene G. Taylor an](http://www.amazon.com/Arlene-G.-Taylor/e/B001JP8BZG/ref=ntt_athr_dp_pel_1)d [Daniel N. Joudrey T](http://www.amazon.com/s/ref=ntt_athr_dp_sr_2?_encoding=UTF8&sort=relevancerank&search-alias=books&field-author=Daniel%20N.%20Joudrey)he Organization of Information

(Library and Information Science Text Series) 3 ed., Libraries Unlimited.

**INFO 533: Knowledge management (3 Cr. Hr) Course description**

Thorough coverage of the latest theory and practice of Knowledge Management (KM), with an integrated interdisciplinary presentation that makes sense of the confusingly wide variety of computer science and business KM perspectives arising simultaneously from artificial intelligence, information systems, and organizational behavior. Solidly covers the "hard" technical components of computer tools and technology for managing knowledge, without losing sight of the "soft" management needs and challenges in leveraging knowledge effectively within an organization. Critically evaluates the nature, computer representation, access, and utilization of knowledge versus information within a human context. Essential preparation for managerial, technical, and systems workers alike in today's modern knowledge-based economy.

**Course objectives**

The goal of this course is to give the graduates a solid foundation covering the major problems, challenges, concepts, and techniques dealing with the organization and management of knowledge with the help of computers. Upon satisfactory completion of this course, you can expect to:

* Understand the fundamental concepts in the study of knowledge and its creation, acquisition, representation, dissemination, use and re-use, and management.
* Appreciate the role and use of knowledge in organizations and institutions, and the typical obstacles that KM aims to overcome.
* Know the core concepts, methods, techniques, and tools for computer support of knowledge management.
* Understand how to apply and integrate appropriate components and functions of various knowledge management systems.
* Be prepared for further study in knowledge generation, engineering, and transfer, and in the representation, organization, and exchange of knowledge.
* Critically evaluate current trends in knowledge management and their manifestation in business and industry.

**Course content**

* Introduction to Knowledge Management, Three pillars of Knowledge Management, Objectives of knowledge management, Knowledge management perspectives, Essential Terms, Principles of Knowledge, Business Environment, KM and the e-Business Space, Significance of Knowledge Management, Evolution of Knowledge Management, Methods, Thrust, Focus, Knowledge Management Technology Scene, Management Challenges, Critical Success Factors
* Knowledge and Learning
* Organizational Learning and Learning Organizations
* Organizational Culture, Change Management and Communities of Practice
* Enabling Technologies
* Knowledge Management Frameworks and Processes
* Knowledge Strategy
* Knowledge Management Assessment and Planning
* Knowledge Management Measurements and Methodologies Basics of Measurement and Metrics
* Significance of KM Measurement, types of Metrics, analysis and Interpretation, the Measurement Process, qualitative and Quantitative Measures
* Building a Business Case for Knowledge Management, the Business development Process, target value drivers for KM, arriving , benchmarks for KM, basics of financial analysis

**Learning outcomes**

On successful completion of the course, you will be able to:

* Explain the meaning, nature and characteristics of knowledge and knowledge management.
* Identify the theories of knowledge management that focuses in the information and knowledge discipline.
* Discuss knowledge management and trend in different information and knowledge agencies.
* Describe the underlying principles governing knowledge management.

**Assessment:** Individual and group presentation

**Prerequisites:** INFO 511

**Readings:**

* Carl Frappaolo. 2006, Knowledge Management, 2 ed. Capstone.
* Kimiz Dalkir. 2005, Knowledge Management in Theory and Practice, Butterworth-Heinemann.
* Melissie Clemmons Rumizen. 2001, The Complete Idiot's Guide to Knowledge Management. Alpha.
* Elias M. Awad and Hassan Ghazir. 2010, International Technology Group.
* Elie Geisler and Nilmini Wickramasinghe . 2009, Principles of Knowledge Management: Theory, Practice and Cases. M.E.Sharpe

**INFO 551: Digital Libraries (advanced level) (3 cr.) Course Objectives**

1. To analyse the research literature on digital libraries, including user interface design.

2. To critically evaluate current digital library practices and implementations.

3. To learn the technical components, tools and skills for developing a digital library, such as document and media formats, user interface evaluation criteria, authoring tools, indexing, retrieval tools and usability testing.

**Course Description**

Principles of design for digital libraries based on published research findings, including user interface design. Critical evaluation of current implementations. Technical components, tools and skills for developing digital libraries. Matching user needs to available technologies.

**Course content**

* Overview of digital libraries
* Information architecture and digital libraries.
* Indexing and classification for digital libraries
* Design process for digital libraries
* Media formats and software for processing media
* User interface design and evaluation
* Usability testing
* Authoring standards
* Electronic publishing technologies
* Content Management Systems
* Databases and content
* Evaluation criteria for digital libraries
* Server and networking technologies

**Learning outcomes**

By the end of the course, a student:

* understands the concept of digital libraries and user interface design;
* can analyze and evaluate critically different digital libraries concepts;
* can define digital libraries in contemporary digital era;
* can synthesize the research findings on digital libraries and related topics topic and present them to the professional and academic audience;
* can use technical components, tools and skills for developing a digital library, such as document and media formats, user interface evaluation criteria, authoring tools, indexing, retrieval tools and usability testing.

**Assessment:** individual and group projects, exam.

**Readings:**

* [G. G. Chowdhury a](http://www.amazon.com/G.-G.-Chowdhury/e/B001JP7KR6/ref=ntt_athr_dp_pel_1)nd [Sudatta Chowdhury**.**](http://www.amazon.com/s/ref=ntt_athr_dp_sr_2?_encoding=UTF8&sort=relevancerank&search-alias=books&field-author=Sudatta%20Chowdhury)2002, Introduction to Digital Libraries, Facet Publishing
* [Diane Kresh**.**](http://www.amazon.com/s/ref=ntt_athr_dp_sr_1?_encoding=UTF8&sort=relevancerank&search-alias=books&field-author=Diane%20Kresh)2007, The Whole Digital Library Handbook ALA Editions
* Terry Reese and [Kyle Banerjee.](http://www.amazon.com/s/ref=ntt_athr_dp_sr_2?_encoding=UTF8&sort=relevancerank&search-alias=books&field-author=Kyle%20Banerjee) 2007, Building Digital Libraries: A How-to- do-it Manual, Neal Schuman Publishers.
* [Michael Lesk.](http://www.amazon.com/Michael-Lesk/e/B001K8R0AY/ref=ntt_athr_dp_pel_1) 2004, Understanding Digital Libraries, Second Edition (The Morgan Kaufmann Series in Multimedia Information and Systems) [Morgan Kaufmann.
* [Ian H. Witten,](http://www.amazon.com/s/ref=ntt_athr_dp_sr_1?_encoding=UTF8&sort=relevancerank&search-alias=books&field-author=Ian%20H.%20Witten) [David Bainbridge a](http://www.amazon.com/s/ref=ntt_athr_dp_sr_2?_encoding=UTF8&sort=relevancerank&search-alias=books&field-author=David%20Bainbridge)nd [David M. Nichols.](http://www.amazon.com/s/ref=ntt_athr_dp_sr_3?_encoding=UTF8&sort=relevancerank&search-alias=books&field-author=David%20M.%20Nichols) 2009, How to Build a Digital Library, Second Edition (The Morgan Kaufmann Series in Multimedia Information and Systems) Morgan Kaufmann.

**INFO 531: Information Storage and Retrieval (advanced level) (3 cr.) Course Objectives**

* to gain familiarity with characteristics of major retrieval systems as well as the principles and mechanics of searching;
* to gain a deeper understanding of how search engines work;
* to explore various ways of processing information retrievable from the Web;
* to learn about advances in information retrieval research and various approaches to information retrieval experiments.

**Course Description:** An intensive study of the applications of online searching in information work, including characteristics of major retrieval systems and the principles and mechanics of searching. An extensive analysis of how search engines work and how to explore and use various forms of Web data and information. Different areas of information retrieval research and experimental approaches will also be covered.

**Course content**

Review of basic concepts; file organization for information retrieval; query specification and search strategy (Boolean operators, proximity operators, etc.); online thesaurus; searching multiple databases simultaneously; non-bibliographic databases; citation-based information retrieval; how Web search engines work; web data mining; automatic indexing and query construction; relevance feedback; document clustering; evaluation of information retrieval systems/Information retrieval experiments. Subject approach to information and controlled vocabulary tools. Image, hypertext and multimedia information retrieval and Evaluation of information retrieval systems. Trends in information storage and retrieval techniques.

