1st Semester

Course Name: Introduction to Information and Communication Technologies
Course Structure: Lectures: 2 Labs: 1 **Credit Hours:** 3
Pre-requisite: None Semester: 1 Course Code: BCS111
Course Description:
This is an introductory course on Information and Communication Technologies.
Topics include ICT terminologies, hardware and software components, the internet and world wide web, and ICT based applications.
After completing this course, a student will be able to:
• Understand different terms associated with ICT
• Identify various components of a computer system
• Identify the various categories of software and their usage
• Define the basic terms associated with communications and networking
• Understand different terms associated with the Internet and World Wide Web.
• Use various web tools including Web Browsers, E-mail clients and search utilities.
• Use text processing, spreadsheets and presentation tools
• Understand the enabling/pervasive features of ICT
Course Contents:
: Basic Definitions & Concepts
: Hardware: Computer Systems & Components
: Storage Devices , Number Systems
: Software: Operating Systems, Programming and Application Software
: Introduction to Programming, Databases and Information Systems
: Networks
: Data Communication
: The Internet, Browsers and Search Engines
: The Internet: Email, Collaborative Computing and Social Networking
: The Internet: E-Commerce
: IT Security and other issues
: Project Week
: Review Week
Text Books/Reference Books:
Introduction to Computers by Peter Norton, 6th International Edition (McGraw HILL)
Using Information Technology: A Practical Introduction to Computer &
Communications by Williams Sawyer, 6th Edition (McGraw HILL)
Computers, Communications & information: A user's introduction by Sarah E.
Hutchinson, Stacey C. Swayer

Fundamentals of Information Technology by Alexis Leon, Mathewsleon Leon press

Course Name: Calculus and Analytic Geometry **Course Code:** BCS112
Course Structure: Lectures: 3, Labs: 0 **Credit Hours:** 3

Prerequisites: None
Objectives: To provide foundation and basic ground for calculus and analytical geometry background.
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 Anti-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:
• Swokowski, Olinick and Pence, Calculus and Analytical Geometry, 6th edition, 1994, Brooks/Cole Publishers.
• Howard Anton, Calculus, 7th edition. 2002, John Wiley and Sons (WIE).
• William E. Boyce Richard C. Diprima, *Calculus*, John Wiley & Sons, ISBN: 0471093335.
• Thomas Finny, Calculus and Analytical Geometry, 10th edition, John Wiley and Sons.
• Erwin Kreyzig, Advanced Engineering Mathematics, 7th edition, 1993, John Wiley & Sons Inc.

Course Name: Basic Electronics Course Code: BCS113
Course Structure: Lectures: 2, Labs: 1 **Credit Hours:** 3
Prerequisites: None
Objectives: Introduction of Electronics
Course Outline: Fundamentals of Semiconductor physics: Band theory, semiconductors (intrinsic and extrinsic), pn junction, pn junctions as a rectifier, clipper and clamper circuits, zener diode and voltage regulator, LED and LCD etc., *Transistors:* Bipolar Junction transistors, BJT biasing circuits, Q-point, BJT as a switch, BJT amplifiers, classes of amplifiers, power amplifiers, Metal oxide transistors, nMOS, pMOS and CMOS inverters circuits. Introduction to A/D and D/A conversion circuits.
Reference Material:
Freedman and Young, *University Physics,* (10th and higher editions).

Resnick, Halliday and Krane, *College Physics* (6th and higher edition).

Course Name: English Composition and Comprehension **Course Code: BCS114**
Course Structure: Lectures: 3, Labs: 0 **Credit Hours:** 3
Prerequisites: None
Objectives: To develop good English writing, language usage and reading skills.
Course Outline: Principles of writing good English, understanding the composition process: writing clearly; word, sentence and paragraph. Comprehension and expression. Use of grammar and punctuation. Process of writing, observing, audience analysis, collecting, composing, drafting and revising, persuasive writing, reading skills, listening skills and comprehension, skills for taking notes in class, skills for exams.

Reference Material: *Warriner's English Grammar and Composition*, John E. Warriner

Course Name: Programming Fundamentals **Course Code: BCS115**
Course Structure: Lectures: 2, Labs: 1 **Credit Hours:** 3
Prerequisites: None
Objectives: The course is designed to familiarize students with the basic structured programming skills. It emphasizes upon problem analysis, algorithm designing, and programme development and testing.
Course Outline: Overview of computers and programming. Overview of language for e.g. C language C. Basics of structured and Modular programming. Basic Algorithms and problem solving, development of basic algorithms, analyzing problem, designing solution, testing designed solution. Fundamental programming constructs, translation of algorithms to programmes, data types, control structures, functions, arrays, records, files, testing programmes.
Reference Material:
1. Problem Solving and Program Design in C / 6E
Hanly & Koffman
Addison-Wesley | Published: 02/06/2009
ISBN-10: 0321535421 | ISBN-13: 9780321535429
2. C How to Program, 5/E
(Harvey & Paul) Deitel & Deitel, ISBN-10: 0132404168 ISBN-13: 9780132404167 Publisher: Prentice Hall Copyright: 2007

2nd Semester

Course Name: Object Oriented Programming **Course Code: BCS121**
Course Structure: Lectures: 2, Labs: 1 **Credit Hours:** 3
Prerequisites: Programming Fundamentals
Objectives: The course aims to focus on object-oriented concepts, analysis and software development.
Course Outline: Evolution of Objecgt Oriented (OO) programming, OO concepts and principles, problem solving in OO paradigm, OO programme design process, classes, methods, objects and encapsulation; constructors and destructors, operator and function overloading, virtual functions, derived classes, inheritance and polymorphism. I/O and file processing, exception handling
Reference Material:
1. C++ How to Program, 6/E
(Harvey & Paul) Deitel & Deitel ISBN-10: 0136152503
ISBN-13: 9780136152507 Publisher: Prentice Hall
2. Java How to Program, 7/E
(Harvey & Paul) Deitel & Deitel ISBN-10: 0132222205 ISBN-13: 9780132222204 Publisher: Prentice Hall

Course Name: Discrete Structures **Course Code: BCS122**
Course Structure: Lectures: 3 / Labs: 0 **Credit Hours:** 3
Prerequisites: None

Objectives: Introduces the foundations of discrete mathematics as they apply to Computer Science, focusing on providing a solid theoretical foundation for further work. Further, this course aims to develop understanding and appreciation of the finite nature inherent in most Computer Science problems and structures through study of combinatorial reasoning, abstract algebra, iterative procedures, predicate calculus, tree and graph structures. In this course more emphasis shall be given to statistical and probabilistic formulation with respect to computing aspects.

Course Outline: Introduction to logic and proofs: Direct proofs; proof by contradiction, Sets, Combinatorics, Sequences, Formal logic, Prepositional and predicate calculus, Methods of Proof, Mathematical Induction and Recursion, loop invariants, Relations and functions, Pigeonwhole principle, Trees and Graphs, Elementary number theory, Optimization and matching. Fundamental structures: Functions; relations (more specifically recursions); pigeonhole principle; cardinality and countability, probabilistic methods.

Reference Material:
Kenneth H. Rosen, *Discrete Mathematics and Its Applications*, 6TH edition, 2006, Mcgraw Hill Book Co.
Richard Johnsonbaugh, *Discrete Mathematics,* 7TH edition, 2008, Prentice Hall Publishers.
Kolman, Busby & Ross, *Discrete Mathematical Structures*, 4th edition, 2000, Prentice-Hall Publishers.
Ralph P. Grimaldi, *Discrete and Combinatorial Mathematics: An Applied Introduction*, Addison-Wesley Pub. Co., 1985.

