This document contains course contents of Bachelor of Science in Software Engineering (BSSE), which have been designed/prepared by the Head of the Department. The course contents are designed in the light of the revisions recommended by HEC National Computer Science Curriculum Revision Committee and HEC National Curriculum Revision Committee for Software Engineering (NCRC-SE).

Apart from HEC, various national and international websites have been visited for assistance in preparation of the stated course contents. This include, International Islamic University Pakistan, NUST Pakistan, UST-Bannu Pakistan, Keele University UK, Computer Science University of TORONTO, IBA [http://cs.iba.edu.pk/index.html], College of New Caledonia Prince George Campus [www.cse.unsw.edu.au/www.studygroup.com] University of Surrey, Australian National University, Canberra [http://cs.anu.edu.au/], Department of Computer Science at the University of Cyprus [http://www.cs.ucy.ac.cy/~dzeina/courses/epl446/schedule.htm], Department of Communication, State University College Fredonia, New York [www.fredonia.edu/department/communication/schwalbe/cm353syl.htm], [http://www.cecs.csulb.edu/~mongs/2009SummerProgram/courseDescriptions.html#globalsweng] and Instituto de Investigaciones en Informatica Institute Turkey [http://www.ii.metu.edu.tr/].

The schemes of studies of BSSE used in this document are already approved by the Vice Chancellor, University of Malakand in anticipation.

Course Contents:

Prepared by:
Dr Siffat Ullah Khan
Head/Chairman
Department of Software Engineering
University of Malakand, Pakistan.

Reviewed by:
Dr Mahmood Niazi
Associate Professor
King Fahad University of Petroleum and Minerals, Saudi Arabia.
Keele University UK

Approved by:
1. Prior Approval by the Vice Chancellor, UOM dated: 30-Sep-2011
2. Approved by the Board of Studies dated: 25-Feb-2012
NOTIFICATION

It is notified for the information of all concerned that the Vice Chancellor, in anticipation of approval from the relevant bodies, has been pleased to approve the enclosed courses for BS-Software Engineering with immediate effect.

This issues with the approval of the Competent Authority.

Encl: (Duly signed list of the approved courses)

Copy to:
1. The Controller of Examinations, University of Malakand.
2. Incharge, Department of Software Engineering, University of Malakand
3. Deputy Director Admissions, University of Malakand.
4. File
<table>
<thead>
<tr>
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<tbody>
<tr>
<td>SE 411</td>
<td>Introduction to Information and Communication Technologies (ICTs)</td>
<td>3</td>
<td>MT 421</td>
<td>Discrete Structures</td>
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<td>SE 412</td>
<td>Programming Fundamentals</td>
<td>3+1</td>
<td>SE 422</td>
<td>Object Oriented Programming</td>
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<td>Calculus and Analytical Geometry</td>
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<td>SE 423</td>
<td>Digital Logic and Design</td>
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<td>Physics</td>
<td>3</td>
<td>SE 424</td>
<td>Introduction to Software Engineering</td>
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<td>EG 415</td>
<td>Functional English</td>
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<td>PS 425</td>
<td>Pakistan Studies</td>
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<td>Islamic Studies</td>
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<td>ST 426</td>
<td>Probability and Statistics</td>
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**Total Credit Hours** 18

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<td>EG 431</td>
<td>Communication &amp; Interpersonal Skills</td>
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<td>SE 441</td>
<td>Data Communication and Computer Networks</td>
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<td>SE 432</td>
<td>Data Structure and Algorithm</td>
<td>3+1</td>
<td>MT 442</td>
<td>Numerical and Symbolic Computing</td>
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<td>SE 433</td>
<td>Computer Organization and Architecture</td>
<td>3</td>
<td>SE 443</td>
<td>Introduction to Database Systems</td>
<td>2+1</td>
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<tr>
<td>MT 434</td>
<td>Linear Algebra</td>
<td>3</td>
<td>EG 444</td>
<td>Technical and Business Writing</td>
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<td>SE 435</td>
<td>Professional Ethics</td>
<td>2</td>
<td>SE 445</td>
<td>Software Requirements Engineering</td>
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<td>SE 436</td>
<td>Operating Systems</td>
<td>3</td>
<td>SE 446</td>
<td>Web Technologies</td>
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**Total Credit Hours** 18

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<td>MT 451</td>
<td>Automata Theory and Compiler</td>
<td>3</td>
<td>SE 461</td>
<td>Human Computer Interaction</td>
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<td>SE 452</td>
<td>Web Engineering</td>
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<td>SE 462</td>
<td>Agile Software Development</td>
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<td>SE 453</td>
<td>Software Engineering Economics</td>
<td>3</td>
<td>SE 463</td>
<td>Software Development and Testing</td>
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<td>SE 555</td>
<td>Advance Database Systems</td>
<td>3</td>
<td>MS 465</td>
<td>Entrepreneurship</td>
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<td>MS 456</td>
<td>Human Resource Management</td>
<td>3</td>
<td>SE 466</td>
<td>Empirical Software Engineering</td>
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**Total Credit Hours** 18

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<tr>
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<td>Senior Capstone Project I</td>
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<td>SE 581</td>
<td>Senior Capstone Project II</td>
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<td>SE 472</td>
<td>Software Project Management</td>
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<td>SE 482</td>
<td>Global Software Engineering</td>
<td>3</td>
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<td>SE 473</td>
<td>Software Quality Engineering</td>
<td>3</td>
<td>SE 483</td>
<td>Software Process Improvement</td>
<td>3</td>
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<td>SE 474</td>
<td>Business Process Management</td>
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<td>SE 484</td>
<td>Open Source Software Development</td>
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<tr>
<td>SE 475</td>
<td>Artificial Intelligence</td>
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**Total Credit Hours** 15

**Total Credit Hours: 135**

Dated: 16-May-2013
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<th>Course Title: Introduction to Information and Communication Technologies (ICTs)</th>
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<tbody>
<tr>
<td>Course Code: SE 411</td>
</tr>
<tr>
<td>Semester: 1</td>
</tr>
<tr>
<td>Credit Hours: 3</td>
</tr>
</tbody>
</table>

**Course Outline:**

- History of Computer
- Basic I/O and Storage devices
- Number Systems
- Boolean Logic
- Basic Machine Organization
- Algorithm Definition, Design, And Implementation
- Programming Paradigms And Languages
- Overview Of Software Engineering And Information Technology
- Operating System
- Computer Networks And Internet, Modes of Data Transmission,
  Communication Technologies

**Reference Material:**

- Introduction To Computing By AmnaNudrat
- Introduction to Computers, by Peter Norton
# Course Title: Programming Fundamentals

**Course Code:** SE 412  
**Semester:** 1  
**Credit Hours:** 4

## Course Outline:

- History of C/C++
- Constants, Variables, Operators and Key words
- Basic Structure of a Program
- Loops
- Transfer of Control statements (Go to, Switch, break)
- Data Types
- Control Structures
- Functions, Arrays, Records, Files
- Algorithms And Problem Solving
- Development Of Basic Algorithms
- Fundamental Programming Constructs
- Translation Of Algorithms To Programs
- Flowcharts

## Reference Material:

- Programming In C++ By Robert Lafore
- How To Program C++ By Dietel&Dietel
<table>
<thead>
<tr>
<th>Course Title: Calculus And Analytic Geometry</th>
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</thead>
<tbody>
<tr>
<td>Course Code: MT 413</td>
</tr>
<tr>
<td>Credit Hours: 3</td>
</tr>
<tr>
<td>Semester: 1</td>
</tr>
</tbody>
</table>

**Course Outline:**

- Complex Numbers
- Demoivre’s Theorem And Its Applications
- Simple Cartesian Curves
- Functions And Graphs
- Symmetrical Properties
- Curve Tracing
- Limit And Continuity
- Differentiation Of Functions
- Derivative As Slope Of Tangent To A Curve And As Rate Of Change
- Application To Tangent And Normal
- Linearization
- Maxima/Minima And Point Of Inflexion
- Taylor And Maclaurin Expansions And Their Convergence
- Integral As Ant derivative
- Indefinite Integration Of Simple Functions
- Methods Of Integration
- Integration By Substitution
- By Parts
- And By Partial Fractions
- Definite Integral As Limit Of A Sum
- Application To Area
- Arc Length
- Volume And Surface Of Revolution.