**Learning outcomes**

Students who complete this course will be able to:

* select and provide access to recorded information in electronic format;
* employ appropriate technologies to carry out computerized searching for information;
* select and apply appropriate information retrieval techniques and tools in providing access to information content and services
* apply basic principles and techniques of research to the study of information retrieval.

**Assessment**: individual and group projects, exam

**Readings:**

* + - * Korfage, Robert.1997. Information Storage and Retrieval. John Wiley & Sons.
      * Lesk, Michael. 1997. Practical Digital libraries: Books, Bytes & Bucks. Morgan Kaufmann.
      * Maybury, Mark, ed. 1997. Intelligent Multimedia Information Retrieval. AAAI Press & MIT Press.
      * Meadow, C.T., Boyce, B.R., Kraft, D.H. 2000. Text Information Retrieval Systems. 2nd edition. San Diego: Academic Press.
      * Salton, G. and McGill, M.1983, Introduction to Modern Information Retrieval. McGraw-Hill.
* Salton, G.1989, Automatic Text Processing: the transformation, analysis, and retrieval of information by computer. Addison-Wesley, Reading, Mass.

**INFO 532: Scholarly Communication (3 cr.) Course objectives**

This course is best suited to students who plan to work in academic and research information environments.

By the end of the semester, students will:

* be able to demonstrate understanding of the nature of scholarly communication and its impact on libraries, archives, and other information organizations;
* have familiarity with technologies useful for capturing and transferring scholarly information; and
* be capable of discussing current issues in scholarly communication and their implications.

**Course description**

This course will introduce the history, theory and practices of scholarly communication, primarily in broad disciplinary cultures, such as the sciences, social sciences, arts and humanities. This course both surveys the state of the art and techniques that exist or are emerging in scholarly communication. It will also discuss in detail about Open Access and Institutional Repositories. Students will complete a paper tracing the development of a scholarly discipline or sub- discipline; compile a webliography of information resources used by their chosen discipline or sub-discipline; write a well-crafted and fully documented research paper on a current issue in scholarly communication; and participate in class discussions by providing insightful observations and by attending other students' presentations.

**No prerequisites**

**Course content**

* Historical Perspectives and Introduction to Scholarly Communication
* The Internet, Scholarly Communication, and Collaborative Research
* Hands-On with Databases and Indexes, How the Science Citation Index
  + Got Started
* Scholarly Traditions, Scholarly Communication: Historical Development and New Possibilities.
* The Scientific Literature, Growth of Knowledge, Growth of Journal Literature: A Historical Perspective, The Role of Journals in Growth of Scientific Knowledge, Bibliometrics: Scholarly Communication and Bibliometrics Revisited, Publication Patterns and Citation Connections.
*  International Issues, Collaboration: Collaboration Networks in Science, Publication Indicators and Database Coverage: How Balanced is the Science Citation Index's Journal Coverage?
* Evaluative Bibliometrics, Citation Analysis: A Short History of the Use of Citations as a Measure of the Impact of Scientific and Scholarly Work, Scientometrics: The Complementarity of Scientometrics and Economics.
* Social Network Analysis, Sociology of Science: Charting Pathways Through Science: Exploring Garfield's Vision of a Unified Index to Science, Visualization (Citation Maps, Nodes, Graphs, & Networks): The Citation Network as a Prototype for Representing Trust in the Virtual Environment.

**Learning outcomes**

Students who complete this course will be able to:

* grasp the nature of scholarly communication and its impact on libraries, archives, and other information organizations;
* apply technologies useful for capturing and transferring scholarly information; and
* discuss current issues in scholarly communication and their implications.

**Assessment:** Individual and group presentation, exams.

**Readings:**

* Mary Feeney. 1986, New Methods and Techniques for Information Management (Scholarly communications guide). Humanities Pr.
* Charles Thomas, Ed.2002, Libraries, The Internet, and Scholarship: Tools and Trends Converging. New York: Marcel Dekker.
* [Mark L. Knapp a](http://www.amazon.com/Mark-L.-Knapp/e/B001IQXDI6/ref=sr_ntt_srch_lnk_1?qid=1294234045&sr=1-1)nd [John A. Daly.](http://www.amazon.com/John-A.-Daly/e/B001HPG4NO/ref=sr_ntt_srch_lnk_1?qid=1294234045&sr=1-1) 2004, [A Guide to Publishing in Scholarly Communication Journals 3 ed. (Published for the International Communication Association) R](http://www.amazon.com/Publishing-Scholarly-Communication-International-Association/dp/0805849521/ref=sr_1_1?s=books&ie=UTF8&qid=1294234045&sr=1-1)outledge.
* Richard Ekman and Richard E. Quandt. 1999, [Technology and Scholarly](http://www.amazon.com/Technology-Scholarly-Communication-Richard-Ekman/dp/0520217632/ref=sr_1_15?s=books&ie=UTF8&qid=1294234045&sr=1-15) [Communication,](http://www.amazon.com/Technology-Scholarly-Communication-Richard-Ekman/dp/0520217632/ref=sr_1_15?s=books&ie=UTF8&qid=1294234045&sr=1-15) University of California Press.
* Heather Morrison . 2009, Scholarly Communications for Librarians (Chandos Information Professional) , Chandos Publishing.

**INFO 561: Management of Information Services and Systems (3 cr.) Course objectives**

* Knowledge on the concepts of management theories, particularly strategic management theories. Knowledge on management in information service institutions.
* Give knowledge of the principles of strategic planning and management and of the possibilities of using them in information science (different knowledge organizations).
*  Provides information needed to manage organizations effectively Management information systems are regarded to be a subset of the overall internal controls procedures in a business, which cover the application of people, documents, technologies, and procedures used by management accountants to solve business problems such as costing a product, service or a business-wide strategy.

**Course description**

The course cover fundamental issues related to the management and leadership of library and information services and systems. Different schools of management will also be discussed with a focus in information services and systems. Cases of management will be discussed in group sessions.

**Course content**

* Information services based on management and strategic planning: defining of vision and mission, parties’ involvement, defining objectives, human resources management, personnel training and development, managing changes, budget planning
* Strategic management, strategic planning and strategic thinking.
*  Main concepts in strategy work and the paradigms of strategic management.
* Different schools of strategic management.
* Analytical methods used in strategic management.
* Organizational diagnostics and therapy.
* Strategic management in a stable, dynamic and unpredictable environment.
* Principles of management by results. Balanced result card as an instrument in strategy work. Strategic leading.
* Strategy supervision and control.
* Strategic planning, staffing and organization for information professionals.
* Quality management and project management while developing information services.

**Learning outcomes**

After completing this course the student demonstrate the knowledge and ability to:

* Show the importance of management and leadership in the library and information services and systems..
* Show how management theories and principles are applied in the information services and systems.
* Explain different management and leadership theories.
* Apply management and leadership skills in the information services and systems environments.

**Assessment:** individual and group presentation based on practical cases, exam

**Prerequisites:** INFO 511

**Readings:**

* Cole, G.A. (1994). Strategic Management: Theory and Practice. London: DP Publications.
* Stacey, R.D. (1996). Strategic Management & Organisational Dynamics. 2nd ed. London: Pitman Publishing.
* Haberberg, A., Rieple, A. (2001). The Strategic Management of Organisations. Upper Saddle River, N.J.: Prentice Hall.
* Mintzberg, H., Quinn, J.B. (eds) (1996). Readings in the Strategy Process. 3rd ed. Upper Saddle River, N.J.: Prentice Hall.
* Roberts, S, Rowley,J. (2004)Managing information services London : Facet. Corrall, S.(1994). Strategic planning for library and information services. London: Corrall, S. (2000). Strategic Management of Information Services: a Planning Handbook. London: Aslib.
* Roberts, S, Rowley,J. (2004). Managing information services. London: Facet.

**INFO 571: Information Policy and Strategies**

**Course Objectives:**

The objectives of the course are to:

* To give an in-depth understanding of the essence and development of information policy and strategies in different areas of the society;
* To support the formation of the ability to analyze and to treat critically the basic documents on information policy;
* to expand student awareness of macro-level (i.e. governmental and intergovernmental) policy making and how policy outcomes ultimately affect local and institutional information policy;
* to provide students an opportunity to explore particular policy areas in depth;
* to encourage students to become involved as professional leaders in national and international information developments.