Course Name: Technical and Business Writing **Course Code: BCS123**
Course Structure: Lectures: 3, Labs: 0 **Credit Hours:** 3
Prerequisites: None
Objectives: To develop efficient literature survey, analysis, report writing and document designing skills.
Course Outline: Overview of technical reporting, use of library and information gathering, administering questionnaires, reviewing the gathered information. Technical exposition; topical arrangement, exemplification, definition, classification and division, casual analysis, effective exposition, technical narration, description and argumentation, persuasive strategy. Organizing information and generation solution: brainstorming, organizing material, construction of the formal outline, outlining conventions, electronic communication, generation solutions. Polishing style: paragraphs, listening sentence structure, clarity, length and order, pomposity, empty words, pompous vocabulary, document design: document structure, preamble, summaries, abstracts, table of contents, footnotes, glossaries, cross-referencing, plagiarism, citation and bibliography, glossaries, index, appendices, typesetting systems, creating the professional report; elements, mechanical elements and graphical elements. Reports: Proposals, progress reports, Leaflets, brochures, handbooks, magazines articles, research papers, feasibility reports, project reports, technical research reports, manuals and documentation, thesis. Electronic documents, Linear verses hierarchical structure documents.
Reference Material:
Greenfield, T., Research Methods, Guidance for Postgraduates, Arnold, 1996, 034064629.

Course Name: Web Fundamentals **Course Code: BCS124**
Course Structure: Lectures: 2, Labs: 1 **Credit Hours:** 3
Prerequisites: None
Objectives:
This course is aimed for IT professionals new to web designing. Computer science students aiming to be web developers and to target excellent web designing job market, can also benefit from this course.
Course Outline:
HTML(Hypertext Markup Language)
a) Internet, Web and HTML Fundamentals
b) What is HTML
c) The World Wide Web and Web Servers
d) Working of Web Browsers
e) HTML's Role on the Web
f) Way of launching the Web Site
Creating Static Web Pages with HTML
a) Creating a Web page and entering Text
b) Changing and Customizations
c) Display Text in List
d) Adding Graphics into Web Pages
e) Hypertext and Creating Links
f) Issuing Links with other HTML Tags
Advance HTML
a) Tables, Forms, Images
b) Frames
c) Multimedia Objects
Java Script
a) Data types
b) Control Structures
c) Object & Function
d) Event Handling
VB Script
Introduction, Data Types, Syntax, Controls, etc.
Reference Material:
1. Thomas A. Powell, HTML The Complete Reference, 2nd Edition, McGraw Hill, 1999.
2. Ann Navarro, Todd Stauffer, HTML by Example, 1st Edition, Que Corp, 1999.
3. Andrew Wooldrige, Mike Morgan, Mona Everett, Scott J. Walter, Special Edition Using Java Script, Que Corp, 1997.

Course Name: Islamic & Pakistan Studies **Course Code: BCS125**
Course Structure: Lectures: 3, Labs: 0 **Credit Hours:** 3
Prerequisites: None
Objectives: To impart an understanding of the fundamental principles and teachings of Islam through study of selected verses of the Quran and Prophetic Sayings. Important facets of the Prophet's life and salient, features of Islamic Civilization. To provide

appreciation of other prominent religions, systems of ethics and cultures to prepare students to survive in international and multicultural work place.

To take an analytical view in the history and development of Muslim society and culture in the sub-continent, emergence of Pakistan and its constitutional development. To develop an appreciation of the issues and challenges currently being faced in Pakistan. The strengths of its people and strategies to deal with the impediments to progress. International relations of Pakistan

Course Outline: Fundamentals of Islam. (Aqaid, Ibadat, Islamic Dawah etc.); Ethical values of Islam; Ser ah of the Holy Prophet (PBUH); Islamic Civilization and its affects on humanity. Study of other prominent world religions and ethical systems in comparison with Islamic viewpoint. Multicultural societies.

Historical background of Pakistan: Muslim society in Indo-Pakistan, the movement led by the societies, The downfall of Islamic society, The establishment of British Raj-Causes and consequences. Political evolution of Muslims in the twentieth century: Sir Syed Ahmed Khan; Muslim League; Nehru; Allama Iqbal: Independence Movement; Lahore Resolution; Pakistan culture and society, Constitutional and Administrative issues, Pakistan and its geo-political dimension, Pakistan and International Affairs, Pakistan and the challenges ahead.

Reference Material:
Chaudary M. Ali ,The Emergence of Pakistan, 1967.
K.K.Aziz,The making of Pakistan, 1976.

3ʀᴅ Semester

Course Name: Digital Logic Design **Course Code: BCS231**
Course Structure: Lectures: 2, Labs: 1 **Credit Hours: 3**
Prerequisites: Introduction to Information and Communication Technologies
Objectives: This course introduces the concept of digital logic, gates and the digital circuits. Further, it focuses on the design and analysis combinational and sequential circuits. It also serves to familiarize the student with the logic design of basic computer hardware components.
Course Outline: Overview of Binary Numbers, Boolean Algebra, switching algebra, and logic gates, Karnaugh Map and Quin-McCluskey methods, simplification of Boolean functions, Combinational Design; two level NAND/NOR implementation, Tabular Minimization, 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, and comparators, Latches and flip-flops, Synchronous sequential circuit design and analysis, Registers, synchronous and asynchronous counters, and memories, Control Logic Design. Modern trends in memory design
Reference Material:
1. Digital Design, 4/E **M. Morris Mano** & **Michael D. Ciletti** ISBN-10: 0131989243 ISBN-13: 9780131989245 Publisher: Prentice Hall
2. *Digital Fundamentals* / 9E By Thomas L. Floyd Published by Floyd Publisher, 2007
Course Name: Probability and Statistics **Course Code: BCS232**
Course Structure: Lectures: 3, Labs: 0 **Credit Hours:** 3

Prerequisites: None
Objectives: To introduce the concepts of data analysis, presentation, counting techniques, probability and decision making.
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 Baye's 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 for explanatory Data analysis.
Reference Material:
• Ronald Walpole, Myers, Myers, Ye, "Probability & Statistics for Engineers & Scientists", 8th edition, 2008, Prentice Hall Publisher.
• Lay L. Devore, Probability and Statistics for Engineering and the Sciences, 2003, Duxbury Publishers.
• G. Cowan, *Statistical Data Analysis*, 1998, Clarendon, Oxford.

Course Name: Data Structures **Course Code:BCS233**
Course Structure: Lectures: 2, Labs: 1 **Credit Hours:** 3
Prerequisites: Object Oriented Programming
Objectives: The course is designed to teach students structures and schemes, which allow them to write programmes to efficiently manipulate, store, and retrieve data. Students are exposed to the concepts of time and space complexity of computer programmes.
Course Outline: Introduction to data structures; Arrays, Stacks, Queues, Priority Queues, Linked Lists, Trees, Spanning Trees, Graphs and Traversals. Recursion, sorting and searching algorithms, Shortest path algorithms, Hashing, Storage and retrieval properties and techniques for the various data structures. Algorithm Complexity, Polynomial and Intractable Algorithms, Classes of Efficient Algorithms, Divide and Conquer, Dynamic, Greedy
Reference Material:
1. Data Structures and Algorithm Analysis in Java, 2/E
Mark Allen Weiss, *Florida International University* ISBN-10: 0321370139
ISBN-13: 9780321370136 Publisher: Addison-Wesley
2. Algorithms in C++, Parts 1-4: Fundamentals, Data Structure, Sorting, Searching, 3/E **Robert Sedgewick**, *Princeton University* ISBN-10: 0201350882 ISBN-13: 9780201350883 Publisher: Addison-Wesley Professional

Course Name: Communication Skills **Course Code:BCS234**
Course Structure: Lectures: 3, Labs: 0 **Credit Hours:** 3
Prerequisites: None
Objectives: To develop good English writing, language usage and reading skills. To appreciate the importance of business communication and to develop understanding of communication concepts, principles, theories and problems. To develop good oral communication and presentation skills.

Course Outline: Principles of writing good English, understanding the composition process: writing clearly; words, sentence and paragraphs. Comprehension and expression. Use of grammar and punctuation. Process of writing, observing, audience collecting, composing, drafting and revising, persuasive writing, reading skills, listening skills and comprehension, skills for taking notes in class, skills for exams. Business communications; planning messages, writing concise but with impact. Letter formats, mechanics of business, letter writing, letters, memo and applications, summaries, proposals, writing resumes, styles and formats, oral communications, verbal and nonverbal communication, conducting meetings, small group communication, taking minutes. Presentation skills; presentation strategies, defining the objective, scope and audience of the presentation, material gathering material organization strategies, time management, opening and concluding, use of audio-visual aids, delivery and presentation.
Reference Material:
Business English, Vawdrey, Stoddard, Bell.