**Reference Material:**

- Calculus and Analytical Geometry by Swokowski, Olinick and Pence.
- Calculus, William E. Boyce Richard C. Diprima, John Wiley & Sons,
Course Title: Physics
Course Code: PH 414
Semester: 1
Credit Hours: 3

Course Outline:

Vector Motion:
- Position,
- Velocity,
- Acceleration Vectors.
- Newton’s Laws.
- Projectile Motion,
- Uniform Circular Motion,
- Application. Rotational Motion:
- Constant Angular Acceleration,
- Torque. Momentum: Linear
- Angular Momentum,
- Two-Body Collisions,
- Conservation Of Momentum.
System Of Particles:
- Motion Of Complex Objects,
- Centre Of Mass Of Solid Objects.
Work And Energy:
- Power,
- Kinetic And Potential Energy,
- Conservative Systems.

Reference Material:

- *University Physics, 8th Edition*, Hugh Young, Addison Wesley.
- Solomon Gratenhaus "Physics, Basic Principles"
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<tr>
<th>Course Title: Functional English</th>
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<tr>
<td>Course Code: EG 415</td>
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<tr>
<td>Semester: 1</td>
</tr>
<tr>
<td>Credit Hours: 3</td>
</tr>
</tbody>
</table>

**Course Outline:**

**Basic Units**
- Syllables, Word, Phrase, Clause, Sentence, Paragraph

**Sentence**
- Parts – Subject, Predicate
- Types – Simple Sentence, Compound Sentence, Complex Sentences

**Parts Of Speech**
- Nouns, Pronouns, Adjectives, Verbs, Adverbs, Preposition, Conjunction, Interjection

**Nouns**
- Definition, Kinds, Gender, Number

**Pronouns**
- Definition, its kinds

**Verbs**
- Definition, its kinds

**Tenses**
- Present, Past, Future

**Voices**
- Active and Passive Voices
- Assertive, Interrogative, imperative, exclamatory

**Narrations**
- Direct and Indirect Narration
- Assertive, Interrogative, imperative, exclamatory

**Punctuation**
- Period, Question Mark, Exclamation Point, Ellipses, Underscore or Italics, Apostrophe, Quotation Marks, Parenthesis, Dash, Hyphen, Colon, Semicolon, Comma

**Similar Words**
- Words that Confuse

**Comprehension**
- Comprehension of Unseen Passage, Answering question About the passage

**Precise**
- One third summary

**Paragraph writing**
- How to write a paragraph
- Four elements in a paragraph

**Reading Material:**
- English Grammar and Composition PC Wren and Martin
- English Grammar and Composition Efzal Anwar Mufti
- English Grammar and Translation Mumtaz Ahmed
- University Grammar of English R Quirk and S Greenbaum
Course Title: Islamic Studies  
Course Code: IS 416  
Semester: 1  
Credit Hours: 2

**Course Outline:**  
Fundamentals of Islam. (Aqaid, Ibadat, Islamic Dawah etc.);

Ethical values of Islam; Serah of the Holy Prophet (Sallalah-o-Alaihe-wasalam)

Islamic Civilization, Values and Culture and its impact on humanity.

Seerat-un- Nabi (Sallalah-o-Alaihe-wasalam)  
Ghazwat-un- Nabi (Sallalah-o-Alaihe-wasalam)  

A brief explanation of any 40 Hadiths of the Prophet Muhammad (Sallalah-o-Alaihe-wasalam)

A brief explanation/Tafseer of the last 20 Surahs of the Holy Quran.
Course Title: Discrete Structures
Course Code: MT 421
Semester: 2
Credit Hours: 3

Course Outline:

**Proposition Logic and Proof**
- Propositional calculus, Conjunction, Disjunction, Negation, Implication, Biconditional, Truth table, Logical Equivalences, Tautologies, Contradiction, Contingency, Methods of proving theorems (Direct, Indirect, contradiction)

**Sets and Functions**
- Basic Definitions, power Set, De Morgan’s Laws, Venn Diagrams, Cartesian
- Product of Sets, Set Identities, Operation on sets
- Inverse Function, Composition of Function,
- Some important Function (Floor and Ceiling Function)

**Integers and Matrices**
- Integers and Division, GCD and LCM, Elementary Number Theory
- Definitions of Matrices, Square and Symmetric Matrix, Transpose of Matrices
- Inverse Matrix, Solutions of System of Linear Equation in Two Variables

**Mathematical Induction and Recursion**
- Simplification of Sequences and Summations, Proofs by Mathematical Induction
- Recursively Defined Functions

**Counting (Techniques)**
- Basic Counting Principles (Product Rules, Sum Rule and Inclusion – Exclusion Principles), Pigeon Hole Principle, Permutation and Combination

**Relations**
- Function as Relation, Relation on Sets, Properties of Relation
- Equivalence Relations and Classes

**Boolean Algebra**
- Boolean Expression and Function, Boolean Identities, Duality
- Networking of Logic gates (Circuits) and Combination of gates
- Preparing Logic diagrams from Expression and obtaining Logic expressions from Diagrams, Obtaining Truth Tables from Diagrams and Diagrams from Truth Table.

**Graph**
- Type of Graph (Simple, Multi, Pseudo, Directed, and Directed Multi Graphs)
- Definitions of Some Special Simple Graphs (Complete Graph (KN), Cycles (CN), Wheels (WN))
- Graph Terminology, Adjacency Matrix (Boolean Matrix), Path Matrix.

**Text Books:**
- Discrete mathematics and its Application by Kenneth Rosen Fifth Edition
- Fundamental Structures of Algebra and Discrete Mathematics by Stephan Folds
- Discrete Mathematics, by Mormon L. Biggs.
<table>
<thead>
<tr>
<th>Course Title: Object Oriented Programming</th>
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<tr>
<td>Course Code: SE 422</td>
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<tr>
<td>Semester: 2</td>
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<tr>
<td>Credit Hours: 3</td>
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</table>

**Course Outline:**
- Evolution Of OO,
- OO Concepts And Principles,
- Problem Solving In OO Paradigm,
- OO Program Design Process,
- Classes,
- Methods,
- Objects
- Encapsulation;
- Constructors And Destructors,
- Operator And Function Overloading,
- Virtual Functions,
- Derived Classes,
- Inheritance And Polymorphism.
- I/O And File Processing,
- Exception Handling

**Reference Material:**

- *Understanding Object Oriented Programming*, Budd, Addison Wesley.
- *C++: How To Program*, Dietel And Dietel, 4/E, Pearson.
- C++ for Programmers by Paul J. Deitel; Harvey M. Deitel
<table>
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<th>Course Title: Digital Logic and Design</th>
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<td>Course Code: SE 423</td>
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<td>Semester: 2</td>
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<td>Credit Hours: 3</td>
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**Course Outline:**

Overview Of Binary Numbers, Boolean Algebra, Switching Algebra, Logic Gates, Karnaugh Map, Boolean Functions, Combinational Design; Two Level Nand/Nor Implementation, Combinational Logic Design: Adders, Subtracters, Code Converters, Parity Checkers, Multilevel Nand/Nor/Xor Circuits, MSI Components, Design And Use Of Encoders, Decoders, Multiplexers, BCD Adders, Comparators, Flip-Flops, Synchronous Sequential Circuit Design And Analysis, Registers, Synchronous And Asynchronous Counters, Memories, Wired Logic And Characteristics Of Logic Gate Families, State Reduction Good State Variable Assignments, Algorithmic State Machine (ASM) Charts, Asynchronous Circuits, Memory Systems, Functional Organization.