**Course description**

Information policy with a focus on Ethiopia and sub-saharan countries. Issues and challenges faced in developing and implementing policies within organizations and companies, and at national level, including the protection and use of intellectual property, access to public information, freedom of access to information, security and protection of privacy of personally identifiable information, legal implications and safeguards. Origins, development, evolution, and pivotal role of information policy, copyright, fair use, and related issues within 21st century information, legal, policy, and economic framework. exceptions for libraries and archives, licensing, alternative protection schema, such as Open Access and Creative Commons.

**Course content**

The content includes:

* Policy process; commodification and privatization of information; copyright and intellectual property right; government information / Freedom of information; publishing policy; broadcasting and information policy.
* Telecommunications policy; Internet, information highway, community networking policy; information privacy, data protection policy; national and international information policy; effects of information policy; Information policy research and theory.
* The areas of informational infrastructure and information policy. The role of information policy in the context of information society. Critical treatments of information society. The characteristic features of Ethiopia as information society.
* Information policy in developed countries and developing countries, particularly Ethiopia. The basic documents and institutions of the nations’ information policy.
* Information policy in public administration: the treatments of public information.
* Social aspects in information policy context.
* Information policy of different organizations.

**Learning outcomes**

Students who complete this course will:

* engage in critical and independent thinking regarding the information policy issues that affect information access and to be reflexive of the relationship between information policy, broadly defined, and professional practice;
* demonstrate an awareness of how information policy relates to professional values and standards;
* respond to global and national policy changes and developments in a spirit of intellectual inquiry;
* analyze major problems of the discipline and of the profession that arise from information policy developments in a spirit of creativity and critical inquiry;
* examine the relationship between public policy and organizational policy outcomes, and the purposes and goals of policy-making within libraries and information centers;
* analyze the role of information policy in the society, recognizes and is able to analyze the information policy of different areas and sectors;
* know the application mechanisms of information policy and is able to critically analyze the documents on information policy and strategy;

**Assessment:** Individual and group assignments, exam

**Prerequisites:** INFO 511

**Readings:**

* Grieves, M. (1998). Information policy in the electronic age.
* Hill, M. W. (2005). The impact of information on society: an examination of its nature, value and usage.
* Webster, F. (2002). Theories of the Information Society. London ; New York: Routledge.
* Borgman, C. (2000). From Gutenberg to the global information infrastructure : access to information in the networked world. Cambridge, Mass.; London: MIT Press.
* Orna, E. (2004 ). Information strategy in practice. Aldershot : Gower. Webster, F. (2002). Theories of the Information Society. London ; New York :
* Routledge.
* Rowlands, I.(ed). (1996). Understanding information policy: proceedings of workshop held at Cumberland Lodge. London : Bowker-Saur. )

**INFO 581: Research Methods in Information Science (3 cr.) Course objectives**:

 To create prerequisites for the formation of knowledge and skills necessary for research work in information science.

 To support the formation of the skill to analyze, think critically, work independently.

**Course description**

**Course description**

The course will cover the essence of research methodologies in information science. The stage of research process will be covered. Data collection and analysis method will be discussed, analysis and interpretation will also be covered adequately.

**Course content**

* The essence of science. The stages of research process. Quantitative, qualitative and mixed methodology.
* Data collection in various types of research. Survey. Observation.
* Interview. Group interviews. Documentary research.
* Analysis and interpretation of data in quantitative and qualitative research.
* Analytic induction. Grounded theory. Text analysis: Content analysis and discourse analysis.
* Research designs (strategies): Case study, etc. Writing the report.
* Independent work: individual work with literature, practical tasks including the analysis of research articles.
* **Learning outcomes**

Students who complete this course will:

* demonstrate knowledge on the research process, research designs and methods of data collection and analysis
* analyse and evaluate the methods used in research, the quality of the presentation of research results; to choose the approach and methods for the thesis.
* Identify perfectly the stages in the research process. **Assessment:** group assignments, term paper, exam **Prerequisite:** complete core courses

**Readings:**

* Powell, R.R. (1997). Basic research methods for librarians. Greenwich: Ablex Pub. Gorman, G. E. (2005). Qualitative research for the information professional: a practical handbook. London: Facet Publishing.
* Bryman, Alan. (2004). Social research methods. Oxford: Oxford University Press.

**INFO 582: Seminar on current topics in Information Science (1 cr.) Course objectives**

* To supporting the development of competencies for proficiency in information science research directions, presentation of research results in scientifically grounded standpoints;
* To analyse the master project’s research stages.
* To prepare students to join in the collective work to expand that body of knowledge.
* To expose students to a variety of the most important texts and papers in the field of information science.

**Course description**

The course will cover the stages of masters project planning. Different related papers will be reviewed and presented in the class. Experience to present and defend the master thesis will be exercised.

**Course content**

* The analytical concepts of information science research direction in correlation with master projects.
* The stages of master project planning and conducting.
* The practical organization of research: planning, commencing and conducting research, and writing.

**Learning outcomes**

* grasp the master project planning and fulfillment;
* Skills in defending research findings in public discussion.

**Assessment:** presentation **Prerequisites:** and core courses **INFO 611: Master Thesis (6 cr.)**

**Course objectives**

* To enable master students to conduct a thorough research and analysis on chosen issue on the basis of contemporary concepts and research methods.
* To support development of skills for identification of research issue, exposing the significance of the research issue, using contemporary methods for solving research tasks, presenting the research content with the analysis and results:
* To support the development of skills for writing of scientific text.

**Course content**

* The planning and fulfillment of a master project.
* Research issues and main research questions.
* The theoretical framework and methodology of the research.
* The preparation of empirical research and its performance.
* The analysis of research results and summarizing, conclusion and discussion.

**Learning outcomes**:

* Skills for orientation in information on the topic,
* Skills for defining the research issues and usage of contemporary methods for solving research tasks,
* Skills for the presentation of the research results in public and defending, discussions on topic.

**Prerequisites**: completing coursework

**Assessment:** follow up through all the stages of the research, proposal defense, and final thesis presentation.

**Course Description: Elective courses**

**INFO 521: Information Behavior (advanced level) (IB) (3 cr.) Course Objectives**

* + - * To conceptualize major concepts, theories and models of information behavior (IB) and help students to examine them critically.
      * To introduce students to a wide range of studies of IB so that students may develop a broad knowledge of a burgeoning field of research.
      * To explore research methods for studying IB and to provide students with the opportunity to design and carry out a study.

**Course Description:** This course focuses on conceptualizing user-centered approaches to human information behavior and explores the information needs, seeking, sources and information use of members of various groups in different contexts in advanced level. In addition, it explore the theoretical frameworks, models and practical research methods that form the foundation for studies of information behavior and offers students the opportunity to carry out a research study. Synthesis of user studies, construction of user profiles, performance of gap analysis, and application of the results of user studies to improve services and system design.

**Course Content**

* Major concepts, theories and models of IB
* Concepts associated with IB: information, information needs, seeking, sources and use.
* Research methodology and methods for IB
* What is a theory? What is a model?
* Key models of IB
* Key theories of IB
* Barriers and enablers to info seeking
* Information behavior in different contexts
* The contemporary research trends in information behavior, retrieval and use.

**Learning outcomes**

By the end of the course a student:

* understands the matter of information seeking, retrieval and behavior;
* is aware of the main concepts in information seeking, retrieval and behavior, research and researchers, and models;
* can analyze and evaluate critically different studies and concepts;
* can define white spots in contemporary scientific studies on information seeking, retrieval and behavior;
* can synthesize the research findings on topic and present them to the professional and academic audience;

**Assessment:** individual and group assignment, exam

**Readings:**

* Case, D. O. (2002). Looking for information: A Survey of Research on Information
* Seeking, Needs, and Behavior. Amsterdam: Academic Press.
* Ingwersen, P. & Järvelin, K. (2005). The Turn: Integration of Information Seeking and Retrieval in Context. Dordrecht, The Netherlands: Springer.
* Fisher, K. E., Erdelez, S. & McKechnie, L. (Eds.) (2005). Theories of Information
* Behavior. Medford, NJ: Information Today.
* Marchionini, G. (1997). Information Seeking in Electronic Environments. Cambridge: Cambridge University Press.

