



## **Course Contents of BS Software Engineering**

**Department of Software Engineering  
University of Malakand, Pakistan**

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](http://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/departments/communication/schwalbe/cm353syl.htm](http://www.fredonia.edu/departments/communication/schwalbe/cm353syl.htm) , <http://www.cecs.csulb.edu/~monge/2009SummerProgram/courseDescriptions.html#globalsweng> and Informatics 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:**

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University of Malakand, Pakistan.

**Reviewed by:**

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King Fahad University of Petroleum and Minerals, Saudi Arabia.  
Keele University UK

**Approved by:**

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



No: UOM/Acad-1/2011/4553

Dated: 30-09-2011

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### **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)

Registrar  
University of Malakand

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

Registrar  
University of Malakand



**University of Malakand**  
Department of Software Engineering

[www.uom.edu.pk](http://www.uom.edu.pk)

Semester I			Semester II		
C. Code	Title	CH	C. Code	Title	CH
SE 411	Introduction to Information and Communication Technologies (ICTs)	3	MT 421	Discrete Structures	3
SE 412	Programming Fundamentals	3+1	SE 422	Object Oriented Programming	3+1
MT 413	Calculus and Analytical Geometry	3	SE 423	Digital Logic and Design	3
PH 414	Physics	3	SE 424	Introduction to Software Engineering	3
EG 415	Functional English	3	PS 425	Pakistan Studies	2
IS 416	Islamic Studies	2	ST 426	Probability and Statistics	3
<b>Total Credit Hours</b>		<b>18</b>	<b>Total Credit Hours</b>		<b>18</b>

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

Semester V			Semester VI		
C. Code	Title	CH	C. Code	Title	CH
MT 451	Automata Theory and Compiler	3	SE 461	Human Computer Interaction	3
SE 452	Web Engineering	3	SE 462	Agile Software Development	3
SE 453	Software Engineering Economics	3	SE 463	Software Development and Testing	3+1
SE 454	Software Design and Architecture	2+1	SE 464	Formal Methods in Software Engineering	3
SE 555	Advance Database Systems	3	MS 465	Entrepreneurship	2
MS 456	Human Resource Management	3	SE 466	Empirical Software Engineering	3
<b>Total Credit Hours</b>		<b>18</b>	<b>Total Credit Hours</b>		<b>18</b>

Semester VII			Semester VIII		
C. Code	Title	CH	C. Code	Title	CH
SE 571	Senior Capstone Project I	3	SE 581	Senior Capstone Project II	3
SE 472	Software Project Management	3	SE 482	Global Software Engineering	3
SE 473	Software Quality Engineering	3	SE 483	Software Process Improvement	3
SE 474	Business Process Management	3	SE 484	Open Source Software Development	3
SE 475	Artificial Intelligence	2+1			
<b>Total Credit Hours</b>		<b>15</b>	<b>Total Credit Hours</b>		<b>12</b>

**Total Credit Hours: 135**

**Dr Siffat Ullah Khan**  
**Head Department of**  
**Software Engineering**  
University of Malakand Pakistan

**Dated: 16-May-2013**



**Bachelor of Science in Software Engineering (BSSE)**  
**UOM Approved Scheme of Study for BSSE**

<b>Course Title: Introduction to Information and Communication Technologies (ICTs)</b>
<b>Course Code: SE 411</b>
<b>Semester: 1</b>
<b>Credit Hours: 3</b>
<b>Course Outline:</b>  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
<b>Reference Material:</b> <ul style="list-style-type: none"><li>• Introduction to Computers Author: <u>Darryl McGraw</u>, Publisher: Carolina Academic Pr, 2011 ISBN:1594602425, 9781594602429</li><li>• Computers: Information Technology In Perspective, 9/E By Larry Long And Nancy Long, Prentice Hall, 2002/ISBN: 0130929891.</li><li>• Introduction To Computing By AmnaNudrat</li><li>• Introduction to Computers, by Peter Norton</li></ul>



**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:**

- An Introduction to Programming with C++, by Diane Zak, 6<sup>th</sup> Edition, 2010.
- Programming In C++ By Robert Lafore
- How To Program C++ By Dietel&Dietel
- C++ Programming: Visual QuickStart Guide, Larry Ullman; Andreas Signer



**Course Title: Calculus And Analytic Geometry**

**Course Code: MT 413**

**Credit Hours: 3**

**Semester: 1**

**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, *H. Anton, John Wiley and Sons (Wie), ISBN: 0471572608.*
- Calculus, William E. Boyce Richard C. Diprima, John Wiley & Sons,
- Calculus, 6<sup>th</sup> Edition by E. W. Swokowski, M. Olinick, D. Pence, J. A. Cole.



<b>Course Title: Physics</b>
<b>Course Code: PH 414</b>
<b>Semester: 1</b>
<b>Credit Hours: 3</b>
<b>Course Outline:</b>  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.
<b>Reference Material:</b>  <ul style="list-style-type: none"><li>• <i>University Physics, 8th Edition</i>, Hugh Young, Addison Wesley.</li><li>• <i>Physics, 2nd Ed. (1999')</i>, McGraw Hill, ISBN: 0-07-023461-2.</li><li>• <i>Physics</i>, Resnick, Halliday, Krane, Wiley Sons.</li><li>• Solomon Gratenhaus "Physics, Basic Principles"</li></ul>