**Reference Material:**

- B. Holdsworth “Digital Logic Design”
- Edward J McCauley “Logic Design Principles”
- Digital Principles and Logic Design by Saha; N. Manna
Course Title: Introduction to Software Engineering
Course Code: SE: 424
Semester: 2
Credit Hours: 3

Course Outline:

<table>
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<tr>
<th>INTRODUCTION TO INFORMATION SYSTEM</th>
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<tr>
<td>• System &amp; Procedures</td>
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<tr>
<td>• Information System Components</td>
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<tr>
<td>• Business Information System</td>
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<tr>
<td>• Types of Information System</td>
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<td>• Organizational Levels</td>
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<td>• System Development Life Cycle</td>
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<th>SYSTEM PLANNING</th>
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<tr>
<td>• Strategic Planning Process</td>
</tr>
<tr>
<td>• Information System Projects</td>
</tr>
<tr>
<td>• Evaluation of System Requirements</td>
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<tr>
<td>• Preliminary Investigation objectives</td>
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<td>• Preliminary Investigation Steps</td>
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<th>SYSTEM ANALYSIS</th>
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<tr>
<td>• System Requirements</td>
</tr>
<tr>
<td>• Interviews</td>
</tr>
<tr>
<td>• Other Fact Finding Technique</td>
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<tr>
<td>• Other System Development Techniques</td>
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<table>
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<th>ANALYZING REQUIREMENTS</th>
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<tbody>
<tr>
<td>• Structured Analysis</td>
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<tr>
<td>• Data Flow Diagram</td>
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<td>• Data Dictionary</td>
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<table>
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<tr>
<th>OUTPUT DESIGN</th>
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<tr>
<td>• System Design Overview, General Guidelines for Systems Design</td>
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<tr>
<td>• Designing &amp; using Codes, Introduction to Output Design</td>
</tr>
<tr>
<td>• Types of output and information delivery</td>
</tr>
<tr>
<td>• Designing Printed Reports, Designing Screen Output</td>
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<table>
<thead>
<tr>
<th>INPUT DESIGN</th>
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<tbody>
<tr>
<td>• Input Design Objectives, Key Tasks in input Design</td>
</tr>
<tr>
<td>• Source document Design, Input record design, Input controls</td>
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</table>

Recommended Books:
- System Analysis & Design (SHELLY CASHMAN ROSENBLATT)
- Software Engineering, A Practitioners Approach, Roger S Pressman
- A Concise Introduction to Software Engineering by Pankaj Jalote
  Springer; January 2008
<table>
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<tr>
<th>Course Title: Pakistan Studies</th>
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<td>Course Code: PS 425</td>
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**Course Outline:**

**Historical Perspective:**
- Ideological rationale with special reference to Shaikh Ahmad Sirhindi, Shah Waliullah, Sir Syed Ahmad Khan.
- Educational Movements, Aligarh, Anjuman-i-Himayat Islam.
- Sindh Madrasah and Islamia College Peshawar

**The Pakistan Ideology**
- Definition and Explanation of Pakistan Ideology.
- The Pakistan Ideology and Allama Muhammad Iqbal
- The Pakistan Ideology and Quaid-E-Azam.

**Muslim Political Struggle**
- Formation of All India Muslim League, 1906.
- Fourteen Points of Qaid-E-Azam, 1929.
- Allama Iqbal’s Presidential Address at Allahabad, 1930
- The 1937 Election and Attitude of Congress Ministries towards Muslims.
- The Pakistan Resolution 1940. The 1940 Election and Transfer of Power.

**Establishment of Pakistan**
- Early Problems and Important Events

**In Corporation of Islamic Provisions in the Constitutions of Pakistan and Political Development**
- Objective Resolution
- Success and failure of Democracy in Pakistan; causes and remedies
- The Islamic Clauses in the constitutions of Pakistan, 1956-1962 and 1973

**Our Land**
- Geographical unity, Location, Geographical Importance of Pakistan; Natural Resources.

**Text Books:**
- The Emergence of Pakistan By Chaudhary Muhammad Ali

**Reference Material:**
- Economic and Social Progress in Asia. Umar Noman, Karachi, 99
- Pakistan’s Foreign policy: An Historical analysis: S.M. Burke, 1993
- Pakistan Political Roots & Development: Safdar Mahmood, Lahore, 94
- 4. Newspaper’s editorial and selected journalistic writings.
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**Course Outline:**

Introduction to Statistics, Descriptive Statistics, Statistics in decision making, Graphical representation of Data Stem-and Lead plot, Box-Cox plots, measures of central tendencies and dispersion, moments of frequency distribution; Counting techniques, introduction to probability, sample space, events, laws of probability, Conditional probability and Bayes’ theorem with application to random variable (Discrete and continuous) Binomial, Poisson, Geometric, Negative Binomial Distributions; Exponential Gamma and Normal distributions. Regression and Correlation, Estimation and testing of hypotheses, use of elementary statistical packages (SPSS) for explanatory Data analysis.

**Reference Material:**

<table>
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<th>Course Title: Communication &amp; Interpersonal Skills</th>
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<tbody>
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<td>Course Code: EG: 431</td>
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<tr>
<td>Course Outline:</td>
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<tr>
<td>Concept of Communication</td>
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<tr>
<td>- Definition and process of communication</td>
</tr>
<tr>
<td>- Components of communication</td>
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<tr>
<td>(Context, Sender-Encoder, Message, Medium, Receiver-Decoder, Feedback)</td>
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<tr>
<td>- Role of communication in an organization</td>
</tr>
<tr>
<td>- Barriers to effective communication</td>
</tr>
<tr>
<td>Types of communication</td>
</tr>
<tr>
<td>- Verbal, Non-verbal, Upward, downward, horizontal, interpersonal, GroupCommunication</td>
</tr>
<tr>
<td>- Upward, Downward and Interpersonal Communication, Group Communication</td>
</tr>
<tr>
<td>The seven C’s of Effective Communication</td>
</tr>
<tr>
<td>- Completeness, Conciseness, consideration, Concreteness, Clarity, Courtesy, correctness</td>
</tr>
<tr>
<td>Strategies for Improving Oral Presentation</td>
</tr>
<tr>
<td>- Steps for preparing effective oral presentations.</td>
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<tr>
<td>- Strategies for an effective Non-verbal delivery</td>
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<tr>
<td>Strategies for reducing stage fright</td>
</tr>
<tr>
<td>- Signs of discomfort, Strategies for decreasing speaking fears</td>
</tr>
<tr>
<td>Strategies for improving listening skills</td>
</tr>
<tr>
<td>- Faults in listening, Purpose for listening, Results of good listening</td>
</tr>
<tr>
<td>Meetings</td>
</tr>
<tr>
<td>- Purposes and kinds, Planning steps before the meeting</td>
</tr>
<tr>
<td>- Procedures during the meeting</td>
</tr>
<tr>
<td>Interview:</td>
</tr>
<tr>
<td>- Preparation before the job interview</td>
</tr>
<tr>
<td>- Procedures during the job interview</td>
</tr>
<tr>
<td>Proposals:</td>
</tr>
<tr>
<td>- Definition, concept, Kinds and Purposes, Parts of a Proposal</td>
</tr>
<tr>
<td>Recommended Books:</td>
</tr>
<tr>
<td>- Effective business Communication 7th Edition by Herta A-Murphy, Herbert Jane</td>
</tr>
<tr>
<td>- Herbert W.Hilderbrandth, James and Thomas MC Hills</td>
</tr>
<tr>
<td>- Bovee Business Communication Today</td>
</tr>
</tbody>
</table>


<table>
<thead>
<tr>
<th>Course Title: Data Structures And Algorithms</th>
</tr>
</thead>
<tbody>
<tr>
<td>Course Code: SE 432</td>
</tr>
<tr>
<td>Semester: 3</td>
</tr>
<tr>
<td>Credit Hours: 3</td>
</tr>
</tbody>
</table>

**Course Outline:**

- Introduction To Data Structures;
- Arrays,
- Stacks,
- Queues,
- Priority Queues,
- Linked Lists,
- Trees,
- Graphs.
- Recursion,
- Sorting And Searching Algorithms,
- Hashing, Storage And Retrieval Properties And Techniques for Various Data Structures.
- Algorithm Complexity And Analysis.