Course Name: Linear Algebra **Course Code: BCS235**
Course Structure: Lectures: 3, Labs: 0 **Credit Hours:** 3
Prerequisites: None
Objectives: To provide fundamentals of solution for system of linear equations, operations on system of equations, matrix properties, solutions and study of their properties.
Course Outline: Vectors, Vector Spaces, Matrices & Determinants, Cofactor and Inverse, Rank, Linear Independence, Solution of system of Linear systems, Positive Definite matrix, Linear Transformations, Operations on matrices, Inner products, orthgonality and least squares, Eigenvalue & Eigenvectors. Applications to Systems of Equations and to Geometry, Singular Value Decomposition.
Reference Material:
• Bernard Kolman, David Hill, Elementary Linear Algebra with Applications, 9th edition, Prentice Hall PTR, 2007.
• Gilbert Strang, Strang, Brett Coonley, Andy Bulman-Fleming, Andrew Bulman-Fleming, Strang's Linear Algebra And Its Applications, 4th edition, Brooks/Cole, 2005
• Howard Anton, Chris Rorres, Elementary Linear Algebra: Applications Version, 9th edition, Wiley, 2005.
• David C. Lay, Linear Algebra and Its Applications, 2nd edition, Addison-Wesley, 2000.

Course Name: Operating Systems **Course Code: BCS236**
Course Structure: Lectures: 2, Labs: 1 **Credit Hours:** 3
Prerequisites: None
Objectives: To help students gain a general understanding of the principles and concepts governing the functions of operating systems and acquaint students with the layered approach that makes design, implementation and operation of the complex OS possible.
Course Outline: 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.
Reference Material:
Applied Operating Systems Concepts, 7th Edition, Silberschatz A., Peterson, J.L., & Galvin P.C. 2004
Modern Operating Systems, 3rd Edition, Tanenmaum A.S., 2008.

4th Semester

Course Name: Analysis of Algorithms Course Code: BCS241
Course Structure: Lectures: 3 / Labs: 0 **Credit Hours:** 3
Prerequisites: Discrete Structure, Data Structures and Algorithms
Objectives: Detailed study of the basic notions of the design of algorithms and the underlying data structures. Several measures of complexity are introduced. Emphasis on the structure, complexity, and efficiency of algorithms.
Course Outline: Introduction; Asymptotic notations; Recursion and recurrence relations; Divide-and-conquer approach; Sorting; Search trees; Heaps; Hashing; Greedy approach; Dynamic programming; Graph algorithms; Shortest paths; Network flow; Disjoint Sets; Polynomial and matrix calculations; String matching; NP complete problems; Approximation algorithms.
Reference Material:
Introduction to Algorithms /2E, T. H. Cormen, C. E. Leiserson, and R. L. Rivest, MIT Press, McGraw-Hill, New York, NY, 2001.
Algorithms in C++; Robert Sedgewick

Course Name: Web Engineering **Course Code: BCS242**
Course Structure: Lectures: 3 / Labs: 1 **Credit Hours:** 3
Objectives:
The World Wide Web has become a major delivery platform for information resources. Many applications continue to be developed in an ad-hoc way, contributing to problems of usability, maintainability, quality and reliability. This course examines systematic, disciplined and quantifiable approaches to developing of high-quality, reliable and usable web applications. The course introduces the methodologies, techniques and tools that support their design, development, evolution, and evaluation.
Course Outline: Introduces Web Engineering, a sub-discipline of Software Engineering whose methods and techniques are adapted to the special characteristics of Web-based applications. Also discusses the critical initial stage of the Web application development process – gathering requirements – and adapting traditional practices to the unique challenges of the Web.
Modeling Web Applications.
Introduces modeling techniques inspired by object-oriented design models found in traditional software engineering, but are adapted to the particular needs of web engineering. Topics include content, hypertext, and customization modeling; use cases, class diagrams, and sequence diagrams

Web Architectures, Application Design, and Accessibility
Reviews general architectures for Web application and technology-aware application designs. Discusses the concepts and techniques for engineering and evaluating user interfaces appropriate for a Web application's intended audience. Explores the interaction between users and the application's user interface. Special attention will be paid to Web technologies and standards available for audiences with special needs.

Client-Side Technologies
The lecture provides a brief review of CSS, cookies, and the Document Object Model. The majority of the lecture is devoted to introducing JavaScript, the language reference, and how JavaScript can be used to manipulate the DOM.

Developing Web Applications
In this lecture we discuss the web application development process on how web application projects are managed. Tasks and challenges in project management, managing teams, and risk management. Iterative development, development cycles, Rational Unified Process (RUP), Extreme Programming (XP).

Server-Side Technologies
Introduces the PHP5 scripting language. Syntax, language reference, libraries, file access, DBMS access (esp. MySQL), form processing, and other techniques will be presented/demonstrated. During the second lecture, we will walk through how to install and configure the Apache Web Server and PHP5 for a development environment, as well as discuss techniques and requirements for making the same platform operable for large-scale use.
Topics include encryption techniques (digital signatures, certificates, PKI), securing client/server interactions, vulnerabilities at the client (desktop security, phishing, etc.) and the server (cross-site scripting, SQL injections, etc.)

Testing, Operation & Maintenance
This lecture introduces and demonstrates Asynchronous Java and XML (AJAX), a technique for combining JavaScript, the HTML DOM, and server-side scripting for building highly interactive web applications.

Introduction to AJAX
Introduces and demonstrates Asynchronous Java and XML (AJAX), a technique for combining JavaScript, the HTML DOM, and server-side scripting for building highly interactive web applications.

Reference Material:
Kappel, G., Proll, B. Reich, S. & Retschitzegger, W. (2006). **Web Engineering, 1st ed.** Hoboken, NJ: Wiley & Sons. ISBN: 04700-1554-3.

Course Name: Multivariable Calculus **Course Code: BCS243**
Course Structure: Lectures: 3 / Labs: 0 **Credit Hours:** 3
Prerequisites: Calculus and Analytical Geometry
Objectives: The goals are to develop the skills to have ground knowledge of multivariate calculus and appreciation for their further computer science courses.
Course Outline: Functions of Several Variables and Partial Differentiation. Multiple Integrals, Line and Surface Integrals. Green's and Stoke's Theorem. Fourier Series: periodic functions, Functions of any period P-2L, Even & odd functions, Half Range expansions, Fourier Transform. Laplace Transform, Z-Transform.

Reference Material:
• James Stewart, Multivariable Calculus, 6th edition, 2007, Cengage Learning publishers.
• Swokowski, Olinick and Pence, *Calculus and Analytical Geometry*, 6th edition, 1994, Thomson Learning EMEA, Ltd.
• Bernard Kolman, William F. Trench, Elementary Multivariable Calculus, 1971, Academic Press.
• Howard Anton, Albert Herr, Multivariable Calculus, 5th edition, 1995, John Wiley.

Course Name: Computer Organization and Assembly Language **Course Code: BCS244**
Course Structure: Lectures: 2, Labs: 1 **Credit Hours: 3**
Prerequisites: Digital Logic Design
Objectives: The main objective of this course is to introduce the organization of computer systems and usage of assembly language for optimization and control. Emphasis should be given to expose the low-level logic employed for problem solving while using assembly language as a tool. At the end of the course the students should be capable of writing moderately complex assembly language subroutines and interfacing them to any high level language.
Course Outline: Microprocessor Bus Structure: Addressing, Data and Control, Memory Organization and Structure (Segmented and Linear Models), Introduction to Registers and Flags, Data Movement, Arithmetic and Logic, Programme Control, Subroutines, Stack and its operation, Peripheral Control Interrupts, Interfacing with high level languages, Real-time application.
Objectives and Perspectives of Assembly Language, Addressing Modes, Introduction to the Assembler and Debugger, Manipulate and translate machine and assembly code, Describe actions inside the processing chip, Discuss operations performed by an instruction set, Write a fully documented program, Using an assembler of choice.
Reference Material:
• Stallings, "Computer Organization & Architecture", 7th ed, Prentice HALL, 2006.
• Irvine, Assembly Language for Intel-based Computers, 5th ed, Prentice Hall, 2007.
• Computer Organization and Design, The Hardware/Software Interface, 4th ed, by David A. Patterson and John L. Hennessy, 2008. Elsevier Publishers.