**INFO 541: Object-Oriented System Analysis and Design (3 cr.) Course Description**: Object-oriented design concepts, features and problems of complex systems, evolution of the object-oriented model, foundations and elements of the object- oriented model, classes and objects, relationships among classes, relationships among objects, interplay of classes and objects, approaches to identifying classes and objects, object-oriented design methodologies, methodology notation (elements of UML or any other selected notation, class and object diagrams, interaction diagrams, state transition diagrams, process and module diagrams, etc.) the object-oriented software development process (analysis, design and implementation), code reusability, management issues, applications and case studies, CASE tools.

**Course Objectives**

* Introducing students to the concepts and terms used in the object-oriented approach to systems analysis and design
* Highlighting the importance of object-oriented analysis and design and its limitations.
* Showing how we apply the process of object-oriented analysis and design to software development.
* Pointing out the importance and function of each UML model throughout the process of object-oriented analysis and design and explaining the notation of various elements in these models.
* Providing students with the necessary knowledge and skills in using object- oriented CASE tools

**Course content**

* Object-Oriented Programming Languages and the object-oriented model
* Complex problems and complex systems
* Basic features and elements of the object-oriented approach
* Object-oriented analysis, design, and implementation
* Models and modeling languages
* Requirement modeling
* Analysis modeling
* Design modeling
* A Unified methodology
* Use Case Models in UML
* Interaction Diagrams in UML
* Classes and Class Models in UML
* State and Activity Diagrams in UML
* Implementation Diagrams in UML
* Packages and subsystems
* Deployment modeling/ component based development
* The RUP of Software Development

**Learning Outcomes:**

After completing this course the student must demonstrate the knowledge and ability to:

* Show the importance of systems analysis and design in solving complex problems.
* Show how the object-oriented approach differs from the traditional approach to systems analysis and design.
* Explain the importance of modeling and how the Unified Modeling Language (UML) represents an object-oriented system using a number of modeling views.
* Construct various UML models (including use case diagrams, class diagrams, interaction diagrams, statechart diagrams, activity diagrams, and implementation diagrams) using the appropriate notation.
* Recognize the difference between various object relationships: inheritance, association, whole-part, and dependency relationships.
* Show the role and function of each UML model in developing object- oriented software.
* Show what UML models are used during the four phases of the Rational
* Unified Process (RUP).
* Apply the RUP for developing object-oriented systems using simple real-life problems
* Apply the Rational Software Suit for the construction of UML models and expressing the appropriate notation associated with each model.

**Assessment:** individual and group projects, exam.

**Reading:**

* Bennett, Simon ; Skelton, John; Lunn, Ken (latest ed). Schuam’s Outline of UML. New York: McGraw-Hill.
* Stevens, 2000. Using UML: Software Engineering with Objects and Components. Updated Ed. Harlow, England: Addison-Wesley.
* Satzinger & Orvik, 2001. The Object-Oriented Approach: Concepts, System Development, and Modeling with UML. Australia: Course Technology.
* [Noushin Ashrafi a](http://www.amazon.com/Noushin-Ashrafi/e/B001JRUC5Q/ref=ntt_athr_dp_pel_1)nd [Hessam Ashrafi 2](http://www.amazon.com/s/ref=ntt_athr_dp_sr_2?_encoding=UTF8&sort=relevancerank&search-alias=books&field-author=Hessam%20Ashrafi)008, Object Oriented Systems Analysis and Design Prentice Hall.
* Brett D. McLaughlin, Gary Pollice and Dave West 2006, Head First Object- Oriented Analysis and Design O'Reilly Media
* Craig Larman 2004, Applying UML and patterns: An Introduction to Object- Oriented Analysis and Design and Iterative Development (3rd Edition) Prentice Hall.
* Martin Fowler 2003, UML Distilled: A Brief Guide to the Standard Object Modeling Language (3rd Edition) Addison-Wesley Professional.
*  Erich Gamma (et.al.) 1994, Design patterns: Elements of reusable object- oriented software. Addison-Wesley Professional

**INFO 542: Decision Support Systems (3cr.)**

**Course objectives**

* Introducing students with the nature and use of modern decision support systems,
* to the concepts and terms used in the object-oriented approach to systems analysis and design
* Highlighting the importance of DSS and its implications.
* Showing how we apply the DSS in different information agencies.
* Pointing out the importance and function of each UML model throughout the process of object-oriented analysis and design and explaining the notation of various elements in these models.
* Providing students with the necessary knowledge and skills in analyzing the DSS
* Exposing students to different simulation modeling tool

**Course description**

The course covers modeling and simulation, decision-making in organizations, nature of decision-support systems, components of DSS, decision trees and value trees, database management system and data warehousing. It has also practical sessions in SQL

**Learning Outcomes**

Students should be able to:

* explain the nature and use of modern decision support systems,
* identify the mechanisms that can be used to store and use knowledge,
* use the simulation modeling tool *SIMUL8*.

**Course contents**

* Modeling and simulation
* Decision-making in organizations
* Decision-making process
* Nature of decision-support systems
* Components of DSS
* Decision trees and value trees
* Representation and storage of information and knowledge
* Overview of intelligent decision support systems:
* Model base management system
* Database management system and data warehousing
* Practical sessions in SQL

**Assessment:** Modeling and Simulation, exam

**Readings:**

* George M. Marakas 2002 Decision Support Systems (2nd Edition) Prentice Hall.
* Efraim Turban, [Ramesh Sharda a](http://www.amazon.com/s/ref=ntt_athr_dp_sr_2?_encoding=UTF8&sort=relevancerank&search-alias=books&field-author=Ramesh%20Sharda)nd [Dursun Delen 2](http://www.amazon.com/s/ref=ntt_athr_dp_sr_3?_encoding=UTF8&sort=relevancerank&search-alias=books&field-author=Dursun%20Delen)010, Decision Support and Business Intelligence Systems (9th Edition) Prentice Hall.
* Elliot Bendoly 2008, Excel Basics to Blackbelt: An Accelerated Guide to Decision Support Designs. Cambridge University Press.
* Christian Albright 2009, VBA for Modelers: Developing Decision Support Systems with Microsoft Office Excel (with Premium Online Content Printed Access Card) 3 ed. South-Western College Pub.
* Vicki Lynn Sauter. 2010, Decision Support Systems for Business Intelligence. 2 ed. Wiley.
* Darlington, 2000. *The Essence of Expert Systems*, Prentice Hall (background, covers Intelligent Decision Support Sytems)
*  Avison and Fitzgerald, 2003. *Information Systems Development: Methodologies, Techniques and Tools* (Third Edition), McGraw-Hill, London (background)
* Alter, 2002. *Information Systems: Foundations of E-Business*, Prentice Hall, (background)

**INFO 572: Government Information (2 cr.) Course Objectives**

The primary purpose of this course is to introduce Ethiopian government information sources. Students may have an opportunity to become somewhat familiar with foreign, international, and state government information.

Items of interest to an academic and professional audience will receive most attention. Government information used in this course will be available in some standard print sources, including digital and retrospective ones, will also receive attention.

**Course Description**

Government publications and/or information from different world sources, particularly that of Ethiopia and their acquisition, organization, and use. Other topics covered include the public's right to know, experiences of the Federal Depository Library Program of different countries, examine government information depository system of Ethiopia, government influences in our daily lives, and future directions in government information.

**Course content**

* Access and official Federal information
* Depository Libraries
* Information about government
* Scientific Information
* Introduction to Ethiopia government information
* Patents and Tra
* demarksParliament and library and information services
* Government information classification system

**Learning Outcomes**

Student should be able to:

* define and discuss the importance and utility of government information sources
* select appropriate sources to meet particular needs
* identify and discuss the several activities involved in making these sources available for use
* identify and discuss the elements of an effective government information program in a library or information agency
* thoughtfully discuss the future of government information in light of present trends

**Assessment:** assignments and exam

**Pre-requisite:** INFO 511

**Readings:**

* Peter Hernon, Harold C. Relyea, Joan F Cheverie, and Robert E. Dugan.
* 2002, United States Government Information: Policies and Sources. Libraries Unlimited.
* Joe Morehead. 1999, Introduction to United States Government Information Sources. 6 ed. Libraries Unlimited.
* Viktor Mayer-SchÃ¶nberger and David Lazer. 2007, Governance and Information Technology: From Electronic Government to Information Government. The MIT Press.
* Andrea M. Morrison and GODORT. 2009, Managing Electronic Government Information in Libraries. Amer Library Assn Editions.
* Vincent Homburg. 2008, Understanding E-Government: Information Systems in Public Administration. Routledge.