**Reference Material:**

- Data Structure In C++ By Aikman Series.
- Data Structures and Algorithm Analysis in C++, Mark Allen Weiss
- Data structures by Seymour Lipchitz (Schaum’s series)
Course Title: Computer Organization and Architecture
Course Code: SE 433
Semester: 3
Credit Hours: 3
Course Outline:
  o Programming model of 8086 family. Addressing Modes.
  o Data types, complements, fixed point representation, floating point representation, binary codes.
  o Instruction Codes, Computer Register, Computer Instruction, Timing and Control, Instruction Cycle, Memory-Reference Instruction, Input-Output, Interrupt, Complete description and design of Basic Computer. Design of Accumulator and ALU.
  o Assembly Language Programming with help of MASM and Debugger Control Memory, Address Sequencing, Micro program, Computer Configuration, Microinstruction format, Symbolic Microinstruction. The Fetch Routine, Symbolic Micro program, Binary Micro program, Design of Control Unit, Micro program Sequencer.
  o Memory Hierarchy, Main Memory, Cache Memory, Virtual Memory, Memory Management.
  o General Register Organization, Stack Organization, Instruction format, Addressing Modes, Date transfer and manipulation, Program Control, RISC & CISC Computer and their characteristics.
  o Parallel Processing, Pipelining, Arithmetic Pipeline, Instruction Pipeline, Vector Processing.

Text Books:
  • Computer System Architecture by M. Morris Mano, Third Edition
  • Computer Architecture by Morio De Blasi.
  • Computer Architecture & Organization by A.J.Van De Goor.
<table>
<thead>
<tr>
<th>Course Title: Linear Algebra</th>
</tr>
</thead>
<tbody>
<tr>
<td>Course Code: MT 434</td>
</tr>
<tr>
<td>Semester: 3</td>
</tr>
<tr>
<td>Credit Hours: 3</td>
</tr>
</tbody>
</table>

**Course Outline:**
- Vectors,
- Vector Spaces,
- Matrices & Determinants,
- Cofactor And Inverse,
- Rank,
- Linear Independence,
- Solution Of Linear Systems,
- Gaussian Elimination,
- Positive Définit Matrix,
- Linear Transformations,
- Operations On Matrices,
- Inner Products,
- Eigenvalues & Eigenvectors.

Applications To Systems of Equations And To Geometry.

**Reference Material:**

- Advanced Engineering Mathematics, 7th Edition by Erwin Kreyszig
<table>
<thead>
<tr>
<th>Course Title: Professional Ethics</th>
</tr>
</thead>
<tbody>
<tr>
<td>Course Code: SE 435</td>
</tr>
<tr>
<td>Semester: 3</td>
</tr>
<tr>
<td>Credit Hours: 2</td>
</tr>
</tbody>
</table>

**Course Outline:**

Historical, social, and economic context of Computing (software engineering, Computer Science, Information Technology); Definitions of Computing (software engineering, Computer Science, Information Technology) subject areas and professional activities; professional societies; professional ethics; professional competency and life-long learning; uses, misuses, and risks of software; information security and privacy; business practices and the economics of software; intellectual property and software law (cyber law); social responsibilities, software related contracts, Software house organization

**Reference Material:**


**HEC Course Outline: Page 26**
<table>
<thead>
<tr>
<th>Course Title: Operating Systems</th>
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</thead>
<tbody>
<tr>
<td>Course Code: SE 436</td>
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</tr>
<tr>
<td>Semester: 3</td>
<td></td>
</tr>
<tr>
<td>Credit Hours: 3</td>
<td></td>
</tr>
</tbody>
</table>

**Course Outline:**


Scheduling and dispatch, Introduction to concurrency.

Lab assignments involving different single and multithreaded OS algorithms.

**Reference Material:**


3. Operating System, by William Stallings


5. Operating Systems Demystified by Patti Short


HEC Course Outline: Page 21
Course Title: Data Communication and Computer Networks

Course Code: SE 441

Semester: IV

Credit Hours: 3+1

Course Outline:

Data Communications and Networking
- Elements or components of Data Communication, Types of Data Communication, Serial communication, Parallel communication, Asynchronous Communication, Synchronous Communication, Direction of dataflow

Network Hardware
- Local Area Network, Metropolitan Area Network, Wide Area Network, Wireless Network, Home Network, Inter Network

Reference Model
- General Model of Communication, the OSI Reference Model, The TCP/IP Reference Model, Encapsulation, De encapsulation

Local Area Network
- Topologies, LAN Devices in Topologies NICs, Repeaters, Hubs, Bridges, Switches, Routers

Transmission Media

Guided Media
- Twisted Pair Cable, Coaxial Cable, Fiber Optic Cable

Unguided Media
- Radio Waves, Micro Waves, Infrared

Layer 2: Technologies
- Introduction, Token Ring, Ethernet, FDDI

Error Detection and Correction
- Types of errors, Single bit error, Burst error, Detection Redundancy, Parity Check, Cyclic Redundancy Check (CRC)
- Correction, Error correction by retransmission, Forward error correction

Point to Point Access
- PPP Stack, Link Control Protocol Authentication protocol, Network Control Protocol

Wireless Networks

Recommended Books:
- Data Communication and Networking By Behrouz A. Forouzan
- Computer Network By Andrew S Tenenbaum
- Data Communication and Networking by C.S.V. Murthy
<table>
<thead>
<tr>
<th>Course Title: Numerical and Symbolic computing</th>
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<tbody>
<tr>
<td>Course Code: MT 442</td>
</tr>
<tr>
<td>Semester: IV</td>
</tr>
<tr>
<td>Credit Hours: 3</td>
</tr>
</tbody>
</table>

**Course Outline:**

- **Review of basic numerical methods**
- **2 Direct methods for Linear Systems (Intro)**
  - Matrix inversion using row operations.
  - Crout's LU decomposition. Matlab methods and routines for direct solution

- **Iterative methods for linear systems (Intro)**
  - Review: Jacobi, Gauss-Seidel, SOR, SSOR, CG, Bi-CGSTAB, GMRES, IDR(s) (only algorithms)
  - Preconditioning for Krylov-subspace solvers.

- **Averaging and Interpolation (Intro)**
  - Review of Kronecker-tensor products.
  - Equidistant Grid based averaging (restriction) in 2D.
  - Full-Weighting (FW), Half-weighting (HW), and injection ops.
  - Equidistant Grid based interpolation (prolongation) in 2D.
  - Linear, bilinear, and cubic ops. Matlab implementation of restriction and prolongation

- **Multi-grid based solution of elliptic PDEs (Intro)**
  - Basic categories of elliptic PDEs. Vertex-centered and cell-centered FDM
  - Discretization. Multi-grid components. Smoothers and transfer operators.

- **Local Fourier Smoothing Analysis (Intro)**
  - The 2-grid algorithm.
  - Migration to V-cycle multi-grid. Other cycle types such as W and F.
  - Complexity analysis of V-cycle multi-grid.

**Reference Material:**

- Applied Numerical Analysis by Gerald & Wheatley, 5th Edition or later.
- Numerical Analysis, 3rd Edition Dr. Saeed Akther
- Templates for the solution of sparse linear systems (available gratis on the Internet)
  - http://fcsiba.wikispaces.com/F11_CSE316_Numeric_and_symbolic_computation
- Walter Gautschi, Numerical Analysis : An Introduction, Springer Verlag, April 1, 1997
Course Title: Introduction to Database Systems
Course Code: SE 443
Semester: IV
Credit Hours: 3

Course Outline:
- Conceptual DB Design
- Relational Data Model
- Conversion of ER to Relational Data Model
- Relational Algebra
- SQL
- PL/SQL
- Relational Calculus
- Relational Database Design Fundamental I: Functional Dependencies & Normal Forms
- Relational Database Design Fundamental II: Design Algorithms
- Database System Access and Storage I: Disk, Buffer, and File Management.
- Database System Access and Storage II: Indexing Techniques.
- Transaction Management.