Course Name: Visual Programming Course Code: **BCS245**
Course Structure: Lectures: 3, Labs: 1 **Credit Hours:** 3
Prerequisites: None
Objectives: The aim of this course is to teach an object oriented programming overviews and specially getting expertise in vb.net application programming. In this course students learn basics of vb.net GUI programming, which includes several built in classes like buttons, text fields etc. After completion of this course the students becomes able to understand the object oriented aspect of this language.
Course Outline:
-Installation of Visual Studio.Net
-Introduction to Vb.Net IDE
-Data Types
-Byte, Short, Integer, Long, Double

-Char, Date
-Declaring Variables & Constants
-Structures
-Operators
-Arithmetic (+, -, *, /, %, ^)
-Concatenation (&)
-Conditions
-If … then…. else statement
-Select… end select statement
-Loops
-For …next, Exit for
-While … end while, Exit do
-Working with strings
-Toupper, Tolower, Replace, Trim, Len, StrReverse
-Advantages of procedures
-Types of Procedures
-Scope of procedures
-Public, Private, Friend
-Exceptions Handling
-Try
-Catch
-Finally
-Introduction to classes
-Simple class
-Declaring objects
-Instance and static class
-Adding methods to class
-Encapsulation
-Inheritance
-Common properties
-Design Vs Run time
-Name,Size, Location, Enabled, Visible,
-Backcolor, Fore color, Font,Text
-Vb.net forms
-Working with different controls in vb.net
-Textbox Control
-Common Properties
-Read only, Password char, Max length, Multi line,
-Border style, Scrollbar, Text align
-Button Control
-Common Properties
-Text, Flat style, Image, Image align, Text align
-Common Properties
-Checkbox and Radio Controls
-Appearance, Checked, Check state, Text, flat style
-Listbox Control

-Scrollbars, Items, Sorted, Size
-Combobox Control
-Items, Max length, Selected item
-Built-in Dialog Controls
-Open file Dialog
-Save file Dialog
-Font Dialog
-Rich Text Box
-Properties
-Autosize, Borderstyle, Lines, Selectionfont, Selectioncolor Methods
-Clear, Load file, Save file, Undo, Redo, Copy, Paste
Reference Material:
Visual Basic.net Bible By Bill Evjen, Jason Beres
Visual Basic.net Mastering series

Course Name: Numerical Computing Course Code: BCS246
Course Structure: Lectures: 2 / Labs: 1 **Credit Hours:** 3
Prerequisites: Calculus and Analytical Geometry
Objectives: On completion of this unit, students will be able to demonstrate
programming proficiency using structured programming techniques to implement
numerical methods for solutions using computer-based programming techniques .using
Matlab for all methods. The course must serve the purpose of scientific software
development for science and engineering problems.
Course Outline: The concepts of efficiency, reliability and accuracy of a method.
Minimising computational errors. Theory of Differences, Difference Operators,
Difference Tables, Forward Differences, Backward Differences and Central
Differences. Mathematical Preliminaries, Solution of Equations in one variable,
Interpolation and Polynomial Approximation, Numerical Differentiation and Numerical
Integration, Initial Value Problems for Ordinary Differential Equations, Direct Methods
for Solving Linear Systems, Iterative Techniques in Matrix Algebra, Solution of nonlinear
equations.
Reference Material:
Numerical Methods in Scientific Computing Germund Dahlquist and Åke Björck .
Numerical Methods for Scientific Computing : J.H. Heinbockel
Numerical Analysis: I.A. Khubaza
Numerical Analysis and Programming : Shan S Kuo
Numerical Analysis by Berden Fairs
Numerical Analysis by Gerald

5th Semester

Course Name: Database-I **Course Code:** BCS351
Course Structure: Lectures: 2, Labs: 1 **Credit Hours:** 3
Prerequisites: Data Structures and Algorithms
Objectives: The course aims to introduce basic database concepts, different data
models, data storage and retrieval techniques and database design techniques. The

course primarily focuses on relational data model and DBMS concepts.

Course Outline: Basic database concepts; Entity Relationship modelling, Relational data model and algebra, Structured Query language; RDBMS; Database design, functional dependencies and normal forms; Transaction processing and optimization concepts; concurrency control and recovery techniques; Database security and authorization. Small Group Project implementing a database. Physical database design: Storage and file structure; indexed files; b-trees; files with dense index; files with variable length records; database efficiency and tuning.

Reference Material:

Database Systems 8E, C.J.Date, Addison Wesley Pub. Co. (2004).

Database Systems: A Practical Approach to Design, Implementation and Management 5E, R.Connolly and P.Begg, Addison-Wesley Pub. Co (2009).

Fundamentals of Database Systems, 5/E, Elmasri and Navathe, Addison-Wesley, ISBN: 0-201-74153-9.

Course Name: Theory of Automata and Formal languages Course Code: BCS352
Course Structure: Lectures: 3 Labs: 0 **Credit Hours:** 3
Prerequisites: Discrete Structures
Objectives: The course aims to develop an appreciation of the theoretical foundations of computer science through study of mathematical & abstract models of computers and the theory of formal languages. *Theory of formal languages* and use of various abstract machines as 'recognizers' and parsing will be studied for identifying/validating the synthetic characteristics of programming languages. Some of the abstract machines shall also study as 'Transducers'.

Course Outline: *Finite State Models:* Language definitions preliminaries, Regular expressions/Regular languages, Finite automata (FAs), Transition graphs (TGs), NFAs, Kleene's theorem, Transducers (automata with output), Pumping lemma and non regular language *Grammars and PDA:* Context free grammars, Derivations, derivation trees and ambiguity, Simplifying CFLs , Normal form grammars and parsing, Decidability, Chomsky's hierarchy of grammars *Turing Machines Theory:* Turing machines, Post machine, Variations on TM, TM encoding, Universal Turing Machine, Context sensitive Grammars, Defining Computers by TMs.

Text Books/Reference Books:

• An Introduction to Formal Languages and Automata, By Peter Linz, 4th edition, Jones & Bartlett Publishers, 2006

• Theory of Automata, Formal Languages and Computation, By S. P. Eugene, Kavier, 2005, New Age Publishers, ISBN (10): 81-224-2334-5, ISBN (13) : 978-81-224-2334-1.

• John Hopcroft and Jeffrey Ullman, *Introduction to Automata Theory, Languages, and Computation*, 2nd edition, 2001, Addison-Wesley.

• Introduction to Languages and the Theory of Computation, By John C. Martin3rd edition, 2002, McGraw-Hill Professional.

Course Name: Differential Equations **Course Code: BCS353**
Course Structure: Lectures: 3 / Labs: 0 **Credit Hours:** 3
Prerequisites: Calculus and Analytical Geometry

Objectives: Develop fundamental skills of solving ordinary differential equations, and developing differential equations for real-world problems.

Course Outline: Ordinary Differential Equations of the First Order: Geometrical Considerations, Isoclines, Separable Equations, Equations Reducible to Separable Form, Exact Differential Equations, Integrating Factors, Linear First-Order Differential Equations, Variation of Parameters. Ordinary Linear Differential Equations; Homogeneous Linear Equations of the Second Order, Homogeneous Second-Order Equations with Constant Coefficients, General Solution, Real Roots, Complex Roots, Double Root of the Characteristic Equation, Differential Operators, Cauchy Equation, Homogeneous Linear Equations of Arbitrary Order, Homogeneous Linear Equations of Arbitrary Order with Constant Coefficients, Non-homogeneous Linear Equations. Modelling of Electrical Circuits. Systems of Differential Equations. Series Solutions of Differential Equations. Partial Differential Equations: Method of Separation of variables, wave, Heat & Laplace equations and their solutions by Fourier series method.