**INFO 535: Information Resources and Services in Science, Technology and**

**Medicine (3 cr.)**

**Course Objectives**

* To develop an awareness of the nature and communication of scientific, medical and technological research;
*  To differentiate the information needs and uses of researchers and practitioners in these disciplines;
* Through practical experience, to familiarize students with the specialized forms of literature and information in science, medicine and technology; and
* To develop an understanding of the organization of library and information services serving these disciplines and methods of evaluating them.

**Course description**

Nature and communication of scientific, medical and technological research. Information resources and services in science and technology, including primary and secondary publications, electronic text, image and numeric databases; Information needs and uses of researchers and practitioners in these disciplines. Specialized forms of literature and information in science, medicine and technology. Organization of library and information services and their evaluation.

**Course Content**

* The nature and scope of science; science and non-science; medicine, and technology.
* History of science and the scientific method.
* Scientific communication and the role of peer review.
* The “information cycle” and the impact of electronic publishing.
* Patent literature.
* Reference resources in engineering, medicine and science.
* Analysis of the structure and unique strengths of databases.
* Information needs of scientists.
* The role of current awareness and document delivery services.
* Evidence based medicine and consumer health.
* Science resources in the public library.
* Science literature for children.

**Learning outcomes**

Students who complete this course will:

* Show in critical e-information searching activities;
* demonstrate an awareness of different information resources and services in STM and other fields;
* apply knowledge and skills to search for international, regional and national e-resources;
* analyze major search engines and search strategies;

**Assessment:** individual and group project presentation, exam

**Pre-requisite:** INFO 511

**Readings:**

Srodin Sharon Informa Healthcare. 2006, Using the Pharmaceutical Literature (BOOKS IN LIBRARY AND INFORMATION SCIENCE)

* Ray and Lester. 2005, New Walford Guide to Reference Resources: Science, Technology and Medicine, Volume 1. Neal-Schuman Publishers.
* Rowena Cullen. 2005, Health Information on the Internet: A Study of Providers, Quality, and Users . Praeger.
* Anne Summers. 1997, How To Find Source Materials: British Library Collections on the History and Culture of Science, Technology and Medicine (How to Find Series). CRC Press.
* Bruce Madge. 2002, How to Find Information: Complementary and Alternative Health Care. The British Library.

**INFO 552: Records Management in Digital Environment (2 cr.) Course Objectives**

Upon completion of the course, students will:

* have reached a deeper understanding of the main theoretical concepts about record-creation, record-making and record-preservation in the context of a digital environment
* have gained an increased awareness of the risks to records posed by the digital environment
* have gained a more robust ability in handling models and methodologies related to the design of records systems
* be able to analyze, evaluate and compare digital record-making, recordkeeping and records preservation systems
* be able to define a roadmap for designing and developing a record-making, a recordkeeping and a record preservation system
* be familiar with recent and current standards, research and literature on electronic record management systems (ERMS)
* be able to discuss and demonstrate understanding of the course topics listed below.

**Course Description**

Introduction to the essentials of records and knowledge management in diverse organizational settings. Organizational theory and how this relates to the history and development of record-keeping systems, electronic-records management and the advent of new technologies, and the place of records and knowledge management in the information professions. Theoretical principles, methodologies, and practical administration of archives, records, and other information sources from print to oral (encompassing explicit and implicit knowledge) contributing to the management of knowledge necessary for organizations and society.

**Course Content**

* Records, organizations and records management: principles to respect in the digital environment
* Functional requirements for electronic records management system
* the role of the digital signature as an authenticity tool
* the role of classification as an identification, organization, authentication and retrieval tool in the digital environment
* managing specific types of digital records (e.g. e-mail, databases) within EDMS
* Models and methodologies for managing electronic records throughout their life cycle Metadata for managing electronic records throughout Information life cycle
* National and international standard impacting on electronic records management
* Relevant projects and best practices in managing electronic records

**Learning outcomes**

Students who complete this course will:

* engage in record-creation, record-making and record-preservation;
* demonstrate an awareness the risks to records posed by the digital environment;
* analyze, evaluate and compare digital record-making, recordkeeping and records preservation systems

**Assessment:** group and individual presentations, practical group project presentation, exam

**Pre-requisite:** INFO 511

**Reference:**

* Dr. Duranti drafted DoD 5015.2 (1997), Moreq1 (1998), and 2 (2008), all key standards in *records management* in the *digital environment*.
* Judith Read and Mary Lea Ginn. 2007, Records Management, Thomson South-Western.
* Don Boadle.2005, *Reinventing the archive in a virtual environment: Australians and the non-custodial management of electronic records.: An article from: Australian Academic & Research Libraries*. Digital - Aug 1, 2005.
* John T. Phillips. 2005, The challange of web site records preservation: managing electronic records in fast-paced, technology-driven web environments has frustrated information. Information Management Journal Digital - Jul 30, 2005
* Robert L. Sanders. 2005 *Personal business records in an electronic environment.* Information Management Journal. Digital - Jul 28, 2005.
* Virginia A. Jones. 2005, *Protecting records--what the standards tell us: key standards have been developed that aid in determining the best method rationale, environment,* Information Management Journal. Digital - Jul 31, 2005.

**INFO 536: Data Mining & Analysis (3 cr.) Course objectives**

At the end of the course, students are expected to:

* Understand the principles and concepts underlying the main data mining techniques, and their strengths and limitations;
* Apply data mining techniques and the knowledge discovery process to discover hidden information in numerical and textual data;
* Understand the different kinds of patterns and models that can be extracted from a data set, and be able to select and use an appropriate technique for each type of pattern and model;
* Be able to interpret and evaluate the results of data mining;
* Describe how data mining can be used in real-life applications;
* Know the main features and functionalities that a good data mining tool should have.

**Course Description:**

This course covers the main data mining techniques used to analyze numerical and textual data in order to discover hidden patterns and develop prediction models. Techniques covered include statistical data analysis, clustering, nearest neighbor categorization, decision-tree induction and neural networks. Industry applications of data mining techniques are examined. Students will have hands-on experience with statistical analysis and data mining software, and with the process of data mining and knowledge-discovery. An introduction to data warehousing and On-Line Analytical Processing (OLAP) will also be provided. The focus is on understanding the concepts and principles underlying the data mining techniques, and on hands-on practical experience.

**Learning outcomes**

After completing this course the student demonstrate the knowledge and ability to:

* Show the importance of systems analysis and design in solving complex problems.
* Show how the different kinds of patterns and models that can be extracted from a data set, and be able to select and use an appropriate.
* Explain how to interpret and evaluate the results of data mining
* Apply data mining techniques and the knowledge discovery process to discover hidden information in numerical and textual data;
* Apply data mining in real-life applications;

**Assessment:** Individual and group project presentation, exam.

**Prerequisites:** INFO 511, INFO 531

**Readings**

* [Han] Han, J., & Kamber, M. (2001). Data mining: Concepts and techniques.
* San Francisco: Morgan Kaufmann.
* [SPSS] Howitt, D., & Cramer, D. (2001). A guide to computing statistics with
* SPSS. Harlow, England: Prentice-Hall.
* [Berson] Berson, A., & Smith, S.J. (1997). Data warehousing, data mining, and OLAP. New York: McGraw-Hill.
* [Weiss] Weiss, S.M., & Indurkhya, N. (1998). Predictive data mining: A
* practical guide. San Francisco: Morgan Kaufmann.
* [Berry] Berry, M.J.A., & Linoff, G. (2000). Mastering data mining: The art and science of customer relationship management. New York: Wiley.
* [Patterson] Patterson, D.W. (1996). Artificial neural networks: Theory and applications. Singapore: Prentice Hall , c1996.
* [Tabachnick] Tabachnick, B.G., & Fidell, L.S. (2001). Using multivariate statistics (4th ed.). Boston: Allyn and Bacon.

**INFO 562: Academic Libraries (2 cr.)**

**Course Objectives**

* To explore strategic issues, trends, challenges and opportunities for the academic library of today and tomorrow.
* To consider the institutional setting and the needs of various user populations within the academic community.
* To examine the role of the academic librarian as an information specialist, scholar, educator and leader.