<b>Course Title: Functional English</b>
<b>Course Code: EG 415</b>
<b>Semester: 1</b>
<b>Credit Hours: 3</b>
<b>Course Outline:</b>
<b>Basic Units</b> Syllables, Word, Phrase, Clause, Sentence, Paragraph
<b>Sentence</b> Parts – Subject, Predicate Types – Simple Sentence, Compound Sentence, Complex Sentences
<b>Parts Of Speech</b> Nouns, Pronouns, Adjectives, Verbs, Adverbs, Preposition, Conjunction, Interjection
<b>Nouns</b> Definition, Kinds, Gender, Number
<b>Pronouns</b> Definition, its kinds
<b>Verbs</b> Definition, its kinds
<b>Tenses</b> Present, Past, Future
<b>Voices</b> Active and Passive Voices Assertive, Interrogative, imperative, exclamatory
<b>Narrations</b> Direct and Indirect Narration Assertive, Interrogative, imperative, exclamatory
<b>Punctuation</b> Period, Question Mark, Exclamation Point, Ellipses, Underscore or Italics, Apostrophe, Quotation Marks, Parenthesis, Dash, Hyphen, Colon, Semicolon, Comma
<b>Similar Words</b> Words that Confuse
<b>Comprehension</b> Comprehension of Unseen Passage, Answering question About the passage
<b>Precise</b> One third summary
<b>Paragraph writing</b> How to write a paragraph Four elements in a paragraph
<b>Reading Material:</b>
<ul style="list-style-type: none"><li>• English Grammar and Composition PC Wren and Martin</li><li>• English Grammar and Composition Efzal Anwar Mufti</li><li>• English Grammar and Translation Mumtaz Ahmed</li><li>• University Grammar of English R Quirk and S Greenbuam</li></ul>





- Living English structure by w. Stan nard Allen.

**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, Bi-conditional, 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 (K<sub>n</sub>), Cycles (C<sub>n</sub>), Wheels (W<sub>n</sub>))
- Graph Terminology, Adjacency Matrix (Boolean Matrix), Path Matrix.

**Text Books:**

- Discrete mathematics and its Application by Kenneth Rosen Fifth Edition
- Discrete Mathematics by K.A. Ross and C.R.B. Wright, Prentice Hall
- Fundamental Structures of Algebra and Discrete Mathematics by Stephan Folds
- Discrete Mathematics, by Mormon L. Biggs.



**Course Title: Object Oriented Programming**

**Course Code: SE 422**

**Semester: 2**

**Credit Hours: 3**

**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.
- *Java: How To Program*, 5/E, Dietel And Dietel, Prentice Hall, International Edition.
- *C++: How To Program*, Dietel And Dietel, 4/E, Pearson.
- *Thinking In C++*, 2nd Edition, Bruce Eckel, Prentice Hall.
- *C++ for Programmers* by Paul J. Deitel; Harvey M. Deitel



**Course Title: Digital Logic and Design**

**Course Code: SE 423**

**Semester: 2**

**Credit Hours: 3**

**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, Subtractors, 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 GoodState Variable Assignments, Algorithmic State Machine (ASM) Charts, Asynchronous Circuits, Memory Systems, Functional Organization,.

**Reference Material:**

- Digital Design, 2nd Ed., M. Morris Mano, Prentice Hall, 1991.
- Practical Digital Logic Design And Testing, P K L alas, Prentice Hall, 1996.
- B. Holds worth “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:**

**INTRODUCTION TO INFORMATION SYSTEM**

- System & Procedures
- Information System Components
- Business Information System
- Types of Information System
- Organizational Levels
- System Development Life Cycle

**SYSTEM PLANNING**

- Strategic Planning Process
- Information System Projects
- Evaluation of System Requirements
- Preliminary Investigation objectives
- Preliminary Investigation Steps

**SYSTEM ANALYSIS**

- System Requirements
- Interviews
- Other Fact Finding Technique
- Other System Development Techniques

**ANALYZING REQUIREMENTS**

- Structured Analysis
- Data Flow Diagram
- Data Dictionary

**OUTPUT DESIGN**

- System Design Overview, General Guidelines for Systems Design
- Designing & using Codes, Introduction to Output Design
- Types of output and information delivery
- Designing Printed Reports, Designing Screen Output

**INPUT DESIGN**

- Input Design Objectives, Key Tasks in input Design
- Source document Design, Input record design, Input controls

**Recommended Books:**

- System Analysis & Design (SHELLY CASHMAN ROSENBLATT)
- Software Engineering, A Practitioners Approach, Roger S Pressman
- A Concise Introduction to Software Engineering by PankajJalote  
Springer; January 2008



**Course Title: Pakistan Studies**

**Course Code: PS 425**

**Semester: 2**

**Credit Hours: 2**

**Course Outline:**

**Historical Prospective :**

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.  
Lucknow Pact, 1916, Khilafat Movement, 1919, Nehru Report 1928.  
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.



<b>Course Title: Probability and Statistics</b>
<b>Course Code: ST 426</b>
<b>Semester: 2</b>
<b>Credit Hours: 3</b>
<b>Course Outline:</b> <p>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.</p>
<b>Reference Material:</b> <ul style="list-style-type: none"><li>○ Ronald Walpole, Myers, Myers, Ye, "Probability &amp; Statistics for Engineers &amp; Scientists", 8<sup>th</sup> edition, 2008, Prentice HallPublisher.</li><li>○ Lay L. Devore, Probability and Statistics for Engineering and the Sciences, 2003, Duxbury Publishers.</li><li>○ G. Cowan, <i>Statistical Data Analysis</i>, 1998, Clarendon, Oxford.</li><li>○ Probability and Statistics for Engineering and the Sciences, 3rd edition by Jay L. Devore.</li></ul>