Texts books:
- Fundamentals of Database Systems, by Elmasri and Navathe
- Modern Database Management, 4th Edition by Jeffery A.
- Databases: A Beginner's Guide by Andy Oppel

Reference books:
- Oracle Programming: A Primer, by Sunderraman
- A First Course in Database Systems, by Ullman and Wisdom
- Database Management Systems, by Ramakrishna
- Oracle PL/SQL, by Feuerstein
- The Theory of Relational Databases, by Maier.
- www.cse.unsw.edu.au/School of computer science and engineering
<table>
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<tr>
<th>Course Title: Technical and Report Writing</th>
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<tbody>
<tr>
<td>Course Code: SG 444</td>
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<tr>
<td>Semester: IV</td>
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<tr>
<td>Credit Hours: 2</td>
</tr>
</tbody>
</table>

**Course Outline:**

**OVERVIEW OF TECHNICAL RESEARCH AND REPORT WRITING**
- Definition and nature of technical writing.
- Properties of technical writing
- Basic principles of technical writing
- Styles in technical writing.
- The role of technical writing.
- The holistic guide of technical writing
- End products of technical writing.

**INFORMATION STRUCTURE/TECHNIQUES IN TECHNICAL WRITING**
- Distinction between technical and literary writing
- Formal definition.
- Description mechanism
- Process description
- Classification
- Cause and effect
- Comparison and contrast
- Analogy

**TYPES OF TECHNICAL REPORT**
- Report layout
- Formal report format
- Memorandum report
- Letter report
- Bulletins
- Abstract
- Proposal
- Research report
- Feasibility study.

**BUSINESS LETTERS**
- Definition and purpose
- Elements and characteristics
- Format and styles
- Types of business letters, Resume and cover letters
PROCESS AND GUIDELINES IN TECHNICAL WRITING
  o Audience analysis
  o Task analysis
  o Power-revision techniques
  o Libraries, documentation, cross-referencing
  o Basic patterns and elements of the sentence
  o Common grammar, usage, punctuation problems
  o Common spelling problems

GRAPHIC AIDS
  o Bar chart
  o Line chart
  o Tables
  o Circle or pie chart
  o Surface or strata chart
  o Map charts
  o Flow charts
  o Flow sheets.
  o Diagrams.
  o Figures
  o Photographs
  o Drawings
  o Important Points In Handling Graphics

CONTEMPORARY COMMUNICATION
  o E-mail
  o Internet
  o Desktop publishing
  o Hypertext

References Material:
  o Writing in English: a practical handbook for scientific and technical writers.© 2000.
  o www.studygroup.com University of Surrey
  o Effective business communication 7th Edition, herta A. Murphy
  o Herbert W.Hildebrandt, James & Thomas MC. Graw Hill
<table>
<thead>
<tr>
<th>Course Title: Software Requirements Engineering</th>
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<tbody>
<tr>
<td>Course Code: SE 445</td>
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<tr>
<td>Semester: IV</td>
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<tr>
<td>Credit Hours: 3</td>
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</tbody>
</table>

**Course Outline:**

Software life-cycle models; requirements modeling and analysis, Software requirements specification; Software requirements elicitation and analysis; Structured methods; object-oriented methods; formal methods in requirements (formal and executable specifications); requirements verification and validation; requirements elicitation (e.g., scripting, development of use cases and interface); software requirements metrics; prototyping user interfaces Customer acceptance of requirements.

**Resources:**

- Davis, A. *Software Requirements: Objects, Functions and States*, Prentice Hall.
- Software Engineering : A Practitioners Approach by Goger S. Pressman
- Software & Systems Requirements Engineering: In Practice by Brian Berenbach Daniel Paulish
### Course Title: Web Technologies

<table>
<thead>
<tr>
<th>Course Code: SE 446</th>
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<tbody>
<tr>
<td>Semester: IV</td>
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<tr>
<td>Credit Hours: 2+1</td>
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</tbody>
</table>

#### Course Outline:

**Web Essentials**

**Markup Languages**
HTML: Introduction, History, Versions, Syntax and Semantics, Fundamental Elements, Relative URL's, Lists, Tables, Frames, Forms, Creating HTML Documents

**Style Sheets**
CSS Introduction, Features, Syntax, Style Sheets and HTML, Text Properties, CSS Box Model, Normal Flow Box Layout, other style properties, Lists, Tables

**Client-Side Programming**
Scripting Languages, Introduction, History and Versions of JavaScript, Writing and Testing JavaScript Programs, Basic Syntax, Variables and Data Types, Statements, Operators, Literals, Functions, Objects, Methods, Constructors, Arrays, Built-in Objects

**Browsers and the DOM**
Introduction, history, levels of Document Object Model, The Document Tree, Elements and Nodes, DOM Event Handling, Accommodating Non-compliant Browsers

**Server-side Programming**
Servlet Architecture, Hello World! Servlet, Generating Dynamic Content, Servlet Life Cycle, Sessions, Cookies, URL Rewriting, Other Servlet Capabilities, Data Storage, Servlets and Concurrency, Related Technologies

**Representing Web Data**

**Separating Programming and Presentation**
JSP and Servlets, Web Applications, Installing a Web Application, ,Defining Web Application Parameters, Basic JSP, JavaBeans and JSP, Model-View-Controller Paradigm, MVC Basics, Related Technologies, JSP Pages with Scriptlets, Active Server Pages and ASP.NET, PHP: Hypertext Preprocessor, ColdFusion

**Web Services**
Web Service Concepts, Java Web Service and clients, WSDL, XML Schema, SOAP, SOAP and HTTP

**Textbook:**

**Reference Material:**
Internet and World Wide Web: How to Program, By Harvey M. Deite, Prentice Hall, 2011.
W3Schools Online Web Tutorials, available at: [http://www.w3schools.com/](http://www.w3schools.com/)
Course Title: Automata Theory and Compiler  
Course Code: MT 451  
Semester: V  
Credit Hours: 3

<table>
<thead>
<tr>
<th>Course Outline:</th>
</tr>
</thead>
<tbody>
<tr>
<td>o <strong>Languages and Regular Expressions:</strong> Defining languages, Kleene closure, Definition of regular expressions (RE's), Languages associated with regular expressions.</td>
</tr>
<tr>
<td>o <strong>Finite Automata (FA):</strong> Definition of FA's, FA’s and their languages, Transition Graphs (TG's), No determinism, Unification of RE's, FA's and TG's.</td>
</tr>
<tr>
<td>o <strong>Finite Automata with Output:</strong> Moore machine, Mealy machines Equivalence of Moore and Mealy machines, Transducers</td>
</tr>
<tr>
<td>o <strong>Regular Languages:</strong> Union, concatenation, Kleene closure, complementation and intersection of regular languages, Decision procedures for the finiteness, and equivalence, No regular languages pumping lemma.</td>
</tr>
<tr>
<td>o <strong>Context-Free Grammars (CFG):</strong> Symbolism for generative grammars, Regular grammars, Chomsky normal form, Leftmost derivations.</td>
</tr>
<tr>
<td>o <strong>Pushdown Automata (PDA):</strong> Adding input tape and pushdown stack to FA's, Definition of PDA's, Non context free languages, Closure, intersection, and complement of context free languages, Decision problems, emptiness, uselessness, finiteness, The CYK algorithm, Parsing.</td>
</tr>
<tr>
<td>o <strong>Turing Theory:</strong> Turing machines, Post machines, Two stack PDA, Recursively enumerable languages, Type 0 grammars, The universal Turing Machine.</td>
</tr>
</tbody>
</table>

**Recommended TextBooks:**
- Introduction to Computer Theory, Languages and Computatio, J Hopcroft, D. Ullman.
- Languages and Machines, An Introduction to the theory of Comp.Sc, @/E Thomas A. Sudkamp, Addison Wesley.
<table>
<thead>
<tr>
<th>Course Title: Web Engineering</th>
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<tbody>
<tr>
<td>Course Code: SE 452</td>
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<tr>
<td>Semester: V</td>
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<td>Credit Hours: 3</td>
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</tbody>
</table>

**Course Outline:**

- **Web Applications:**
  - Introduction, categories, Characteristics
- **Requirements Engineering for Web Applications**
- **Web Application Modeling:**
  - Requirements, content modeling, hypertext modeling, presentation modeling, methods and tools
- **Web Application architectures:**
  - Introduction, components, layered and data-aspect architectures
- **Technologies for web applications:**
  - Client side, server side, communication, and document specific technologies
- **Testing, operation and maintenance of web applications**
- **Web Project management**
- **Web Application Development Process**
- **Advanced Topics:**
  - Usability, performance, security of web applications, semantic web, semantic web services