Reference Material:
• Michael Greenberg, *Advanced Engineering Mathematics, 1996*, Prentice Hall publishers.
• Erwin Kreyzig, *Advanced Engineering Mathematics*, 7th edition, 1993, John Wiley & Sons Inc.
• Zill, Prindle, Weber and Schmidt, *A First Course in Differential Equations,* 1996, Brooks/Cole Publishing,
• Dennis G. Zill, Michael R. Cullen. *Differential Equations with Boundary-Value Problems*, 1996, Brooks/Cole Publishing,
• C. H .Edwards, David E. Penney, *Elementary Differential Equations With Applications,* 1993, Prentice Hall.

Course Name: Data Communication Course Code: BCS354
Course Structure: 3 **Credit Hours:** 3
Pre-requisite:
Objectives: To provide knowledge of Data Communication and different mechanisms of communication
Course Outlines: Introduction, Data and Network, Layers, OSI Model, Introduction to Signals, Transmission Media, Digital Transmission, PAM, PCM, ASK, FSK, PSK, QAM, Data Communication Techniques and technologies, Modulation, Multiplexing, Types of errors, Data Communication Protocols, Current technologies being used for data communication.
Reference Material: 1) Behrouz A. Forouzan, Data Communication and Networking, 3rd Edition.
2) William Stalling, Business Data Communication.

Course Name: Human Resource Management Course Code: BCS355
Course Structure: Lectures: 3 / Labs: 0 **Credit Hours:** 3
Objectives: The basic idea is to acquaint with students to the importance of the human resource in the organizational development process. The course will also help the students to develop their expertise in solving different problems regarding recruitment, selection, training, and development, and career planning of human resource in dynamic environment of 21st century.

The course is duly supported by case studies, practical assignments and presentations, in order to clear the bewildering concepts and theories of human resource management.

Course Outline:

INTRODUCTION

Concepts of human resource management

Human Resource Challenges

The objectives of Human Resource Management

ENVIRONMENTAL CHALLENGES

External Organizational Challenges to Human Resource Management

Internal Organizational Challenges to Human Resource Management

JOB DESIGN

An overview of Job design

Techniques of job design

JOB ANALYSIS

Collection of job information

Applications of job analysis information

HUMAN RESOURCES PLANNING

Significance of Human Resource Planning

The Supply of Human Resources

The implementation of program

Assignments

Case Studies

Course Review

Test

RECRUITMENT & SELECTION

Recruitment organizational Policies

Source of recruitment

Selection process

CAREER PLANNING & DEVELOPMENT

Promotion

Demotion

Separation

TRAINING AND DEVELOPMENT

Significance of training & development

Training methods

Individual Career Development

MOTIVATION AND REWARD SYSTEM

Concept of motivation

Reward systems

Motivation techniques

PERFORMANCE APPRAISAL

Appraisal: Definition

Uses of Performance appraisal

Elements of Performance Appraisal System

Appraisal methods
Past oriented Appraisal methods
Future oriented Appraisal methods
Appraisal challenges
COMPENSATION AND SERVICES
Objectives of compensation Management
Challenges affecting compensation
Wage and Salary Surveys
Policy and principles
Job analysis and evaluation
Compensation for administrators & professionals
DISCIPLINES
Concepts of discipline
Preventive & corrective discipline
Negative & positive approach
Administration of disciplinary action
Grievance handling
Human Resource Practices in Pakistan

Reference Material:
1. Human Resource & Personnel, William B. Werther & Keith Davis
McGraw Hill.
2. HUMAN RESOURCE MANAGEMENT, Bernardin & Russell, 2nd Edition.
McGraw Hill.
3. ORGANIZATIONAL BEHAVIOR, Fred Luthans. 8th Edition, McGraw Hill.
4. Organizational Behavior, Robert Kreitner & Angelokinicki , 2nd Edition, IRWIN.

6th Semester

Course Name: Software Engineering-I **Course Code: BCS361**
Course Structure: Lectures: 2, Labs: 1 **Credit Hours: 3**
Prerequisites: Object Oriented Paradigm/Programming
Objectives: To study various software development models and phases of software development life cycle. The concepts of project management, change control, process management, software development and testing are introduced through hands-on Team Projects.
Course Outline: Introduction to Computer-based System Engineering; Project Management; Software Specification; Requirements Engineering, System Modelling; Requirements Specifications; Software Prototyping; Software Design: Architectural Design, Object-Oriented Design, UML modelling, Function-Oriented Design, User Interface Design; Quality Assurance; Processes & Configuration Management; Introduction to advanced issues: Reusability, Patterns; Assignments and projects on various stages and deliverables of SDLC.
Reference Material:
Software Engineering 8E by Sommerville Addison Wesley, 2006
Software Engineering: A Practitioner's Approach /7E, Roger Pressman, McGraw-Hill, 2009

Course Name: Computer Networks **Course Code: BCS362**
Course Structure: Lectures: 2, Labs: 0 **Credit Hours: 3**
Course Outline: Review of basic concepts: The OSI Model, packet and circuit switching, network topology, ISDN. The TCP/IP protocol stack: IP, ARP, TCP and UDP, DNS, ICMP, Internet Addressing, Routing, IP Multicast, RSVP, Next Generation IP – Ipng, Wireless: Radio basics, Satellite Systems, WAP, current trends, Issues with wireless over TCP. Congestion Control: Control vs. Avoidance.
Algorithms, Congestion in the Internet. Mobile IP, Voice over IP (VoIP), VPNs, Network Security. Management: Quality of Service (QoS), network vs. distributed systems management Protocols, web-based management
Reference Material:
James F. Kurose and Keith W. Ross, "Computer Networking – A Top-Down Approach Featuring the Internet", Addison Wesley.
Coulouris, Dollimore, Kindberg, "Distributed Systems – Concepts and Design", Addison Wesley.
William Stallings, "Data and Computer Communications", Prentice-Hall — Sixth Edition (for those who want to review basics of networking).

Course Name: Computer Architecture Course Code: BCS363
Course Structure: Lectures: 3, Labs: 0 **Credit Hours: 3**
Prerequisites: Digital Logic and Design
Objectives: Get a deeper understanding of how computers work, working knowledge of various subsystems and the general principles that affect their performance, analyze the performance of systems and quantify the performance measurements, fundamentals of all technologies, and advanced architectural features that boost the performance of computers

Course Outlines:

Fundamentals of Computer Design including performance measurements & quantitative principles, principles of Instruction Set Design, Operands, addressing modes and encoding, pipelining of Processors: Issues and Hurdles, exception handling features, Instruction-Level Parallelism and Dynamic handling of Exceptions, Memory Hierarchy Design, Cache Design, Performance Issues and improvements, Main Memory Performance Issues, Storage Systems, Multiprocessors and Thread Level Parallelism. Case Studies.

Resources:

Computer Architecture: A Quantitative Approach by Hennessy & Patterson, Morgan & Kauffman Series (2006) Fourth Edition
Computer Organization & Design : *The Hardware/Software Interface* By Patterson & Hennessy, Morgan & Kauffman Series (2008) Fourth Edition
Course Name: Compiler Construction Course Code: **BCS364**
Course Structure: Lectures: 2 / Labs: 1 **Credit Hours:** 3
Prerequisites: Theory of Automata and Formal Languages
Objectives: At the end of the course students should understand the overall structure of a compiler, and will know significant details of a number of important techniques commonly

used. They will be aware of the way in which language features raise challenges for compiler builders.

Course Outline: Compiler techniques and methodology. Organization of compilers. Lexical and syntax analysis. Parsing techniques. Object code generation and optimization, detection and recovery from errors. Contrast between compilers and interpreters.

Reference Material:
• Compilers: Principles, Techniques, and Tools By Alfred V. Aho, Ravi Sethi, Jeffrey D. Ullman, Contributor Jeffrey D. Ullman ,Addison-Wesley Pub. Co., 2nd edition,1987 Original from the University of Michigan
• Modern Compiler Design, By Dick Grune, Henri E. Bal, Ceriel J. H. Jacobs, Koen G. Langendoen, John Wiley, 2000.
• Modern Compiler Implementation in C, By Andrew W. Appel, Maia Ginsburg, Contributor Maia Ginsburg, Cambridge University Press, 2004.
• Modern Compiler Design by Dick Grune, Henri E. Bal, Ceriel J. H. Jacobs, Koen G. Langendoen, 2003, John Wiley & Sons.