<b>Course Title: Communication &amp; Interpersonal Skills</b>
<b>Course Code: EG: 431</b>
<b>Semester: 3</b>
<b>Credit Hours: 3</b>
<b>Course Outline:</b> <b>Concept of Communication</b> <ul style="list-style-type: none"><li>• Definition and process of communication</li><li>• Components of communication (Context, Sender-Encoder, Message, Medium, Receiver-Decoder, Feedback)</li><li>• Role of communication in an organization</li><li>• Barriers to effective communication</li></ul> <b>Types of communication</b> <ul style="list-style-type: none"><li>• Verbal, Non-verbal, Upward, downward, horizontal, interpersonal, Group Communication</li><li>• Upward, Downward and Interpersonal Communication, Group Communication</li></ul> <b>The seven C's of Effective Communication</b> <ul style="list-style-type: none"><li>• Completeness, Conciseness, consideration, Concreteness, Clarity, Courtesy, correctness</li></ul> <b>Strategies for Improving Oral Presentation</b> <ul style="list-style-type: none"><li>• Steps for preparing effective oral presentations.</li><li>• Strategies for an effective Non-verbal delivery</li></ul> <b>Strategies for reducing stage fright</b> <ul style="list-style-type: none"><li>• Signs of discomfort, Strategies for decreasing speaking fears</li></ul> <b>Strategies for improving listening skills</b> <ul style="list-style-type: none"><li>• Faults in listening, Purpose for listening, Results of good listening</li></ul> <b>Meetings</b> <ul style="list-style-type: none"><li>• Purposes and kinds, Planning steps before the meeting</li><li>• Procedures during the meeting</li></ul> <b>Interview:</b> <ul style="list-style-type: none"><li>• Preparation before the job interview</li><li>• Procedures during the job interview</li></ul> <b>Proposals:</b> <ul style="list-style-type: none"><li>• Definition, concept, Kinds and Purposes, Parts of a Proposal</li></ul> <b>Recommended Books:</b> <ul style="list-style-type: none"><li>• Effective business Communication 7<sup>th</sup> Edition by Herta A-Murphy, Herbert Jane</li><li>• Herbert W.Hilderbrandth, James and Thomas MC Hills</li><li>• Bovee Business Communication Today</li></ul>





**Course Title: Data Structures And Algorithms**

**Course Code: SE 432**

**Semester: 3**

**Credit Hours: 3**

**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 Techniquesfor Various Data Structures.

Algorithm Complexity And Analysis.

**Reference Material:**

- Data Structure In C++ By Aikman Series.
- *Fundamentals Of Data Structures In C++*, Horowitz, Sahni, And Mehta, Computer Science Press, 1995.
- 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:**

- Introduction to Computer Architecture, Evolution of Computers, Types of Computers, Hardware, Firmware and Software. Future trends.
- Programming model of 8086 family. Addressing Modes.
- Data types, complements, fixed point representation, floating point representation, binary codes..
- Register Transfer Language. Bus and Memory Transfer. Arithmetic Micro-operations, Logic Micro-operations, shift micro-operation, Arithmetic Logic Unit.
- 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.
- 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.
- Memory Hierarchy, Main Memory, Cache Memory, Virtual Memory, Memory Management.
- General Register Organization, Stack Organization, Instruction format, Addressing Modes, Data transfer and manipulation, Program Control, RISC & CISC Computer and their characteristics.
- Parallel Processing, Pipelining, Arithmetic Pipeline, Instruction Pipeline, Vector Processing.

**Text Books:**

- Computer Architecture and Organization by John P. Hayes, 3rd Edition, McGraw Hill.
- Computer System Architecture by M. Morris Mano, Third Edition
- Computer Architecture by Morio De Blasi.
- Computer Architecture & Organization by A.J.Van De Goor.



**Course Title: Linear Algebra**

**Course Code: MT 434**

**Semester: 3**

**Credit Hours: 3**

**Course Outline:**

Vectors,  
Vector Spaces,  
Matrices & Determinants,  
Cofactor And Inverse,  
Rank,  
Linear Independence,  
Solution Of Linear Systems,  
Gaussian Elimination,  
Positive Definit Matrix,  
Linear Transformations,  
Operations On Matrices,  
Inner Products,  
Eigenvalues & Eigenvectors.  
Applications To Systems of Equations And To Geometry.

**Reference Material:**

- *Linear Algebra*, David C Lay, Pearson Addison Wesley, 1999, ISBN: 0201660369
- Introduction to Linear Algebra, 2nd Edition by Lee W. Johnson, R. Dean Riess and Jimmy T. Arnold.
- Advanced Engineering Mathematics, 7<sup>th</sup> Edition by Erwin Kreyszig



<b>Course Title: Professional Ethics</b>
<b>Course Code: SE 435</b>
<b>Semester: 3</b>
<b>Credit Hours: 2</b>
<b>Course Outline:</b>  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 practice and the economics of software; intellectual property and software law (cyber law); social responsibilities, software related contracts, Software house organization
<b>Reference Material:</b> <ul style="list-style-type: none"><li>• <i>Professional Issues in Software Engineering</i>, M.F. Bott et al.</li><li>• Deborah G. Johnson, "Computer Ethics", Pearson Education (2001) 3rd edition.</li></ul>
<b>HEC Course Outline: Page 26</b>



<b>Course Title: Operating Systems</b>
<b>Course Code: SE 436</b>
<b>Semester: 3</b>
<b>Credit Hours: 3</b>
<b>Course Outline:</b> History and Goals, Evolution of multi-user systems, Process and CPU management, Multithreading, Kernel and User Modes, Protection, Problems of cooperative processes, Synchronization, Deadlocks, Memory management and virtual memory, Relocation, External Fragmentation, Paging and Demand Paging, Secondary storage, Security and Protection, File systems, I/O systems, Introduction to distributed operating systems. Scheduling and dispatch, Introduction to concurrency.  Lab assignments involving different single and multithreaded OS algorithms.
<b>Reference Material:</b> <ol style="list-style-type: none"><li>1. Applied Operating Systems Concepts, 7th Edition, Silberschatz A., Peterson, J.L., &amp; Galvin P.C. 2004.</li><li>2. Modern Operating Systems, 3rd Edition, Tanenmaum A.S., 2008.</li><li>3. Operating System, by William Stallings</li><li>4. Operating System Concepts, By Silberschartz, Garvin, Gagne.</li><li>5. Operating Systems Demystified by Patti Short McGraw-Hill Companies, Inc.; December 2011, ISBN 9780071752275</li></ol>
<b>HEC Course Outline: Page 21</b>