**Required Text:**


**Reference Text:**

- *Web Engineering*, edited by Emilia Mendes and Nile Mosley, Springer-Verlag, 2005
### Course Title: Software Engineering Economics

<table>
<thead>
<tr>
<th>Course Code: SE 453</th>
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<tr>
<td>Semester: V</td>
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<tr>
<td>Credit Hours: 3</td>
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</table>

#### Course Outline:

#### Resources:
- Software Engineering Foundations: Unifying Theories, by Yingxu Wang

(HEC Pakistan, **International Islamic University Islamabad**)
<table>
<thead>
<tr>
<th>Course Title: Software Design and Architecture</th>
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<tbody>
<tr>
<td>Course Code: SE 454</td>
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<tr>
<td>Semester: V</td>
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<tr>
<td>Credit Hours: 3</td>
</tr>
<tr>
<td>Course Outline:</td>
</tr>
<tr>
<td>In-depth study of design patterns, building on material learned previously.</td>
</tr>
<tr>
<td>Application of design patterns to several example applications. In-depth study of middleware architectures including COM, Corba, and .Net. Extensive case studies of real designs. Basics of software metrics; measuring software qualities.</td>
</tr>
<tr>
<td>Reengineering and reverse engineering techniques.</td>
</tr>
</tbody>
</table>

**Resources:**

- Software Architecture in Practice by Len Bass, Paul Clements, Rick Kazman
- Evaluating Software Architectures by Paul Clements, Rick Kazman, Mark Klein
- Software Architecture Design - Methodology and Styles Stipes Publishing L.L.C. Copyright © 2006 Lixin Tao, Xiang Fu and Kai Qian
- Enterprise Software Architecture and Design: Entities, Services, and Resources By Dominic Duggan
<table>
<thead>
<tr>
<th>Course Title: Advance Database Systems</th>
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<tbody>
<tr>
<td>Course Code: SE 555</td>
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<tr>
<td>Semester: V</td>
</tr>
<tr>
<td>Credit Hours: 3</td>
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</tbody>
</table>

**Course Outline:**

- **Introduction to Advanced Database Management Systems**
  Overview of the Minibase system, Review of basic definitions: Data Models, Levels of Abstractions, Data Independence, Query Optimization, Transactions, Concurrency Control, Detailed Course Outline.

- **Overview of Storage and Indexing**
  DBMS Layer 1: Data on External Storage, Storage Mediums & Storage Hierarchy, DBMS Layer 2: Disk Space Manager (DSM), DBMS Layer 3: Buffer Manager (BM), DBMS Layer 4: Alternative File Organizations & Indexes (Access Methods), B+ Tree Index Overview, Hash-Based Index Overview, Clustered vs. Unclustered Indexes, Primary vs. Secondary Indexes.

- **Overview of Storage and Indexing**
  Comparison of File Organizations (System and Cost Model, Assumptions), I/O cost analysis (Heap Files, Sorted Files and Clustered B+Tree Index File), Indexes and Performance Tuning (Understanding the Workload, Index Specification in SQL, Index-Only Plans, Index Selection Guidelines).

- **Storing Data: Disks and Files**
  Disks (Components, Accessing a Block, Arranging Pages), RAID (Basic Concepts, Levels: 0 to 5 and 0+1), Disk Space Manager, Buffer Manager: Definitions (Pin/Unpin, Dirty-bit), Replacement Policies (LRU, MRU, clock), Sequential Flooding, Buffer in OS, File, Page and Record Formats: File Structure (Linked-List/Directory-based), Page Structure with Fixed/Variable-length records, Record Structure (Fixed-length/Variable-length), System Catalog.

- **Tree-based Indexing: ISAM**
  Introduction to Tree Indexes, Structure of Nodes in Trees, Binary Search over Sorted Files, Binary vs. N-ary Search Trees, ISAM: Indexed Sequential Access Method (Outline, Search, Insert, Delete, Examples).

- **Tree-based Indexing: B+Trees**

- **Hash-based Indexing**
  Static Hashing, Dynamic Hashing (Extendible Hashing, Linear Hashing), Extendible vs Linear Hashing

- **Overview of Query Evaluation**
  Revision of the Relational Model and Relational Operators, Overview of Query Evaluation, Introduction to Query Optimization, Alternative Plans: Motivation with Examples
<table>
<thead>
<tr>
<th>Topic</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>External Sorting</strong></td>
<td>Introduction (When a DBMS sorts data), Simple Two-Way Merge-Sort, External Merge-Sort, Double Buffering Using B+Tree for Sorting.</td>
</tr>
<tr>
<td><strong>Evaluating Relational Operator</strong></td>
<td>Introduction to Algorithms for Relational Operators, The Selection Operation (No Index/Unsorted Data, No Index/Sorted Data, B+Tree Index, Hash Index), General Selection Conditions (Conjunctive Normal Form &amp; Index Matching, Selections with No Disjunctions, Selections with Disjunctions, The Project Operation (using Sorting, using Hashing, Sorting vs. Hashing).</td>
</tr>
<tr>
<td><strong>Overview of Transaction Management &amp; Concurrency Control</strong></td>
<td>Introduction to Transactions, The ACID (Atomicity-Consistency-Isolation-Durability) Properties, Transactions and Schedules, Concurrent Executions of Transactions and Problems, 16.6) Transaction Support in SQL,Transactions and Schedules (Serial, Complete Schedules), Serializability (Conflicting Actions, Conflict Equivalence, Conflict Serializability, Testing for Serializability using Precedence Graphs, View Equivalence and View Serializability), Concurrent Execution of Transaction, Recoverability (Recoverable Schedule, Cascade less schedule, Strict Schedules).</td>
</tr>
<tr>
<td><strong>Concurrency Control with Locking</strong></td>
<td>Introduction to DBMS Concurrency Control, Concurrency Control with Locking, Locks and Types of Locks, Implementing Locks in a DBMS, Conversion of Locks (Upgrade/Downgrade), CC with Locking Techniques (Conservative 2PL, Basic 2PL, Strict 2PL, Rigorous 2PL), Deadlocks and Starvation.</td>
</tr>
<tr>
<td><strong>Concurrency Control with Timestamps</strong></td>
<td>Timestamp based CC: Definitions, Basic Timestamp Ordering (TO) Algorithm and Examples, Strict Timestamp Ordering, Multi-version Concurrency Control, Optimistic Concurrency Control.</td>
</tr>
<tr>
<td><strong>Crash Recover</strong></td>
<td>Definitions, Purpose, Failure Reasons, ACID Properties and Responsibilities, Undo Logging and Recovery, Check pointing and No quiescentCheckup,Redo Logging and Recovery, Redo-Undo Logging and Recovery, ARIES Algorithm.</td>
</tr>
<tr>
<td><strong>Introduction to Distributed Databases</strong></td>
<td>Introduction to Distributed Databases, Types of Distributed Databases, Homogeneous, Heterogeneous (Federated, Multi-DBs), Distributed Databases.</td>
</tr>
</tbody>
</table>
Architectures (Client Server, Collaboration Server, Middleware), Data Fragmentation & Replication (Horizontal, Vertical and Mixed Fragmentation).

Synchronous vs. Asynchronous Replication, Distributed Catalog Management. Distributed Query Processing (Centralized, Ship-to-one-site, Semi-join, Bloom-join)

Reference Material:
- Department of Computer Science at the University of Cyprus
  [http://www.cs.ucy.ac.cy/~dzeina/courses/epl446/schedule.htm](http://www.cs.ucy.ac.cy/~dzeina/courses/epl446/schedule.htm)
- Database Management System by Raghu Ramakrishnan and Johannes Gehrke.
- Advanced Database Technology And Design by Mario Piattini.
<table>
<thead>
<tr>
<th>Course Title: Human Resource Management</th>
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<tr>
<td>Course Code: MS 456</td>
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<tr>
<td>Semester: V</td>
</tr>
<tr>
<td>Credit Hours: 3</td>
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</table>

**Course Outline:**


**Reference Material:**

- Introduction to Human Resource Management by John Stredwick
Course Title: Human Computer Interaction

Course Code: SE 461

Semester: VI
Credit Hours: 3

Course Outline:

The Human, Computer and Interaction, Usability paradigm and principles, Introduction to design basics, HCI in software process.