Course Name: DataBase-II Course Code: BCS365
Course Structure: Lectures: 3 / Labs: 1 **Credit Hours:** 3
Objectives: This course provides students with the technical skills required to program a database solution by using Some tool. Like Oracle or MS SQL server.
Course Outline: Concern DBMS Overview
• What Is concern DBMS?
• Its Integration
• DBMS Databases
• DBMS Security
• Working with DBMS
Overview of Programming DBMS
• Designing Enterprise Application Architecture
• DBMS Programming Tools
• The Transact-SQL Programming Language
• Elements of Transact-SQL
• Additional Language Elements
• Ways to Execute Transact-SQL Statement
Creating and Managing Databases
• Creating Databases
• Creating Filegroups
• Managing Databases
• Introduction to Data Structures
Creating Data Types and Tables
• Creating Data Types
• Creating Tables
• Generating Column Values
• Generating Scripts
Implementing Data Integrity
• Types of Data Integrity
• Enforcing Data Integrity

- Defining Constraints
- Types of Constraints
- Disabling Constraints
- Using Defaults and Rules
- Deciding Which Enforcement Method to Use

Planning Indexes
- Introduction to Indexes
- Index Architecture
- How DBMS Retrieves Stored Data
- How DBMS Maintains Index and Heap Structures
- Deciding Which Columns to Index

Creating and Maintaining Indexes
- Creating Indexes
- Creating Index Options
- Maintaining Indexes
- Introduction to Statistics
- Querying the **sysindexes** Table
- Setting Up Indexes Using the Index Tuning Wizard
- Performance Considerations

Implementing Views
- Introduction to Views
- Advantages of Views
- Defining Views
- Modifying Data Through Views
- Optimizing Performance by Using Views
- Performance Considerations

Implementing Stored Procedures
- Introduction to Stored Procedures
- Creating, Executing, Modifying, and Dropping Stored Procedures
- Using Parameters in Stored Procedures
- Executing Extended Stored Procedures
- Handling Error Messages
- Performance Considerations

Implementing User-defined Functions
- What Is a User-defined Function?
- Defining User-defined Functions
- Examples of User-defined Functions

Implementing Triggers
- Introduction to Triggers
- Defining Triggers
- How Triggers Work
- Examples of Triggers
- Performance Considerations

Programming Across Multiple Servers
- Introduction to Distributed Queries
- Executing an Ad Hoc Query on a Remote Data Source

- Setting Up a Linked Server Environment
- Executing a Query on a Linked Server
- Managing Distributed Transactions
- Modifying Data on a Linked Server
- Using Partitioned Views

Optimizing Query Performance
- Introduction to the Query Optimizer
- Obtaining Execution Plan Information
- Using an Index to Cover a Query
- Indexing Strategies
- Overriding the Query Optimizer

Analyzing Queries
- Queries That Use the AND Operator
- Queries That Use the OR Operator
- Queries That Use Join Operations

Managing Transactions and Locks
- Introduction to Transactions and Locks
- Managing Transactions
- DBMS Locking
- Managing Locks

Reference Material:
Introduction to SQL Server by Joseph

Course Name: Human Computer Interaction Course Code: BCS366
Course Structure: Lectures: 2, Labs:1 **Credit Hours: 3**
Prerequisites: Data Structures and Algorithms
Objectives: This course introduces the human issues of usability and its importance. It considers the implications of human understanding on the usability of computer systems and the importance of understanding the context of use. It describes guidelines for use of different media and interface styles. Topics include Usability Design principals, standards and models, evaluation techniques. Groupware, pervasive and ubiquitous applications.
Course Outlines:
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:
1. 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
2. Designing the User Interface: Strategies for Effective Human-Computer Interaction, 4/E

7th Semester

Course Name: Network and System Programming Course Code: BCS471
Course Structure: Lectures:3, Labs: 1 **Credit Hours:** 3
Prerequisites: C and Data Structure, Computer Networks
Objectives:
Outline:
• Unix Programming Environment
• TCP Protocol Suite
• Socket Programming
• UDP and TCP Sockets
• I/O Multiplexing including Non-blocking I/O
• Advanced Socket Options
• Name and Address Conversions
• IPv4 and IPv6 Interoperability
• Unix Domain Protocols
• Broadcasting and Multicasting
• Routing and Raw Sockets
• Data Link Access
• Daemon Processes
• Posix Threads
• Inter Process Communication
• Pipes and FIFOs
• Message Queues
• Mutexes and Locks
• Semaphores
• Doors and RPCPosix Shared Memory
Resources:

Course Name: Professional Practice Course Code: BCS472
Course Structure: Lectures:3, Labs: 0 **Credit Hours:** 3
Prerequisites: None
Objectives: A Computing graduate as professional has some responsibilities with respect to the society. This course develops student understanding about historical, social, economic, ethical, and professional issues related to the discipline of Computing. It identifies key sources for information and opinion about professionalism and ethics. Students analyze, evaluate, and assess ethical and professional computing case studies.
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 lifelong 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:

Professional Issues in Software Engineering, M.F. Bott et al.

Course Name: Software Engineering-II Course Code: BCS473

Course Structure: Lectures: 3hrs **Credit Hours:** 3

Course Objective: The students will study techniques for software verification, validation and testing. They would also study reliability and performance issues in software design and development.

Course Description:

Object Oriented Analysis and Design

Introduction

a) Introduction & Definitions

b) OO Modeling Concepts

c) OO Developments

Modeling as a Design Technique

a) Object Modeling Technique

Object Modeling

a) Objects & Class

b) Links & Associations

c) Generalization & Inheritance

d) Grouping Constructs

e) Aggregation

f) Abstract Class

g) Multiple Inheritance, Meta Data, Candidate Key

Dynamic Modeling

a) Events & States.

b) Operations, Nested State Diagram

c) Concurrency, Advanced Dynamic Modeling Concepts

Functional Modeling

a) Functional Models, DFD

b) Specifying Operations, Constraints

c) Relation of Functional to Object and Dynamic Model

Design Methodology

a) Methodology review

b) OMT as Software Engineering Methodology

c) OMT Methodology, Impact of OO approach

System Design

a) Overview of System Design

b) Breaking of System into Sub Systems

c) Identifying Concurrency

d) Allocating Subsystems to Processors and Tasks

e) Management of Data Store

f) Handling Global Recurs

g) Choosing Software Control Implementation

h) Handling Boundary Conditions
i) Settling Traded-off Priorities
j) Common Architectural Framework
k) Architecture of ATM System
Implementation
a) Form Design to Implementation
b) Implementation using programming languages
c) Implementation using Database System
d) Implementation using Outside a Computer
OO Testing
a) Testing OOA and Models
b) OO Testing Strategies
c) Test Case Design for OO Software
d) Testing methods applicable at class levels
e) Inter class test case design
Object Diagram Compiler
a) Background
b) Problem Statement
c) Analysis
d) System Design
e) Object Design
f) Implementation
Text Books/Reference Books:
1. James Rumbaugh, Object Oriented Modeling and Design, 6th Edition, Prentice Hall International, 2000.
2. Craig Larman, Applying UML and Patterns: An introduction to Object-Oriented analysis and Design, 2nd Edition, Prentice Hall International, 2001.
3. James R.Rumbaugh, Michael R.Blaha, William Premerlani, Frederick Eddy, William Lorensen,Object Oriented Modeling and Design with UML, 2nd Edition, Prentice Hall, 2004.