**Course Description**

Academic libraries in institutions of higher learning; Strategic issues and trends, including scholarly communication; publishing, funding and access models; and evolving technologies. User populations, their needs and information-seeking behaviour. Impact of digital resources on collections, access, services and instruction. The academic librarian as information specialist, educator; scholar and leader.

**Course Content**

* The contemporary university and college
* The library in its institutional context
* The role of libraries and librarians in scholarly communication
* Publishing, access and funding models
* Collection development in academic libraries in an increasingly digital world
* Just-in-time, just-in-case and just-for-you models.
* Resource sharing, document delivery, consortia, e-resources. Information literacy competencies, standards, performance indicators and outcomes. Instructional design and pedagogical considerations for information literacy programs. Reference services - traditional and electronic
* Planning and budgeting in an academic environment
* The role of technology: current and emerging technologies The university libraries, their user populations and services Faculty status for librarians
* Performance measures and indicators Marketing the library within the institution The academic library of the future
* Profiles of academic librarians: Academic librarian as information specialist, scholar, educator and leader.

**Learning outcomes**

Students who complete this course will be able to:

* respond to change in an open and flexible way, based on a thorough understanding of the academic environment and culture;
* identify the needs of users within the academic community and develop appropriate collections and services to meet these needs;
* employ relevant technologies within academic libraries;
* communicate and work cooperatively and effectively with users, colleagues, employers and other members of the academic community;
* apply contemporary management principles to the academic library setting.

**Assessment:** individual assignments, exam.

**Readings:**

* [Camila A. Alire a](http://www.amazon.com/Camila-A.-Alire/e/B001JP48W6/ref=sr_ntt_srch_lnk_1?qid=1294254385&sr=1-1)nd G. Edward Evans. 2010, Academic Librarianship by, Neal-Schuman Publishers.,
* John Budd. 2005, The Changing Academic Library: Operations, Culture, Environments (Acrl Publications in Librarianship) Association of College & Research Libraries.
* Elizabeth Connor (et. al.). 2008, An Introduction to Instructional Services in Academic Libraries The Haworth Press.
* Susan Higgins. 2011, [Managing Academic Libraries Pr](http://www.neal-schuman.com/bdetail.php?isbn=9781843346210)inciples and Practice, Neal-Schuman.
* Christopher Stewart. 2010, The Academic Library Building in the Digital Age: A Study of Construction, Planning, and Design of New Library Space, Amer LibraryAssn.

**INFO 563: Library and Information Centers Design and Planning (2 cr.)**

**Course Objectives**

* To familiarize students with the current literature on library and information centers planning and design principles on a variety of topics and issues.
* To develop within students the necessary knowledge and skills for planning, designing and assessing library and information centers spaces of various kinds.
* To provide students with the skills and knowledge required to critically evaluate existing library and information centers facilities, suggest improvements and implement changes.

**Course Description**

This course introduces students to the basic concepts and skills of library and information centers space planning and design. Through a succession of individual and group assignments, lectures and class activities, students learn how to plan welcoming library spaces that are flexible and responsive to user needs. Some basic theory is also introduced.

**Course content**

* Architecture and Communication, Public Spaces
* Library Buildings Past and Present, Stages of Design and Construction
* Understanding User-Centred Design, Conducting a User Needs Assessment
* Site Evaluation, Building Program and Architect Selection
* Using ALA and IFLA Standards, Building/Fire Codes and Other Guidelines
* Accessibility and Ergonomic Standards
* Space Planning, Power Relationships and Proxemics
* Collection, Staff, Reference, and Community Spaces
* Acoustics, Lighting, Colours and Signage
* Technology: Planning For Change
* Greening the Library, Security Considerations
* Organizational Spaces, the Future of Libraries as Places

**Learning outcomes**

Students who complete this course will be able to:

* identify needs of particular user groups of public, academic and special libraries and information centers and develop facilities that respond to those needs;
* analyze long-standing planning and design issues (e.g., “form versus function”) and more current issues (e.g., installing today’s information technology in older library spaces) in a spirit of critical inquiry;
* communicate and work cooperatively and effectively with others in library and information centers planning projects such as writing building programs, planning user needs assessments and designing library and information centers facilities.

**Assessment:** Individual and group assignments and presentations, exam.

* **Readings:** Nolan Lushington. 2002, Libraries Designed for Users: A 21st Century Guide Neal-Schuman Publishers.
* Ayub Khan. 2009, Better by Design: An Introduction to Planning and Designing a New Library Building, Facet Publishing.
* Terry Webb. 2004, Building Libraries for the 21st Century: The Shape of Information McFarland & Company.

**Department: Statistics**

**Program Name: Masters of Science in Statistics** **(Econometrics and Biometry Streams)**

1. **Course Breakdown by Semester**

**Econometrics Stream**

|  |  |  |  |
| --- | --- | --- | --- |
| **Year I** | **Course Code** | **Course Title** | **Cr. Hrs** |
| Semester I | Stat 571 | Statistical Theory | 3 |
| Stat 575 | Linear Statistical Models | 3 |
| Econ 511 | Microeconomics | 3 |
| Stat 570 | Sampling Theory and Applications | 3 |
| Total | | **12** |
| Semester II | Stat 531 | Microeconometrics | 3 |
| Econ 512 | Macroeconomics | 3 |
|  | Elective | 3 |
|  | Elective | 3/2 |
| Total | | **12/11** |

|  |  |  |  |
| --- | --- | --- | --- |
| **Year II** | **Course Code** | **Course Title** | **Cr. Hrs** |
| Semester I | Stat 635 | Macroeconometrics | 3 |
| Stat 789 | M. Sc Thesis |  |
|  | |  |
| Semester II | Stat 689 | M. Sc Thesis |  |

**Biometry Stream**

|  |  |  |  |
| --- | --- | --- | --- |
| **Year I** | **Course Code** | **Course Title** | **Cr. Hrs** |
| Semester I | Stat 571 | Statistical Theory | 3 |
| Stat 575 | Linear Statistical Models | 3 |
| Stat 570 | **Sampling Theory and Applications** | 3 |
| Stat 577 | Design and Analysis of Experiments | 3 |
|  | Elective | 3 |
| Total | | **15** |
| Semester II | Stat 576 | Applied Regression | 3 |
| Stat 581 | Categorical Data Analysis | 3 |
|  | Elective | 3 |
|  | Elective | 3/2 |
| Total | | **12/11** |

|  |  |  |  |
| --- | --- | --- | --- |
| **Year II** | **Course Code** | **Course Title** | **Cr. Hrs** |
| Semester I |  | Elective (Optional) | 3/2/1 |
| Stat 689 | M. Sc Thesis |  |
|  | |  |
| Semester II | Stat 689 | M. Sc Thesis |  |

1. Course Description

**Stat 522: Epidemiological Methods (3)**

Bioassay including analysis of death rates in relation to epidemics and related causes, standardization techniques, introduction to more commonly used research study designs, randomized prospective trials, causation, case control studies, cohort-analytic and cross sectional studies with application to epidemiological problems. Statistical methods for analyzing data from such studies with particular emphasis on categorical data analysis including methods for covariate adjustment of risks and relative risk ratios, and corresponding statistical models including proportional hazards model for censored data, population prevalence surveys; statistical software packages for epidemiological studies.

**Teaching-Learning Method**: Lecture, practicing with real data, literature review and presentations

**Mode of Assessment**: Assignments (20%), Presentations (20%), Written Examination (60%)

**Stat 524: Statistical Ecology (3)**

Ecological community data, spatial and temporal pattern analysis, species abundance relations, community classification, community ordination, community interpretation, analysis of ecological time series, agricultural ecology, bio-economic models, conservation genetics, fisheries models, global environmental policy, and pest control models; statistical software packages for ecological data analysis.

**Teaching-Learning Method**: Lecture, practicing with real data

**Mode of Assessment**: Assignments (20%), Written Examination (80%)

**Econ 538: Theory of Business Decisions (3)**

The concepts of decision theory and their relationship to economic rather than mathematical or computational methods: selected topics from the following: programming including shadow prices and their use in schemes of decentralization, concepts of probability including decision of objective and subjective e interpretations. Expected utility; decision rules for problems involving risk, with selected applications e.g. to insurance or investment problems. Random processes, Bayes and mini-max solutions of games against nature, and zero-sum two persons games. Organizations considered as games and as teams; survey of informal organization theory.