Design rules, prototyping, evaluation techniques, task analysis, Universal design and User support and Computer Supported Cooperative Work.

Introduction to specialized topics such as Groupware, pervasive and Ubiquitous applications.

Resources:

- HCI Models, Theories, and Frameworks: Toward a Multidisciplinary Science by John Carroll
- Carroll Usability Engineering: Scenario-Based Development of Human Computer Interaction by Mary Rosson, John Carroll, Mary Beth Rosson

HEC Course Outline : Page no 23
Course Title: Agile Software Development
Course Code: SE 462
Semester: VI
Credit Hours: 3

Course Objectives

- Examine the common agile development practices and methods, including XP, Scrum, etc.
- Cover agile development methods and techniques concerning the entire software development process from problem conception through development, testing and deployment
- Compare and contrast different agile methods and other software engineering methods with respect to the productivity of development process and the qualities of the software products produced.

Course Outline:

- **Introduction**
  - Introduction and overview of various agile methods, such as eXtreme Programming (XP), Scrum, Feature-Driven Development, and Agile Modeling
  - Introduction and set up of the tools to be used in the class
  - Requirements and constraints of the projects. Source control tools.
- **Unit 1: Agile development using XP**
  - XP practices and tools. Test driven development (TDD)
  - Tools and frameworks for testing and mocking, Pair programming
- **Unit 2: Agile development using Scrum**
  - Scrum practices and tools, Continuous integration, Using and extending frameworks, such as Spring, Refactoring, Comparisons of iterative development and architecture-centric/ design-driven development methods, Maximizing reusability, extensibility, maintainability
- **Unit 3: Agile development using a dynamic language**
  - Strengths and weaknesses of using dynamic languages in agile software development, Importance of TDD in software development using dynamic languages, Test coverage monitoring, Improving performance and quality

Recommended books:

- Agile Software Development by Torgeir Dingsoyr (ed.), Tore Dyba (ed.), Nils Brede Moe
<table>
<thead>
<tr>
<th><strong>Course Title:</strong> Software Development and Testing</th>
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<tr>
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<td><strong>Semester:</strong> VI</td>
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<td><strong>Credit Hours:</strong> 3</td>
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**Course Outline:**
Basics of formal languages; syntax and semantics; grammars; Backus Naur Form. Parsing; regular expressions and their relationship to state diagrams.
Lexical Analysis; tokens; more regular expressions and transition networks; principles of scanners
Using tools to generate scanners; applications of scanners. Relation of scanners and compilers.
Parsing concepts; parse trees; context free grammars, LL Parsing
Overview of principles of programming languages. Criteria for selecting programming languages and platforms.
Tools for automating software design and construction. Modeling system behavior with extended finite state machines. SDL Representing concurrency, and analyzing concurrent designs.

*Sample labs and assignments:*
- Use of software engineering tools to create designs
- Use of parser generators to generate languages

**Testing Overview**

Testing Types (Manual Testing, Automation testing)
Testing Methods (Block Box, White Box, Gray Box)
Levels of Testing (Functional Testing, Non Functional Testing)
Testing Documentation (Test Plan, Test Scenario, Test case, traceability matrices)
Testing Estimation Techniques (Functional Point analysis, Mark-II Method)

**Reference Material:**
- Software Engineering by Roger S. Pressman.
- Software Engineering by Ian Somerville, 8th edition, Addison & Wesley. 2006
**Course Title:** Formal Methods in Software Engineering  
**Course Code:** SE 464  
**Semester:** VI

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<thead>
<tr>
<th>Course Outline:</th>
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<tbody>
<tr>
<td><strong>Admin &amp; Revision</strong></td>
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<tr>
<td>- Propositional logic, Predicate calculus</td>
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<tr>
<td>- Sets, Functions, Relations, Induction</td>
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<tr>
<td>- Bush Day - no lecture</td>
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<td>- Basic Haskell</td>
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<tr>
<th><strong>Logic</strong></th>
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<tr>
<td>- Natural Deduction,</td>
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<td>- Natural Deduction</td>
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<tr>
<th><strong>Inductive Types</strong></th>
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<tr>
<td>- Specification</td>
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<tr>
<td>- Structural Induction</td>
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<tr>
<th><strong>Hoare Logic</strong></th>
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<tr>
<td>- Partial Correctness</td>
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<td>- Proof Rules</td>
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<td>- Program Proof</td>
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<tr>
<th><strong>WP Calculus</strong></th>
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<td>- Total Correctness</td>
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<td>- Proof Rules</td>
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<td>- Program Proof</td>
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<tr>
<th><strong>Finite Automata</strong></th>
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<tr>
<td>- Finite State Machines</td>
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<td>- Regular Languages</td>
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<tr>
<td>- Non-determinism</td>
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<tr>
<th><strong>Specification in Z</strong></th>
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<tr>
<td>- Modeling and Specification</td>
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<td>- Schemas</td>
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<tr>
<td>- Examples</td>
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<tr>
<th><strong>Grammars &amp; Languages</strong></th>
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</thead>
<tbody>
<tr>
<td>- Grammars, Push-down Automata</td>
</tr>
<tr>
<td>- Quiz preparation review, Parsing</td>
</tr>
</tbody>
</table>
Reference Material:


- Bergmann, Merrie *The Logic Book*, McGraw-Hill.


- Australian National University, Canberra
  
  http://cs.anu.edu.au/
<table>
<thead>
<tr>
<th><strong>Course Title:</strong> Entrepreneurship</th>
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<tbody>
<tr>
<td><strong>Course Code:</strong> MS 465</td>
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<td><strong>Semester:</strong> VI</td>
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<td><strong>Credit Hours:</strong> 2</td>
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**Outline:**
- Introduction; Overview; Basic Definitions & Concepts of Entrepreneurship
- Entrepreneurial Insights
  - Nature
  - Role in Economic Development Entrepreneurship
- Starting a New Venture, New Ideas, Opportunity Recognition, Problem Solving, Product Planning & Development e-Commerce & Business Start-up
- Business Plan Development
- Marketing Plan Industry Analysis & Market Research. The Marketing Mix Preparation of the Marketing Plan Technology & Marketing
- Financing the Venture
  - Sources of Capital
  - SME
- Resource optimization, Profiling Entrepreneurs, Idea Generation
- Expanding the Venture
  - Goal Setting – Vision
  - Penetration
  - Diversification
  - Five Forces Model
- Ending a Venture – Exit Strategies, Venture Liquidation, Bankruptcy, Listing Ventures, Going Public

**Reference Materials:**
- Entrepreneurship Strategies and Resources 3-Edition; Marc J. Dollinger –Pearson Education.
Course Title: Empirical Software Engineering
Course Code: SE 466
Semester: VI
Credit Hours: 3

Course Outline:
Introduction & Orientation
- Course objectives
- Assessments
- Intro to Research Idioms

What is Science?
- Philosophy of Science
- Sociology of Science
- Metatheories

Research Design and Ethics
- Evidence-based software engineering
- What makes a good research paper?
- Research Design
- Research Ethics

Basics of Doing Research
- Finding good research questions
- Theory building
- Evidence and Measurement
- Peer Review Process

Experiments
- Controlled Experiments
- Quasi-experiments
- Sampling
- Replication

Case Studies
- Single and Multi-case
- Longitudinal Case Studies
- Approaches to Data Collection

Survey and Observation
- Surveys
- Focus Groups
- Ethnographies

Interventions
- Action Research
- Pilot Studies
- Benchmarking

Qualitative Analysis
- Grounded Theory
- Phenomenography
- Mixed Methods Research
Quantitative Analysis

- Basic Stats
- Significant figures!
- Choosing a statistical model
- Statistical Power Analysis
- Meta-Analysis

Publishing and Reviewing

- Where to publish
- The peer review process

Replication and Beyond

- How important is replication?
- Bias and Influences
- Threats to Validity (and how to reduce them)
- When to use empirical methods
- When NOT to use empirical methods

Recommended Books

- Strauss, A; Corbin, J; Basics of Qualitative Research : Techniques and Procedures for Developing Grounded Theory. Sage 199

Computer Science University of TORONTO
http://www.cs.toronto.edu/~sme/CSC2130/index.html
http://web.cs.toronto.edu
Course Title: Senior Capstone Project I
Course Code: SE 571
Semester: VII
Credit Hours: 3

Course Objectives

The course is designed to achieve the following objectives:

- Introduction to Develop a large software project for a community, university, private enterprise
- Understand the significance of teamwork in building software systems
- Apply effective project management techniques
- Utilize a variety of techniques to capture and understand user requirements
- Utilize design techniques appropriate to project assigned
- Introduction to Systematic Literature Review

Recommended Readings:


- SLR Guidelines by Barbara Kitchenham
<table>
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<tr>
<th>Course Title: Software Project Management</th>
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<td>Course Code: SE 472</td>
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<td>Semester: VII</td>
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<td>Credit Hours: 3</td>
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**Course Outline:**

- Introduction To Software Project Management,
- Software Development Problems
- Software Development Under Contract
- Software Development Life Cycle
- Principles Of Managing Software Engineers
- Project Support Function
- Preparation Of Estimates.