Course Name: Digital Signal Processing **Course Code: BCS475**
Course Structure: Lectures:3 Labs: 1 **Credit Hours:** 3
Prerequisites:
Course Objective:
Introduction to signal, Analog and digital/discrete signal, Applications of DSP
Energy of a signal, Transformation Of independent variable, Signal types.
Mathematical representation of periodic signal, Relation of complex no. with circle, Euler's relation, Difference b/w continuous time and discrete time signal.
Unit impulse and unit step and their relationship, Convolution, Impulse response of an LTI system, Examples of an LTI system, Properties of an LTI system, Commulative property, Distributive property, Associative property, LTI system with and without memory, Invertability, Properties of an LTI system, Causality, Stability, Step response of an LTI system, Fourier series representation of periodic signal, Session 1 of Matlab, Session 2 of Matlab, Fourier series representation of periodic signals, Fourier series representation, Examples of Fourier series representation, Examples of Fourier series

representation.
Reference Material: 1) Oppenheim, Signals and systems.
2) Oppen Heim, Discrete time signal Processing

Course Name: Wireless Networks: **Course Code: BCS476**
Course Structure: Lectures: 3 Labs: 0 **Credit Hours:** 3
Course Description: This course covers fundamental techniques in design and operation of first, second, and third generation wireless networks: cellular systems, medium access techniques, radio propagation models, error control techniques, handoff, power control, common air protocols (AMPS, IS-95, IS-136, GSM, GPRS, EDGE, WCDMA, cdma2000, etc), radio resource and network management. As an example for the third generation air interfaces, WCDMA is discussed in detail since it is expected to have a large impact on future wireless networks. This course is intended for graduate students who have some background on computer networks.
Text Books/Reference Books:
W. Stallings, "Wireless Communications and Networks", Prentice Hall, 2002.
T.S. Rappaport, "Wireless Communications: Principles & Practice", Second Edition, Prentice Hall, 2002.
J. Schiller, "Mobile Communications", Addison Wesley, 2000.
V.K. Garg, "IS-95 CDMA and cdma 2000", Prentice Hall PTR, 2000.
J.P. Castro, "The UMTS Network and Radio Access Technology - Air Interface Techniques for Future Mobile Systems", Wiley, 2001.
H. Holma and A. Toskala, "WCDMA for UMTS Radio Access for Third Generation Mobile Communications", John Wiley & Sons, 2001.

Course Name: Data Mining & Data Warehousing Course Code: BCS477
Course Structure: Lectures: 3 Labs: 0 **Credit Hours:** 3
Course Description: Features of a data warehouse. Transformation Process. Multidimensional queries. Data warehousing job functions. Data warehousing operations: Hash join processing, bitmapped indexes, star queries, parallel processing, read-ahead mechanisms. Data Mining: Benefits. Data Mining Techniques: Association, discovery, classification, clustering. Data Marts: Stand along data marts, subset data marts, multidimensional database. Queries against data mart. Data Mining Tools.
Text Books/Reference Books:
1. \Alex Berson, Stephen J. Smith, Data Warehousing, Data Mining, and OLAP (Data Warehousing/Data Management), Computing McGraw Hill, 1997.
2. George M. Marakas, Modern Data Warehousing, Mining and Visualization: Core Concepts, 1st Edition, Prentice Hall, 2002.
3. Margaret H. Dunham, Data Mining: Introductory and Advanced Topics, 1st Edition, Prentice Hall, 2002.

Course Name: Management Information System Course Code: BCS478
Course Structure: Lectures: 3 Labs: 0 **Credit Hours:** 3
Course Description: Information systems, strategic role of information systems, organizations and business process, information management and decision making,

ethical and social impact of IS. Computers and IS Software and hardware data resources and telecommunication ensuring quality in information system, enhancing decision making. Accounting, Executive, Decision support, Management Marketing Information Systems. Controlling and managing international information system.

Text Books/Reference Books:

1. Kenneth C. Laudon, Jane P. Laudon, Management Information Systems, 8th Edition, Prentice Hall, 2003.

2. James A. O'Brien, *Management Information Systems: Managing Information Technology in the E-Business Enterprise,6th Edition, McGraw Hill, 2003.*

3. Raymond McLeod, George Schell, *Management Information Systems, 9th Edition, Prentice Hall,2003.*

Course Name: Parallel and Distributed Computing: Course Code: BCS479
Course Structure: Lectures: 3 Labs: 0 **Credit Hours:** 3
Course Description: Why use parallel and distributed systems? Why not use them? Speedup and Amdahl's Law, Hardware architectures: multiprocessors (shared memory), networks of workstations (distributed memory), clusters (latest variation). Software architectures: threads and shared memory, processes and message passing, distributed shared memory (DSM), distributed shared data (DSD). Possible research and project topics, Parallel Algorithms, Concurrency and synchronization, Data and work partitioning, Common parallelization strategies, Granularity, Load balancing, Examples: parallel search, parallel sorting, etc. Shared-Memory Programming: Threads, Pthreads, Locks and semaphores, Distributed-Memory Programming: Message Passing, MPI, PVM. Other Parallel Programming Systems, Distributed shared memory, Aurora: Scoped behaviour and abstract data types, Enterprise: Process templates. Research Topics

Text Books/Reference Books:

B. Wilkinson and M. Allen, *Parallel Programming: Techniques and Applications Using Networked Workstations and Parallel Computers, 1/e,* Prentice Hall, 1999.

W. Stevens, *Advanced Programming in the Unix Environment,* Addison Wesley, 1993.

8TH Semester

Course Name: Artificial Intelligence Course Code: BCS481
Course Structure: Lectures: 2 / Labs: 1 **Credit Hours:** 3
Prerequisites: Discrete Structures
Objectives:
This course studies four main objectives of AI. Modelling the environment by constructing computer representations of the real world. Perception and reasoning - obtaining and creating information/knowledge to populate a computational representation. Taking actions by using the knowledge of the environment and desired goals to plan and execute actions. Learning from past experience.
Course Outline: Artificial Intelligence: Introduction, Intelligent Agents. Problea m-solving: Solving Problems by Searching, Informed Search and Exploration, Constraint Satisfaction Problems, Adversarial Search. Knowledge and reasoning: Logical Agents, First-Order Logic, Inference in First-Order Logic, Knowledge Representation. Planning

and Acting in the Real World. Uncertain knowledge and reasoning: Uncertainty, Probabilistic Reasoning, Probabilistic Reasoning over Time, Making Simple Decisions, Making Complex Decisions. Learning: Learning from Observations, Knowledge in Learning, Statistical Learning Methods, Reinforcement Learning. Communicating, perceiving, and acting: Communication, Probabilistic Language Processing, Perception and Robotics. Introduction to LISP/PROLOG and Expert Systems (ES) and Applications.
Reference Material:
• Artificial Intelligence: Structures and Strategies for Complex Problem Solving: International Edition By George F. Luger, 6th edition: Pearson Education, 2008.
• Artificial Intelligence: A Modern Approach, By Stuart Jonathan Russell, Peter Norvig, John F. Canny, 2nd Edition, Prentice Hall, 2003.

Course Name: Computer Graphics Course Code: BCS482
Course Structure: Lectures: 2 / Labs: 1 **Credit Hours:** 3
Prerequisites: Object Oriented Programming , Visual Programming
Objectives: Study of various algorithms in computer graphics and their implementation in any programming language.
Course Outline: Graphics hardware. Fundamental algorithms. Applications of graphics. Interactive graphics programming — graph plotting, windows and clipping, and segmentation. Programming raster display systems, Differential Line Algorithm, panning and zooming. Raster algorithms and software — Scan-Converting lines, characters and circles. Scaling, Rotation, Translation, Region filling and clipping. Two and three dimensional imaging geometry(Perspective projection and Orthogonal projection) and transformations. Curve and surface design, rendering, shading, colour and animation.
Reference Material:
1. Computer Graphics, Principles and Practice, J. D. Foley, A. van Dam, S. K. Feiner and J. F. Hughes, Addison-Wesley ISBN: 0-201-12110-7.
2. *Computer Graphics,* F.S.Hill, Maxwell MacMillan ISBN: 0-02-354860-6.
3. Interactive Computer Graphics: Functional, Procedural and Device-level methods; Peter Burger and Duncan. F. Gillies; Addison-Wesley, (2003)

Course Name: Advance Database System Course Code: BCS483
Course Structure: Lectures: 2 / Labs: 1 **Credit Hours:** 3
Prerequisites: Data Base-1 And Database-II
Objectives: To provide students with a detailed theoretical and practical knowledge of how database management systems (DBMS) are programmed in SQL, how DBMSs may be linked to form `distributed' DBMS (DDB), and how DBMSs may handle temporal data.
Course Outline:
• Advanced relational algebra and SQL
   o Set vs bag semantics, NULL values, Distinct operator
   o Semi join, left join, right join
   o SQL constraints and triggers
   o Data mining and OLAP operators: Group By, Roll Up, Cube, Pivot
   o Relationally complete SQL and temporary tables

• Distributed databases
o Horizontal/vertical fragmentation
o Basic distributed query processing
o Semi-join query processing
• Schema integration
o Advanced ER modelling: generalisations, n-ary relationships, lookacross and look-here semantics
o Alternatives for the translation of an ER schemas into a relational schema
o Translation of a relational schema into ER schemas
o Translation of between equivalent ER schemas
o Schema conforming, merging and improvement
• XML for semi-structured data
o XML language and its tree representation
o XML schema language
o XPath/XQuery languages
o Translation of an XML schema into a relational schema
• Temporal Databases
o Valid time and transaction time
o Discrete bounded linear flow of time and the temporal structure
o US logic and derived model operators
o Representation of US logic as a temporal relational algebra

Reference Material:
1. M. Tamer Özsu and P. Valduriez, *Principles of Distributed Database Systems*, Prentice Hall, 1999.
2. P.A. Bernstein and V. Hadzilacos and N. Goodman, *Concurrency Control and Recovery in Database Systems*, Addison Wesley.