**Teaching-Learning Method**: Lecture, practicing with real data, literature review and presentations

**Mode of Assessment**: Assignments (20%), Presentations (20%), Written Examination (60%)

**Stat 542: Demography of Developing Countries (3)**

Sources of information about population, current and cohort methods of description and analysis; the construction of life tables: measurement of fertility, mortality and nuptiality; the determinants of age structure and the intrinsic growth rate; sources of data and approaches to them: distribution and growth of population in developing countries and their demographic characteristics; causes and concomitants of fertility differentials and trends: mortality, nuptiality, contraception, breast-feeding, education, economic motivation, urbanization, status of women; family planning programmes and their evaluation; statistical software packages for demographic data analysis.

**Teaching-Learning Method**: Lecture, practicing with real data, literature review and presentations

**Mode of Assessment**: Assignments (20%), Presentations (20%), Written Examination (60%)

**Stat 571: Statistical Theory (3)**

Review of probability theory and distribution theory, Bayesian and frequentist theories and likelihood methods; the classical probability models; sampling distributions, laws of large numbers; order statistics; inference; likelihood, profile, conditional and marginal likelihood; Bayesian methods, decision theory.

**Teaching-Learning Method**: Lecture

**Mode of Assessment**: Assignments (30%), Written Examination (70%)

**Stat 573: Data Management and Analysis (3)**Data collection, data quality control, data management and organization, data security, software for data management; relational database, databases set-up; introduction to statistical packages and computer aided learning, defining analysis objectives, the information content in data and links with the design, exploratory analysis, statistical programming using standard batch-style and interactive packages and modern statistical language; practical exercises on design of data management process and data analysis.

**Teaching-Learning Method**: Lecture, practicing with real data in computer laboratory

**Mode of Assessment**: Assignments (40%), Written Examination (60%)

**Stat 575: Linear Statistical Models (3)**

System of linear equations and their solutions; the regular inverse of a non-singular square matrix; generalized inverse; quadratic forms and distribution of quadratic forms; linear models - the full rank (regression) model; regression on dummy variables; models not of full rank; the one-way classification and the two-way nested classification; the two-way crossed classification; introduction to variance components.

**Teaching-Learning Method**: Lecture

**Mode of Assessment**: Assignments (30%), Written Examination (70%)

**Stat 576: Applied Regression Analysis (3)**

Simple and multiple regression: parameter estimation, testing, and prediction; model adequacy checking/validation; transformation and weighting to correct model inadequacies; diagnostics for leverage and influence; the general concept of indicator variables, regression approach to analysis of variance; variable selection and model building; multicollinearity; introduction to nonlinear regression; statistical software packages for regression analysis .

**Teaching-Learning Method**: Lecture, practicing with real data, literature review and presentations

**Mode of Assessment**: Assignments (20%), Presentations (20%), Written Examination (60%)

**Stat 570: Sampling Theory and Applications (3)**

Review of basic single-stage sampling methods: Simple random sampling, systematic sampling, stratified random sampling, cluster sampling; multistage sampling: two and three stage Simple Random Sampling; multiphase(double sampling); difference estimators; ratio estimators; regression estimators; determination of sample size; models for non-sampling errors; randomized response techniques; small area estimation.

**Teaching-Learning Method**: Lecture, practicing with real data, literature review and presentations (evaluating M. Sc thesis of non-statistics graduates, journal articles…)

**Mode of Assessment**: Assignments (20%), Presentations (20%), Written Examination (60%)

**Stat 582: Non-parametric Methods (3)**

Introducing the theory and applications of distribution-free (non-parametric) statistical methods; test goodness of fit, sign tests, order statistics, rank test for location and for scale; two-sample and *k*-sample comparisons; test of associations; statistical software packages for non-parametric methods.

**Teaching-Learning Method**: Lecture, practicing with real data, literature review and presentations

**Mode of Assessment**: Assignments (20%), Presentations (20%), Written Examination (60%)

**Stat 577: Design of Clinical Experiments (3)**

Introduction to the application of traditional experimental design theory to biomedical control experiments including event time studies, methods of bias and variability, randomization, blocking, factorial designs, stratification and adequate sample size, analysis of results from such designs with emphasis on clinical experiments common in biometric research; protocol designs, power, sample size, blindness; ethical considerations, parallel studies, crossover designs, survival data, dropouts and protocol violator, repeated measurements, meta-analysis of clinical trials, multi-center trials, sequential methods, monitory a clinical trial, sequential designs, stratification and covariate adjustment applications; software packages for clinical data analysis.

**Teaching-Learning Method**: Lecture, practicing with real data, literature review and presentations

**Mode of Assessment**: Assignments (20%), Presentations (20%), Written Examination (60%)

**Stat 593: Survival Data Analysis (3)**

Estimation of the survivor function and hazard function, parametric and non-parametric representations of the survival and hazard distributions, log-rank test for comparing two groups, k-sample tests and parametric models for time-to-event data based on the Weibull distribution. Proportional hazard models, accelerated time models, models for grouped survival data, model checking diagnostics, calculation of the required sample size, competing risks, counting process approach to the analysis of censored failure time data: Nelson-Alan estimator of the cumulative hazard function, the Kaplan Meir estimator of survivor function, the weighted log-rank statistics; asymptotic properties of estimator, applications to clinical and epidemiological examples; software package for survival data analysis.

**Teaching-Learning Method**: Lecture, practicing with real data, literature review and presentations

**Mode of Assessment**: Assignments (20%), Presentations (20%), Written Examination (60%)

**Econ 511: Microeconomics (3)**

Recent advances in consumer behavior approaches; maximization of consumer satisfactions; Theory of firm - optimization of objectives in short run and long run under the status of perfect knowledge risk, and uncertainty, profit maximizing strategies under alternate input-output relations; cost theories-traditional vis-à-vis modern; use of various cost concepts in the process of decisions making; Market structures and output-pricing decisions; General equilibrium theory; Theories of distribution and factor pricing; Welfare Economics - Components analysis.

**Teaching-Learning Method**: Lecture, literature review and presentations **Mode of Assessment**: Presentations (30%), Written Examination (70%) **Econ 512: Macroeconomics (**

Macroeconomic concepts, variables, relations and models; Growth in macroeconomics theories - classical, Keynesian and modern; Classical macroeconomics - Say's law and Quantity theory of money; Saving and investment; Determination of income and employment; Obstacles to the classical full employment theory; Keynesian and modern macroeconomics - consumption function and income determination, fiscal policies and income determination, investment theories, money-demand and supply and interest rate; General macroeconomics equilibrium - product and money market, IS-LM functions, full employment and interest rate theories; Inflation-theories, causes and control measures; Growth theories; Business cycles; International economy and exchange rate mechanisms.

**Teaching-Learning Method**: Lecture, literature review and presentations

**Mode of Assessment**: Presentations (30%), Written Examination (70%)

**Stat 531: Microeconometrics (3)**

Review of basic microeconomic theories; review of matrix algebra; the classical multiple regression model; functional forms; specification analysis and model selections; non-linear regression models; the generalized regression model; simultaneous equation methods; maximum likelihood and minimum distance estimation; the generalized method of moments; non- linear simultaneous equation models; statistical packages for econometric analysis

**Teaching-Learning Method**: Lecture, practicing with real data

**Mode of Assessment**: Assignments (30%), Written Examination (70%)

**Econ 533: Selected Topics in Industrial Economics (3)**

Treatment of risk in the theory of value and capital; selection of risky assets, including risk pooling, diversification and insurance; portfolio selection and pricing in the case of quoted securities; speculative prices as random processes; the cost of corporate capital, including the effect of dividend policy, gearing, taxation and inflation; the economics of industry and licensing; industrial policy; the joint stock company; the multinational company; the patent system; insurance markets; product liability; organized futures markets; international commodity schemes; pricing practices, systems and polices in respect of monopoly and competitions; small business, state enterprises, function of industry.