<b>Course Title: Data Communication and Computer Networks</b>
<b>Course Code: SE 441</b>
<b>Semester: IV</b>
<b>Credit Hours: 3+1</b>
<b>Course Outline:</b>
<b>Data Communications and Networking</b> Elements or components of Data Communication, Types of Data Communication, Serial communication, Parallel communication, Asynchronous Communication, Synchronous Communication, Direction of dataflow
<b>Network Hardware</b> <ul style="list-style-type: none"><li>• Local Area Network, Metropolitan Area Network, Wide Area Network, Wireless Network, Home Network, Inter Network</li></ul>
<b>Reference Model</b> General Model of Communication, the OSI Reference Model, The TCP/IP Reference Model, Encapsulation, De encapsulation
<b>Local Area Network</b> Topologies, LAN Devices in Topologies NICs, Repeaters, Hubs, Bridges, Switches, Routers
<b>Transmission Media</b>
<b>Guided Media</b> Twisted Pair Cable, Coaxial Cable, Fiber Optic Cable
<b>Unguided Media</b> Radio Waves, Micro Waves, Infrared
<b>Layer 2: Technologies</b> Introduction, Token Ring, Ethernet, FDDI
<b>Error Detection and Correction</b> Types of errors, Single bit error, Burst error, Detection Redundancy, Parity Check, Cyclic Redundancy Check (CRC) Correction, Error correction by retransmission, Forward error correction
<b>Point to Point Access</b> PPP Stack, Link Control Protocol Authentication protocol, Network Control Protocol
<b>Wireless Networks</b>
<b>Recommended Books:</b> <ul style="list-style-type: none"><li>• Data Communication and Networking By Behrouz A. Forouzan</li><li>• Computer Network By Andrew S Tenenbaum</li><li>• Data Communication and Networking by C.S.V. Murthy</li></ul>



<b>Course Title: Numerical and Symbolic computing</b>
<b>Course Code: MT 442</b>
<b>Semester: IV</b>
<b>Credit Hours: 3</b>
<b>Course Outline:</b> <b>Review of basic numerical methods 2</b> <b>Direct methods for Linear Systems (Intro)</b> Matrix inversion using row operations. Crout's LU decomposition. Matlab methods and routines for direct solution  <b>Iterative methods for linear systems (Intro)</b> Review: Jacobi, Gauss-Seidel, SOR, SSOR, CG, Bi-CGSTAB, GMRES, IDR(s) (only algorithms) Preconditioning for Krylov-subspace solvers.  <b>Averaging and Interpolation (Intro)</b> 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  <b>Multi-grid based solution of elliptic PDEs (Intro)</b> Basic categories of elliptic PDEs. Vertex-centered and cell-centered FDM Discretization. Multi-grid components. Smoothers and transfer operators.  <b>Local Fourier Smoothing Analysis (Intro)</b> 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.  <b>Reference Material:</b> <ul style="list-style-type: none"><li>○ Applied Numerical Analysis by Gerald &amp; Wheatley, 5th Edition or later.</li><li>○ Multi-grid Tutorial by Briggs, Henson, and McCormick 2nd Edition (available gratis on the Internet).</li><li>○ Multigrid by Trottenberg et al, 2001. Academic Press.</li><li>○ Numerical Analysis, 3<sup>rd</sup> Edition Dr. Saeed Akther</li><li>○ Templates for the solution of sparse linear systems (available gratis on the Internet <a href="http://cs.iba.edu.pk/index.html">http://cs.iba.edu.pk/index.html</a> <a href="http://fcsiba.wikispaces.com/F11_CSE316_Numeric_and_symbolic_computation">http://fcsiba.wikispaces.com/F11_CSE316_Numeric_and_symbolic_computation</a>)</li><li>○ Walter Gautschi, Numerical Analysis : An Introduction, Springer Verlag, April 1, 1997</li></ul>



**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, 4<sup>th</sup> Edition by Jeffery A.
- Databases: A Beginner's Guide by Andy Opper

**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](http://www.cse.unsw.edu.au)/School of computer science and engineering





**Course Title: Technical and Report Writing**

**Course Code: SG 444**

**Semester: IV**

**Credit Hours: 2**

**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**

- Audience analysis
- Task analysis
- Power-revision techniques
- Libraries, documentation, cross-referencing
- Basic patterns and elements of the sentence
- Common grammar, usage, punctuation problems
- Common spelling problems

**GRAPHIC AIDS**

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

**CONTEMPORARY COMMUNICATION**

- E-mail
- Internet
- Desktop publishing
- Hypertext

**References Material:**

- Manalo, e. &fermin, v. (2007). Technical and report writing. Ecc graphics. Quezon city
- Vicente, c. Et. Al. (2004). Technical writing. Popular bookstore. Quezon city, Philippines.
- Writing in English: a practical handbook for scientific and technical writers.© 2000.
- [www.studygroup.com](http://www.studygroup.com) University of Surrey
- Effective business communication 7<sup>th</sup> Edition, herta A. Murphy
- Herbert W.Hildebrandt, James & Thomas MC. Graw Hill



**Course Title: Software Requirements Engineering**

**Course Code: SE 445**

**Semester: IV**

**Credit Hours: 3**

**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.
- Dorfman, M. Thayer, R & Davis, A. Eds. *Software Requirements Engineering*, IEEE
- Software Engineering : A Practitioners Approach by Goger S. Pressman
- Software & Systems Requirements Engineering: In Practice by Brian Berenbach; Daniel Paulish