Course Name: Digital Image Processing Course Code:BCS485
Course Structure: Lectures:2 Labs: 1 **Credit Hours:** 3
Prerequisites:
Course Outline:
Introduction
Images as Digital Objects
Images Storage and Display
Image Acquisition
Image Types and Application
Bi-Level Images
Usefulness of Bi-Level Images
Connectivity and Geometry
Measurable Properties of Regions
Area
Perimeter
Length
Moments – Center of Mass
Simple Shapes

Derivative and Complex Shape Measures
Operations on Bi-Level Image
Boundary enhancement
Erosion and dilation
Sketonization
Chain Code
Run-Length Coding
Grey-Level Images
Introduction to Multiple Levels and Histograms
Thresholding
Selecting a Single Threshold
Selecting Multiple Threshold
Grey-Level Modification
Line and Edges
Geometric Operation
Noise
Color
Classifying and Recognizing Object
Features
Statistical Pattern Analysis
Decision Functions
Template Matching
Structural Methods
1. Representing Relationship
2. Identifying Components
Counting and Classifying Objects
Counting Simple Objects
Classifying Seeds
Classifying Galaxies
Detecting Forged Signatures
Computer Readable Codes
The Universal Product Code
Fonts for Machine Readable Text
Reading Printed Text
The General OCR Problem
Scientific Images
Chromatography and DNA Sequencing: Biology
Stellar Image: Astronomy
Voyager Image Color Synthesis
Making Distance Measurements: Archaeology
Books:
*1. J. R. Parker, Practical Computer Vision Using C, John Wiley &
Sons, 1993.*
*2. R. C Gonzalez and R. E. Woods, Digital Image Processing,
Addison-Wesley Publishing Company, 1992.*

Course Name: Data and Network Security: Course Code: BCS486
Course Structure: Lectures: 3 Labs: 0 **Credit Hours:** 3
Course Description:
Introduction; Cryptology and simple cryptosystems; Conventional encryption techniques; Stream and block ciphers; DES; More on Block Ciphers; The Advanced Encryption Standard. Confidentiality & Message authentication: Hash functions; Number theory and algorithm complexity; Public key Encryption. RSA and Discrete Logarithms; Elliptic curves; Digital signatures. Key management schemes; Identification schemes; Dial-up security. E-mail security, PGP, S-MIME; Kerberos and directory authentication. Emerging Internet security standards; SET; SSL and IPsec; VPNs; Firewalls; Viruses; Miscellaneous topics.
Text Books/Reference Books:
W. Stallings, *Cryptography and Network Security*, Prentice Hall PTR, Upper Saddle River, NJ, 2003.
C. Kaufman, R. Perlman, M. Speciner, *Network Security: Private Communication in a Public World* – Prentice Hall PTR, Upper Saddle River, NJ, 2002.
M. Bishop, *Computer Security: Art and Science* – Addison-Wesley, 2003.
D. Stinson, *Cryptography: Theory and Practice,* CRC Press, Boca Raton, FL, 1995.
Richard A. Mollin, *An Introduction to Cryptography*, Chapman and Hall/CRC, 2001.
B. Schneier, *Applied Cryptography,* John Wiley and Sons, NY, 1996.
A. Menezes, P. Oorshcot, and S. Vanstone, *Handbook of Applied Cryptography*, CRC Press, Boca Raton, FL, 1997.

Course Name: Modeling and Simulation Course Code: BCS487
Course Structure: Lectures:3 Labs: 1 **Credit Hours:** 3
Prerequisites: None
Objectives:
Course Outline: Introduction to OPNET: Introduction, Tool Environment, System Buttons, Tools, Online Documentation.
Introduction to Network Simulation:M/M/1 Queue Example, objectives, M/M/1 Queue Extensions.
Automatic Request Repeat (ARQ) Protocols: Objectives, Preparation, Stop and Wait, Go-Back-N, Selective Repeat, Conclusions.
Multiple Access Protocols: Objectives, Preparation, Aloha, CSMA, Ethernet, Token Ring, Conclusions.
Frame Relay: Objectives, Preparation, Network Model, Specify Probes, Prepare a simulation Set Object, Conclusions, extensions.
Fiber Distributed Data Interface: Objectives, Network Model, Specify Probes, Simulation, Execution and Result Analysis, Conclusions.
Job Service Disciplines: First-in-First-out, Priority Job Discipline, Preempt and Resume, Processor sharing, Shortest –job First discipline, Conclusions.
Reference Material:
1. Modeling and Simulation Communication Networks: A hands on Approach Using OPNET, 1st Edition, Prentice Hall Inc, 1998.
2. Andrew S. Tanenbaum, Computer Networks, 3rd Edition, Prentice Hall, 1996.

Course Name: Database Administration Course Code: BCS488
Course Structure: Lectures:3 Labs: 1 **Credit Hours: 3**

Prerequisites: None
Objectives:
Course Outline: Data administration objectives and functions. Data dictionary: Management uses and features. Developing a Data Dictionary System. Database security: Threats Analysis, Cryptographic controls. Database Integrity. Auditing of databases. Evaluation of Controls. Case histories.
Reference Material:
1. Craig S. Mullins, Database Administration: The Complete Guide to
Practices and Procedures, 1st Edition, Addison Wesley
Professional, 2002.
2. Jeffery A.Hoffer, Mary Prescott, Fred McFadden, Modern
Database Management, 7th Edition, Prentice Hall, 2004.

Course Name: Telecommunication Systems Course Code: BCS489
Course Structure: Lectures:3 Labs: 0/3 **Credit Hours: 3**
Prerequisites: None
Objectives: To provide a first level exposure to the broad domain of telecommunication Systems
Course Outline: Introduction to media, bandwidth and noise. Twisted pair (UTP, STP), coaxial cables (types and specifications), optical fibres (types and losses), Introduction to optical sources and detectors. Microwave links, satellite communication and infrared links. Frequency Division Multiplexing (FDM), TDM, FDMA, TDMA and CDMA. Switching: circuit and packet switching. Introduction to mobile and cellular communications. Block diagram and current trends.
Reference Material:
Introduction to telecommunications Network Engineering, 2nd edition, T. Aattalainen*,* Artech House 2003, ISBN: 1580535003.
Fundamentals of Telecommunication Networks, T. Saadawi, Wiley US, ISBN: 0471515825.
Telecommunication Systems, P. G. Fonteolliet, Artech House 1991.

Course Name: Multimedia Technologies Course Code: BCS4810
Course Structure: Lectures:3 Labs: 0 **Credit Hours:** 3
Prerequisites: None
Objectives:
Course Outline: Introduction to multimedia programming, scope of multimedia programming, convention and trends, media used in current application (including digital video, audio, and graphics), system level issues of performance synchronization, storage and server schemes, dynamic Interactivity, hyperlinking, multimedia, device control, distributed media development and delivery, non-standard media and programming frame works, introduction to multi-media networks.
Reference Material:
1. Stephen M. Alessi, Stanley R. Trollip, Multimedia for Learning:
Methods and Development, 3rd Edition, Allyn & Bacon, 2000.
2. Richard E. Mayer, Multimedia Learning, New Edition, Cambridge
University Press, 2001.