**Teaching-Learning Method**: Lecture, literature review and presentations

**Mode of Assessment**: Presentations (30%), Written Examination (70%)

**Stat 635: Macroeconometrics (3)**

Review of differential equations; review of basic macroeconomic theories and policy issues; stationary time series models; modeling economic time series ; trends and volatility; testing for trends and unit roots; multiequation time series models; cointegration and error- correction models; nonlinear time series models, VAR models; and factor asset pricing models; the analysis of relationships among such variables as national income, employment, inflation and the quantity of money and other macroeconometrics topics; statistical package for macroeconometric data analysis

**Teaching-Learning Method**: Lecture, practicing with real data, literature review and presentations

**Mode of Assessment**: Assignments (20%), Presentations (20%), Written Examination (60%)

**Stat 572: Multivariate Methods (3)**

The multivariate normal distribution; tests of hypotheses about means; inference in multivariate analysis of variance. Inference from covariance matrices (*two topics from the following four*) - canonical analysis, principal components analysis, discriminant and classification analysis, factor analysis, cluster analysis, multidimensional scaling; software package for multivariate methods.

**Teaching-Learning Method**: Lecture, practicing with real data, literature review and presentations

**Mode of Assessment**: Assignments (20%), Presentations (20%), Written Examination (60%)

**Stat 673: Bayesian Inference (3)**

The nature of Bayesian inference, Baye’s theorem, Bayesian decision analysis, Bayesian estimation and tests of hypothesis, prediction in Bayesian inference, Bayesian techniques for regression and analysis of variance; applications of Bayesian theory; software packages for Bayesian approach.

**Teaching-Learning Method**: Lecture, practicing with real data, literature review and presentations

**Mode of Assessment**: Assignments (20%), Presentations (20%), Written Examination (60%)

**Econ 575: Economic and Social Accounting (3)**

Dimensions of human development: key conceptual and measurement problems in measuring the quality of life in different social groups; economic measurement: national income accounting; the overseas sector; coping with prices and inflation; development planning: government decision making; input output analysis; social accounting matrices; social cost-benefit analysis; human resources; measuring unemployment; education, health and nutrition in the process of economic and human development; recent trends in measuring development and poverty.

**Teaching-Learning Method**: Lecture, practicing with real data, literature review and presentations

**Mode of Assessment**: Assignments (20%), Presentations (20%), Written Examination (60%)

**Stat 577: Design and Analysis of Experiments (3)**

Principles of experimental designs; one-way and two-way layouts; theory and construction of block designs, multiple replicates, single-replicate and design and analysis of fractional and confounded fractional experiments; response surfaces; change-over designs; split-plot experiments and incomplete block designs; repeated measures design; non-linear experimental designs; multiple experiments; additive main additive main effects and multiplicative interaction models; software packages for designs of experiment data analysis.

**Teaching-Learning Method**: Lecture, practicing with real data, visiting agricultural experimentation sites, literature review and presentations

**Mode of Assessment**: Assignments (20%), Presentations (20%), Written Examination (60%)

**Stat 579: Time Series Analysis (3)**

Time series data and models; traditional linear stationary time series; decomposition of time series data; estimation methods of various components; smoothing and forecasting; the time domain approaches including ARIMA models; the frequency domain and spectral analysis with applications; recent developments in time series analysis; software packages for time series analysis .

**Teaching-Learning Method**: Lecture, practicing with real data

**Mode of Assessment**: Assignments (40%), Written Examination (60%)

**Stat 581: Categorical Data Analysis (3)**

Types of categorical data; cross-classifications and contingency tables; measures of association and tests of independence; multidimensional tables; probability models for contingency tables; exact and asymptotic tests of independence; ordinal regression models; logit and log-linear models; maximum likelihood estimation; tests of goodness-of-fit; software packages for categorical data analysis.

**Teaching-Learning Method**: Lecture, practicing with real data, literature review and presentations

**Mode of Assessment**: Assignments (20%), Presentations (20%), Written Examination (60%)

**Stat 583: Analysis of Longitudinal Data (3)**

Longitudinal study design, exploring longitudinal data, linear and general linear regression models for correlated data, including marginal, random effects, mixed-effects and transition models; handling missing data; applications of longitudinal data analysis; software packages for longitudinal data analysis.

**Teaching-Learning Method**: Lecture, practicing with real data, literature review and presentations

**Mode of Assessment**: Assignments (20%), Presentations (20%), Written Examination (60%)

**Stat 511: Statistical Genetics and Bioinformatics** (3)

Fundamental elements of mathematical and population genetics, and statistical theory of the methods of genetic analysis: Hardy-Weinberg equilibrium, Mendelian inheritance, inbreeding, selection, mutation, models for polygenic and multifactorial inheritance, variance components estimation for the genetic analysis of familial aggregation, linkage and segregation analysis, and ascertainment problems; database searches (of DNA, RNA, amino acids and proteins databases); hidden Markov models, genome assembly and next-generation sequencing, protein-protein interaction and networks, phylogenetics, protein structure and prediction, molecular dynamics and docking, genetic linkage and association, gene expression arrays, text mining, and proteomics.

**Teaching-Learning Method**: Lecture, practicing with real data, literature review and presentations

**Mode of Assessment**: Assignments (20%), Presentations (20%), Written Examination (60%)

**Econ 577: General Equilibrium Theory (3)**

General equilibrium modeling in economic theory; systematic development of general equilibrium theory with applications in finance and macroeconomics; competitive markets and general equilibrium; existence, uniqueness and stability of general equilibrium; Pareto efficiency and welfare theorems; general equilibrium under uncertainty; contingent commodities, forward markets and asset markets; Arrow-Debru equilibrium and Radner equilibrium; general equilibrium models with time; overlapping generations models.

**Teaching-Learning Method**: Lecture, literature review and presentations

**Mode of Assessment**: Presentations (30%), Written Examination (70%)

**Stat 685: Statistical Consultancy (2)**

Revision of major concepts and procedures in Statistical Consultancy and Research Methods and applying them to the real problems- guiding undergraduate student research and own research; developing teaching materials for undergraduate courses (next batch develops the same material) so that it can be used by the students; handling undergraduate courses; helping the department in developing development and/research projects; helping the department in delivering consultancy service

**Mode of Assessment**: Undergraduate students’ assessment; supervisor’s continuous evaluation; and quality of the final product as judged by Department Graduate Committee.

**Stat 689: M. Sc Thesis (6)**

Upon successful completion of course requirements a candidate writes an MSc thesis under the supervision of a senior staff or co-supervisors. The thesis work will be an application of statistical theory and methods. The areas of application could be Agriculture, Biology, Economics, Education, Environment, Sociology, and the like. The student can do his/her research work on advances in statistical methods in the scope of specialization of the student.

The application area of the thesis work will be selected in consultation with the student’s supervisor(s) and be approved by the department. Searching for co-advisors from national research organizations or laboratories is advisable but not mandatory.

**Econ 591: Game Theory (3)**

Formal representation of game: games in extensive form, concepts of strategies, games in strategic form; dominance arguments: dominant strategy equilibrium, iterative elimination of dominated strategies, rationalizable strategies; Nash Equilibrium: definition, existences and uniqueness of a Nash equilibrium, trembling-hand perfect equilibrium, proper equilibrium; games with incomplete information: Bayesian decision theory, Bayes- nah equilibrium; refinement of the Nash equilibrium: subgame perfect equilibrium, perfect Bayesian equilibrium, sequential equilibrium; Principal-Agents problems: adverse selection, moral hazard, signaling games; repeated games: representation of repeated games, infinitely repeated games, finitely repeated games.

**Teaching-Learning Method**: Lecture, literature review and presentations

**Mode of Assessment**: Presentations (40%), Written Examination (60%)

**Stat 590: Operations Research (3)**

Definition and nature of operations research(OR); major phases of an OR study; linear programming, feasible and optimal solutions linear programming techniques, graphical solution of two-variables linear model, simple method, duality theory; the transportation model, assignment model; network analysis, CPM and PERT model; decision analysis, decision making without and with experimentation, decision trees, utility analysis; game theory, the formulation of two-person zero-sum games, games with mixed strategies, graphical solution procedure, solving by linear programming; queuing theory, single channel and multi-channel problems, single server waiting time models; inventory theory, inventory model with production planning and simulation techniques. Software for OR analyses

**Teaching-Learning Method**: Lecture, practicing with real data, literature review and presentations

**Mode of Assessment**: Assignments (20%), Presentations (20%), Written Examination (60%)

**Stat 600: Mathematics for Economics (3)**

Review of basic calculus and algebra; linear functions and models in economics; non-linear equations and their applications in economics; mathematics of finance; differentiation and integrations in economics; linear algebra and applications in economics; multivariate calculus and its applications in economics; constrained optimization and dynamics in economics

**Teaching-Learning Method**: Lecture

**Mode of Assessment**: Assignments (40%), Written Examination (60%)