<b>Course Title: Web Technologies</b>
<b>Course Code: SE 446</b>
<b>Semester: IV</b>
<b>Credit Hours: 2+1</b>
<b>Course Outline:</b>
<b>Web Essentials</b> The Internet, The Web, HTTP, Http Request Message, Http Response Message, Web Clients, Web Servers, Logging, Access Control
<b>Markup Languages</b> HTML: Introduction, History, Versions, Syntax and Semantics, Fundamental Elements, Relative URL's, Lists, Tables, Frames, Forms, Creating HTML Documents
<b>Style Sheets</b> CSS Introduction, Features, Syntax, Style Sheets and HTML, Text Properties, CSS Box Model, Normal Flow Box Layout, other style properties, Lists, Tables
<b>Client-Side Programming</b> 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
<b>Browsers and the DOM</b> Introduction, history, levels of Document Object Model, The Document Tree, Elements and Nodes, DOM Event Handling, Accommodating Non-compliant Browsers
<b>Server-side Programming</b> 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
<b>Representing Web Data</b> XML Documents and Vocabularies, Versions, Declaration, Namespaces, DOM-based XML Processing, Event-oriented Parsing-SAX, Transforming XML Documents, XSL – Introduction and Component, XPath, XSLT-Template-based Transformation, Related Technologies
<b>Separating Programming and Presentation</b> 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
<b>Web Services</b> Web Service Concepts, Java Web Service and clients, WSDL, XML Schema, SOAP, SOAP and HTTP
<b>Textbook:</b> Web Technologies: A Computer Science Perspective By Jeffrey C. Jackson, Prentice Hall, 2007.
<b>Reference Material:</b> Programming the World Wide Web, 6 <sup>th</sup> Edition, By Robert W. Sebesta, Addison Wesley; 2010. Internet and World Wide Web: How to Program, By Harvey M. Deite, Prentice Hall, 2011. W3Schools Online Web Tutorials, available at: <a href="http://www.w3schools.com/">http://www.w3schools.com/</a>



**Course Title: Automata Theory and Compiler**

**Course Code: MT 451**

**Semester: V**

**Credit Hours: 3**

**Course Outline:**

- **Languages and Regular Expressions:** Defining languages, Kleene closure, Definition of regular expressions (RE's), Languages associated with regular expressions.
- **Finite Automata (FA):** Definition of FA's, FA's and their languages, Transition Graphs (TG's), No determinism, Unification of RE's, FA's and TG's.
- **Finite Automata with Output:** Moore machine, Mealy machines Equivalence of Moore and Mealy machines, Transducers
- **Regular Languages:** Union, concatenation, Kleene closure, complementation and intersection of regular languages, Decision procedures for the finiteness, and equivalence, No regular languages pumping lemma.
- **Context-Free Grammars (CFG):** Symbolism for generative grammars, Regular grammars, Chomsky normal form, Leftmost derivations.
- **Pushdown Automata (PDA):** 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.
- **Turing Theory:** Turing machines, Post machines, Two stack PDA, Recursively enumerable languages, Type 0 grammars, The universal Turing Machine.

**Recommended TextBooks:**

- Introduction to Computer Theory, 2nd Edition, by Daniel I A. Cohan John Wiley, 1997.
- Introduction to Computer Theory, Languages and Computatio, J Hopcraft, D. Ullman.
- Languages and Machines, An Introduction to the theory of Comp.Sc, @/E Thomas A. Sudkamp, Addison Wesley.



<b>Course Title: Web Engineering</b>
<b>Course Code: SE 452</b>
<b>Semester: V</b>
<b>Credit Hours:3</b>
<b>Course Outline:</b> 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
<b>Required Text:</b>  <i>Web Engineering - The Discipline of Systematic Development of Web Applications</i> , edited by Gerti Kappel, Birgit Pröll, Siegfried Reich, and Werner Retschitzegger, John Wiley & Sons, 2006
<b>Reference Text:</b>  <i>Web Engineering: Modelling and Implementing Web Applications</i> , edited by Gustavo Rossi, Oscar Pastor, Daniel Schwabe and Luis Olsina, Springer Verlag HCIS, 2007, ISBN 978-1-84628-922-4 <i>Web Engineering</i> , edited by Emilia Mendes and Nile Mosley, Springer-Verlag, 2005 <i>Web Engineering: Principles and Techniques</i> , edited by Woojong Suh, Idea Group Publishing, 2005 <i>Building Web Applications with UML</i> (2nd edition), by Jim Conallen, Pearson Education, 2003 <i>Web Application Architecture – Principles, Protocols and Practices</i> , by Leon Shlkar and Richard Rosen, 2003



<b>Course Title: Software Engineering Economics</b>
<b>Course Code: SE 453</b>
<b>Semester: V</b>
<b>Credit Hours: 3</b>
<b>Course Outline:</b> Programming aspects, economic aspects, human relations aspects, software trends: cost, social impact, the plurality of SE Means, The GOALS Approach to Software Engineering, The Software Work Breakdown Structure (WBS), Software Maintenance, introduction to COCOMO, definitions and assumptions, development effort and schedule, phase distribution, The Rayleigh Distribution, interpolation, basic software maintenance effort estimation. Performance Models, Optimal Performance, Sensitivity Analysis, Cost-Effectiveness Models.
<b>Resources:</b> <ul style="list-style-type: none"><li>○ Boehm, Software Engineering Economics, Prentice Hall, 1981.</li><li>○ Boehm et al., Software Cost Estimation with COCOMO II , Prentice Hall, 2000.</li><li>○ Reifer, Don. Making the Software Business Case: Improvement by the Numbers, Addison Wesley, 2001.</li><li>○ Software Engineering Foundations: Unifying Theories, by Yingxu Wang</li></ul>
(HEC Pakistan, <b>International Islamic University Islamabad</b> )



**Course Title: Software Design and Architecture**

**Course Code: SE 454**

**Semester: V**

**Credit Hours: 3**

**Course Outline:**

In-depth study of design patterns, building on material learned previously.