**Reference Materials:**

- Software Project Management, A Practitioner's Approach, E M Benetton
**Course Title:** Software Quality Engineering  
**Course Code:** SE 473  
**Semester:** VII  
**Credit Hours:** 3  

**Course Outline:**  
Introduction to software quality assurance, The Quality Challenge, Quality Control v/s Quality Assurance, Quality Assurance in Software Projects (Phases), Principles and Practices, Quality Management, Quality Assurance and Standards, Quality Planning and Quality Control, Verification and Validation, Planning Verification and Validation, Critical System Validation, Reliability Validation, Safety Assurance, Security assessment, Inspections and reviews, Principles of software validation, Software verification.  
Planning for Software Quality Assurance, Software Quality Assurance (SQA) Plans, SQA-Organizational Level Initiatives, SQA Planning (Observations, Numbers, Results), Software Testing, Specification based test construction techniques, White-box and grey-box testing, Others comprehensive software testing techniques for SDLC.  
Control flow oriented test construction techniques, Data flow oriented test construction techniques, Clean-room approach to quality assurance, Product Quality and Process Quality, Standards for process quality and standards for product quality, Walkthroughs and Inspections, Structure, Checklist, Audits, Roles and Responsibilities (Reviews, Inspections, etc), How to make Reviews and Inspections most effective  

**Lab Work:**  
- Planning and Development of test cases  
- Planning and implementation of different Testing Techniques e.g. White Box Testing, Black Box Testing, Recursion Testing etc  
- Collection and Generation of test data  
- Practicing Testing methodologies using automated testing tool & technologies  
- Analysis of Test results & Extreme testing  

**Resources:**  

**HEC Course Outline:** Page 89
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<tr>
<td>Course Code: SE 474</td>
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<td>Semester: VII</td>
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<td>Credit Hours: 3</td>
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**Course Outline:**

Historical, social, and economic context of Computing (software engineering, Computer Science, Information Technology); Definitions of Computing (software engineering, Computer Science, Information Technology) subject areas and professional activities; professional societies; professional ethics; professional competency and life-long learning; uses, misuses, and risks of software; information security and privacy; business practices and the economics of software; intellectual property and software law (cyber law); social responsibilities, software related contracts, Software house organization

**Resources:**


**HEC Course Outline: Page 26**
Course Title: Artificial Intelligence
Course Code: SE 475
Semester: VII
Credit Hours: 3

Course Outline:
- **Introduction**: The Turing Test approach, The cognitive modeling approach, The laws of thought approach, The rational agent approach
- **Solving Problems by Searching**: Breadth-first search, Uniform cost search, Depth-first search, Depth-limited search, Iterative deepening search, Bidirectional search
- **Informed Search Methods**: Best-First Search, Heuristic Functions, Memory Bounded Search, Iterative Improvement Search
- **Game Playing**: Alpha-Beta pruning, Mini max
- **Knowledge and Reasoning**: A Knowledge-Based Agent, Propositional Logic
- **First-Order Logic**: Syntax and Semantics, Extensions and Notational Variations, Using First-Order Logic, Deducing Hidden Properties of the world
- **Building a Knowledge Base**: General Ontology, Representing Categories

Recommended TextBooks:
- Artificial Intelligence by, 4th edition Pearson Education By Luger
- Crash Course in Artificial Intelligence and Expert systems By Louise E. Frenzel, Jr Howard W. Sams& Co.
Course Title: Senior Capstone Project II
Course Code: SE 581
Semester: VIII
Credit Hours: 3

Learning Objectives

The course is designed to achieve the following objectives:

- Develop a large software project for a community, university, or private enterprise
- Understand the significance of teamwork in building software systems
- Apply effective project management techniques
- Utilize a variety of techniques to capture and understand user requirements
- Utilize design techniques appropriate to project assigned
- Develop and implement strategic test plans
- Develop user and system documentation

Recommended Readings

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<tr>
<th>Course Title: Global Software Engineering</th>
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<td>Course Code: SE 482</td>
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<td>Semester: VIII</td>
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<td>Credit Hours: 3</td>
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**Course Outline:**

**Chapter 1. Introduction**
- History of GSD/GSE
- Advantages and disadvantages of GSD/GSE
- Issues in GSD

**Chapter 2. Types of GSD**
- Software Outsourcing (Offshore, nearshore, onshore etc)
- Software Outsourcing Partnership
- Subsidiary based GSD
- Virtual teams in GSD
- Freelancing

**Chapter 3. GSD process**
- Global software development process model
- Selection of a global software development process model including discussion of agile processes

**Chapter 4. GSD project Management**
- Global software project management concepts, tools, and techniques.
- Managing virtual teams.
- Cross-cultural collaboration.
- Global project leadership.
- Measuring organization’s readiness for global software development
- Software outsourcing vendors’ readiness model (SOVRM)
- Global software development risk management.
- DAR (Decision Analysis Resolution) process for making key business decisions
- Tracking progress approaches for global teams

**Chapter 5. GSD Cost estimation**
- Cost estimation including experience with software cost estimation models
- Creating a software development schedule

**Chapter 6. GSD Cost Quality assurance**
- Quality assurance plans for global software development teams
- Software quality in global software development (CMMI, ISO 9001:2000),
- Creating a virtual software development team
- Acceptance testing

**Chapter 7. GSD Challenges**
- Global software development challenges,
- Professional practices for global software development (Intellectual Property Rights, Group working, conflict and negotiations management, Presentations, writing and referencing)
## Course Title: Software Process Improvement

### Course Code: SE 483

### Semester: VIII

### Credit Hours: 3

### Course Outline:
- Fundamentals of software quality management
  - Process
  - Quality
- Software patterns
  - Crosby Maturity Grid, Control Patterns, Software subcultures
- Software process modeling
- Software process improvement and assessment models
  - ISO 15504
  - CMMI
- SPI and Cultural change
  - Beyond SPI
  - Beyond Management and Technology
- Measuring and improving the processes
  - Statistical process control

### Course Textbooks

### Reference Material:
- [http://www.ii.metu.edu.tr/Informatics Institute Turkey](http://www.ii.metu.edu.tr/Informatics Institute Turkey)
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<tr>
<th><strong>Course Title:</strong> Open Source Software Development</th>
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<td><strong>Semester:</strong> VIII</td>
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<td><strong>Credit Hours:</strong> 3</td>
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**Course Outline:**

- Open Source support of process and product evaluation: the GQM method and the GQM tools.
- Licensing, compliance and governance of Open Source
- Quality and trustworthiness assessment of Open Source Software products
- Evaluation of Open Source Software development processes
- Open Source marketing: how to make your product attractive for the community and end users
- Testing Open Source Software
- ERP, SCM and CRM Open Source
- The business of Open Source Software
- Grassroots Free Software: the case of volunteers FOSS projects and their management

**Recommended Books:**

- Understanding Open Source Software development
  By Joseph Feller, Brian Fitzgerald

- Open Source Development, Adoption and Innovation: 2007, Joseph Feller(ed.) ; B. Fitzgerald(ed.) ; Walt Scacchi(ed.) ; A. Sillitti...