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.

Reengineering and reverse engineering techniques.

**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
- Christine Hofmeister, Robert Nord, DilipSoni, Applied Software Architecture, 1999, Pearson.
  
- Enterprise Software Architecture and Design: Entities, Services, and Resources By Dominic Duggan





**Course Title: Advance Database Systems**

**Course Code: SE 555**

**Semester: V**

**Credit Hours: 3**

**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**  
Introduction to B+ Trees, B+Tree Functions: Search / Insert / Delete (Algorithms & Examples), B+ Trees in Practice: i) Prefix-Key Compression and ii) Bulk Loading 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



- **External Sorting**  
Introduction (When a DBMS sorts data), Simple Two-Way Merge-Sort, External Merge-Sort, Double Buffering Using B+Tree for Sorting.  
**Tentative:**Minimizing I/O cost versus number of I/O.
- **Evaluating Relational Operator**  
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 & Index Matching, Selections with No Disjunctions, Selections with Disjunctions, The Project Operation (using Sorting, using Hashing, Sorting vs. Hashing).
- **Typical Relational Query Optimize**  
What a Typical Optimizer Does (Alternative Plans Considered, Left-Deep Plans, Estimating the Cost of a Plan), Translating SQL Queries into Algebra, Estimating the Cost of a Plan, Relational Algebra Equivalences, Enumeration of Alternative Plans (Single-Relation Queries, Multiple-Relation Queries).
- **Overview of Transaction Management & Concurrency Control**  
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).
- **Concurrency Control with Locking**  
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
- **Concurrency Control with Timestamps**  
Timestamp based CC: Definitions, Basic Timestamp Ordering (TO) Algorithm and Examples, Strict Timestamp Ordering, Multi-version Concurrency Control, Optimistic Concurrency Control.
- **Crash Recover**  
Definitions, Purpose, Failure Reasons, ACID Properties and Responsibilities, Undo Logging and Recovery, Check pointing and No quiescent Checkup, Redo Logging and Recovery, Redo-Undo Logging and Recovery, ARIES Algorithm
- **Introduction to Distributed Databases**  
Introduction to Distributed Databases, Types of Distributed Databases, Homogeneous, Heterogeneous (Federated, Multi-DBs), Distributed Databases



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>
- Database Management System by Raghu Ramakrishnan and Johannes Gehrke.
- Advanced Database Technology And Design by Mario Piattini.



<b>Course Title: Human Resource Management</b>
<b>Course Code: MS 456</b>
<b>Semester: V</b>
<b>Credit Hours: 3</b>
<b>Course Outline:</b>  An overview of Human Resource Management and Human. Resource Manager. The Environment of Human Resource Management,external and Internal Environment. Equal Employment Opportunity andAffirmative Action. Job Analysis: A Basic Human Resource Tool. HumanResource Planning, Recruitment, and Selection. Organization Change and Human Resource Development. Corporate Culture and Organization Development. Career Planning Development. Performance Appraisal.
<b>Reference Material:</b> <ul style="list-style-type: none"><li>○ <i>Managing Human Resource</i> by Wayne F. Cascio.</li><li>○ Introduction to Human Resource Management by John Stredwick</li></ul>



<b>Course Title: Human Computer Interaction</b>
<b>Course Code: SE 461</b>
<b>Semester: VI</b>
<b>Credit Hours: 3</b>
<b>Course Outline:</b>  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.
<b>Resources:</b> <ul style="list-style-type: none"><li>○ Human-Computer Interaction, 3/E Alan Dix, Computing Dept, Lancaster University Janet E. Finlay, Leeds Metropolitan University, Gregory D. Abowd, Georgia Institute of Technology, Russell Beale, University of Birmingham ISBN-10: 0130461091 ISBN-13: 9780130461094 Publisher: Prentice Hall</li><li>○ Designing the User Interface: Strategies for Effective Human-Computer Interaction, 4/E Ben Shneiderman, University of Maryland Catherine Plaisant, University of Maryland ISBN-10: 0321197860 ISBN-13: 9780321197863 Publisher: Addison-Wesley.</li><li>○ HCI Models, Theories, and Frameworks: Toward a Multidisciplinary Science by John Carroll</li><li>○ Usability Engineering: Scenario-Based Development of Human Computer Interaction by Mary Rosson, John Carroll, Mary Beth Rosson</li></ul>
<b>HEC Course Outline : Page no 23</b>



**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<sup>(ed.)</sup>; Tore Dyba<sup>(ed.)</sup>; Nils Brede Moe  
Agile Software Development: Principles, Patterns, and Practices By Robert Martin.



**Course Title: Software Development and Testing**

**Course Code: SE 463**

**Semester: VI**

**Credit Hours: 3**

**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.
- Code Complete 2<sup>nd</sup> edition: A practical handbook of software construction, published by Microsoft Press, 2004.
- Software Engineering by Ian Somerville, 8<sup>th</sup> edition, Addison & Wesley. 2006



**Course Title: Formal Methods in Software Engineering**

**Course Code: SE 464**

**Semester: VI**

**Course Outline:**

**Admin & Revision**

- Propositional logic, Predicate calculus
- Sets, Functions, Relations, Induction
- Bush Day - no lecture
- Basic Haskell

**Logic**

- Natural Deduction,
- Natural Deduction

**Inductive Types**

- Specification
- Structural Induction
- Structural Induction

**Hoare Logic**

- Partial Correctness
- Proof Rules
- Program Proof

**WP Calculus**

- Total Correctness
- Proof Rules
- Program Proof

**Finite Automata**

- Finite State Machines
- Regular Languages
- Non-determinism

**Specification in Z**

- Modeling and Specification
- Schemas
- Examples

**Grammars & Languages**

- Grammars, Push-down Automata
- Quiz preparation review, Parsing





**Reference Material:**

- Grassman, winfriedkarlgrassman&tremblay, jean-paul *logic and discrete mathematics: a computer science perspective*, prentice hall, upper saddle river, new jersey, 1996.
- Thompson, simon *haskell: the craft of functional programming*, international computer science series. Addison-wesley, wokingham, england, 1999.
- Epp, susanna s. *Discrete mathematics with applications* computer science press, new york, 1995.
- Bergmann, merrie *the logic book*, mcgraw-hill.
- Munro, john *discrete mathematics for computing* thomas Nelson.
- Australian National University, Canberra  
<http://cs.anu.edu.au/>  
<http://studyat.anu.edu.au/courses/COMP2600;details.html>  
<http://cs.anu.edu.au/student/comp2600/outline.php>



**Course Title: Entrepreneurship**

**Course Code: MS 465**

**Semester: VI**

**Credit Hours: 2**

**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
- Organizational and Financial Plan Types of Ownerships Budgeting Analysis and Financial Statements Financial Ratios.
- 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 6th Edition; Robert D. Hisrich, Michael P Peters, Dean A Shepherd.
- Entrepreneurship Strategies and Resources 3rd Edition; Marc J. Dollinger – Pearson Education.
- New Venture Creation: Entrepreneurship for the 21st Century 5th Edition; Jeffrey A. Timmons – McGraw Hill



<b>Course Title: Empirical Software Engineering</b>
<b>Course Code: SE 466</b>
<b>Semester: VI</b>
<b>Credit Hours: 3</b>
<b>Course Outline:</b> <b>Introduction &amp; Orientation</b> <ul style="list-style-type: none"><li>• Course objectives</li><li>• Assessments</li><li>• Intro to Research Idioms</li></ul> <b>What is Science?</b> <ul style="list-style-type: none"><li>• Philosophy of Science</li><li>• Sociology of Science</li><li>• Metatheories</li></ul> <b>Research Design and Ethics</b> <ul style="list-style-type: none"><li>• Evidence-based software engineering</li><li>• What makes a good research paper?</li><li>• Research Design</li><li>• Research Ethics</li></ul> <b>Basics of Doing Research</b> <ul style="list-style-type: none"><li>• Finding good research questions</li><li>• Theory building</li><li>• Evidence and Measurement</li><li>• Peer Review Process</li></ul> <b>Experiments</b> <ul style="list-style-type: none"><li>• Controlled Experiments</li><li>• Quasi-experiments</li><li>• Sampling</li><li>• Replication</li></ul> <b>Case Studies</b> <ul style="list-style-type: none"><li>• Single and Multi-case</li><li>• Longitudinal Case Studies</li><li>• Approaches to Data Collection</li></ul> <b>Survey and Observation</b> <ul style="list-style-type: none"><li>• Surveys</li><li>• Focus Groups</li><li>• Ethnographies</li></ul> <b>Interventions</b> <ul style="list-style-type: none"><li>• Action Research</li><li>• Pilot Studies</li><li>• Benchmarking</li></ul> <b>Qualitative Analysis</b> <ul style="list-style-type: none"><li>• Grounded Theory</li><li>• Phenomenography</li><li>• Mixed Methods Research</li></ul>



### **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**

- Blum, B. I. Beyond Programming: To A New Era of Design. Oxford University Press. 1996.
- Chalmers, A. Science and Its Fabrication. University of Minnesota Press. 1990.
- Creswell, J. W. Research Design: Qualitative, Quantitative, and Mixed Methods Approaches. Second Edition. Sage. 2002.
- Crotty, M. Foundations of Social Research: Meaning and Perspective in the Research Process. Sage. 1998.
- Endres, A.; Rombach, D.; A Handbook of Software and Systems Engineering: Empirical Observations, Laws, and Theories. Addison Wesley, 2003.
- Meltzoff, J. Critical Thinking About Research: Psychology and Related Fields. American Psychological Association, 1998.
- Shull, F.; Singer J.; Sjoberg, D.I.K. (eds); Guide to Advanced Empirical Software Engineering. Springer, 2007.
- 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 1**

**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:**

- Systems Analysis and Design, Dennis, Wixom, and Roth, Wiley, 4<sup>th</sup> edition.
- <http://sci.tamucc.edu/~amahdy/Teaching/Spring11/cosc5354/cosc5354.html>
- SLR Guidelines by Barbara Kitchenham



**Course Title: Software Project Management**

**Course Code: SE 472**

**Semester: VII**

**Credit Hours: 3**

**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
- Software Engineering: A Practitioner's Approach, 4th Edition, Roger S. Pressman, McGraw-Hill Higher Education, And ISBN: 0070521824.
- Mike Cottrell and Bob Hughes, Software Project Management, 2nd Edition, McGraw Hill, 1999. ISBN 0-07-709505-7
- Chris F. Kemmerer, Software Project Management – Readings and Cases, McGraw Hill, 1997. ISBN 0-256-18545-X



**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:**

1. Software Quality Assurance: Principles and Practice (Hardcover). by Nina S. Godbole, published by Alpha Science, 2004
2. Software Quality Engineering: Testing, Quality Assurance, and Quantifiable Improvement by Jeff Tian, published by John Wiley & sons, 2005
3. Software Testing in the Real World: Improving the Process by Kit, Edward, Addison & Wesley, 1998.
4. Perfect Software: And other illusions about testing by Gerald M. Weinberg, published Dorest House, 2008

**HEC Course Outline: Page 89**



**Course Title: Business Process Management**

**Course Code: SE 474**

**Semester: VII**

**Credit Hours: 3**

**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 practice and the economics of software; intellectual property and software law (cyber law); social responsibilities, software related contracts, Software house organization

**Resources:**

- *Professional Issues in Software Engineering*, M.F. Bott et al.
- *Business Process Management: Practical Guidelines to Successful Implementation* by John Jeston, Johan Nelis [Taylor & Francis](#); March 2008.
  - *Business Process Management: A Rigorous Approach* by Martyn A. Ould [British Informatics Society Limited](#); January 2005

**HEC Course Outline: Page 26**





<b>Course Title: Artificial Intelligence</b>
<b>Course Code: SE 475</b>
<b>Semester: VII</b>
<b>Credit Hours: 3</b>
<b>Course Outline:</b> <ul style="list-style-type: none"><li>○ <b>Introduction:</b> The Turing Test approach, The cognitive modeling approach, The laws of thought approach, The rational agent approach</li><li>○ <b>Solving Problems by Searching:</b> Breadth-first search, Uniform cost search, Depth-first search, Depth-limited search, Iterative deepening search, Bidirectional search</li><li>○ <b>Informed Search Methods:</b> Best-First Search, Heuristic Functions, Memory Bounded Search, Iterative Improvement Search</li><li>○ <b>Game Playing:</b> Alpha-Beta pruning, Mini max</li><li>○ <b>Knowledge and Reasoning:</b> A Knowledge-Based Agent, Propositional Logic</li><li>○ <b>First-Order Logic:</b> Syntax and Semantics, Extensions and Notational Variations, Using First-Order Logic, Deducing Hidden Properties of the world</li><li>○ <b>Building a Knowledge Base:</b> General Ontology, Representing Categories</li></ul>
<b>Recommended TextBooks:</b> <ul style="list-style-type: none"><li>○ Peter Norvig, “Paradigms of Artificial Intelligence Programming: Case studies in Common Lisp”, Morgan Kaufman Publishers, Inc. 1992.</li><li>○ Artificial Intelligence by, 4th edition Pearson Education By Luger</li><li>○ Crash Course in Artificial Intelligence and Expert systems By Louise E. Frenzel, Jr Howard W. Sams &amp; Co.</li></ul>



**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**

- Systems Analysis and Design, Dennis, Wixom, and Roth, Wiley, 4<sup>th</sup> edition.
- <http://sci.tamucc.edu/mahdy/Teaching/Spring11/cosc5354/cosc5354.html>



<b>Course Title: Global Software Engineering</b>
<b>Course Code: SE 482</b>
<b>Semester: VIII</b>
<b>Credit Hours: 3</b>
<b>Course Outline:</b>
<b>Chapter 1. Introduction</b>
<ul style="list-style-type: none"><li>• History of GSD/GSE</li><li>• Advantages and disadvantages of GSD/GSE</li><li>• Issues in GSD</li></ul>
<b>Chapter 2. Types of GSD</b>
<ul style="list-style-type: none"><li>• Software Outsourcing (Offshore, nearshore, onshore etc)</li><li>• Software Outsourcing Partnership</li><li>• Subsidiary based GSD</li><li>• Virtual teams in GSD</li><li>• Freelancing</li></ul>
<b>Chapter 3. GSD process</b>
<ul style="list-style-type: none"><li>• Global software development process model</li><li>• Selection of a global software development process model including discussion of agile processes</li></ul>
<b>Chapter 4. GSD project Management</b>
<ul style="list-style-type: none"><li>• Global software project management concepts, tools, and techniques.</li><li>• Managing virtual teams.</li><li>• Cross-cultural collaboration.</li><li>• Global project leadership.</li><li>• Measuring organization's readiness for global software development</li><li>• Software outsourcing vendors' readiness model (SOVRM)</li><li>• Global software development risk management.</li><li>• DAR (Decision Analysis Resolution) process for making key business decisions</li><li>• Tracking progress approaches for global teams</li></ul>
<b>Chapter 5. GSD Cost estimation</b>
<ul style="list-style-type: none"><li>• Cost estimation including experience with software cost estimation models</li><li>• Creating a software development schedule</li></ul>
<b>Chapter 6. GSD Cost Quality assurance</b>
<ul style="list-style-type: none"><li>• Quality assurance plans for global software development teams</li><li>• Software quality in global software development (CMMI, ISO 9001:2000),</li><li>• Creating a virtual software development team</li><li>• Acceptance testing</li></ul>
<b>Chapter 7. GSD Challenges</b>
<ul style="list-style-type: none"><li>• Global software development challenges,</li><li>• Professional practices for global software development (Intellectual Property Rights, Group working, conflict and negotiations management, Presentations, writing and referencing)</li></ul>



<http://www.cecs.csulb.edu/~monge/2009SummerProgram/courseDescriptions.html#globalsweng>

**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**

- Weinberg, G. M., Quality Software management, Volume 1, System Thinking, Dorset House, 1992.
- Humphrey, W., Managing the Software Process, Addison-Wesley Publishing Company, 1989.

**Reference Material:**

- Weinberg, Gerald M. Quality Software Management, Volume 2, First Order Measurement, Dorset House, 1993.
- Grady, Robert B. Practical Software Metrics for Project Management and Process Improvement, Prentice-Hall, Inc., 1992.
- Argyris, C., Knowledge for action: A guide to overcoming barriers to organizational change. Jossey-Bass, 1993.
- Senge, P. M. The Fifth Discipline: The Art and Practice of the Learning Organization, 1990.
- <http://www.ii.metu.edu.tr/Informatics> Institute Turkey



**Course Title: Open Source Software Development**

**Course Code: SE 484**

**Semester: VIII**

**Credit Hours: 3**

**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<sup>(ed.)</sup>