BS COMPUTER SCIENCE (134 CREDIT HOURS)

Major in Software Systems/ Communication and Networks/ Telecommunication/ Artificial Intelligence

Semester 1:

Course Code	Course Title	Credit Hours
CSC301	Introduction to Computing	3(2+1)
CSC302	Programming Fundamentals	4(3+1)
ELC301	Basic Electronics	3(2+1)
MTH301	Calculus and Analytic Geometry	3(3+0)
HUM301	English – I (Communication Skills)	3(3+0)
HUM302	Islamic Studies	3(3+0)
		19

Semester 2:

Course Code	Course Title	Credit Hours
CSC303	Object Oriented Programming	4(3+1)
CSC304	Digital Logic Design	3(2+1)
CSC305	Discrete Structures	3(3+0)
STA301	Probability & Statistics	3(3+0)
HUM303	English – II (Technical and Business Writing)	3(3+0)
HUM304	Pakistan Studies	3(3+0)
		19

Semester 3:

Course Code	Course Title	Credit Hours
CSC401	Data Structures and Algorithms	3(2+1)
CSC402	Computer Organization & Assembly Language	3(2+1)
CSC403	Database Management Systems	3(2+1)
MTH401	Differential Equations	3(3+0)
CSC404	Visual Programming	3(2+1)
HUM401	Urdu	3(3+0)
		18

Semester 4:

Course Code	Course Title	Credit Hours
CSC405	Advanced Database Systems	3(2+1)
CSC406	Operating Systems	3(2+1)
CSC407	Computer Architecture	3(3+0)
CSC408	Data Communication	3(3+0)
CSC409	Software Engineering	3(3+0)
MTH402	Linear Algebra	3(3+0)
		18

Semester 5:

Course Code	Course Title	Credit Hours
CSC501	Computer Communication & Networks	3(2+1)
CSC502	Design & Analysis of Algorithms	3(3+0)
CSC503	Artificial Intelligence	3(2+1)
XX-XXX	Elective – 1	3
XX-XXX	Elective – 2	3
XX-XXX	Elective – 3	3
		18

Semester 6:

Course Code	Course Title	Credit Hours
CSC504	Theory of Automata & Formal Languages	3(2+1)
CSC505	Numerical and Symbolic Computing	3(2+1)
CSC506	Web Programming	3(2+1)
XX-XXX	Elective – 4	3
XX-XXX	Elective – 5	3
XX-XXX	Elective – 6	3
		18

Semester 7:

Course Code	Course Title	Credit Hours
CSC601	Human Compute Interaction	3(2+1)
CSC602	Compiler Construction	3(3+0)
XX-XXX	Elective – 7	3
XX-XXX	Elective – 8	3
XX-XXX	Elective – 9	3
PRJ601	Final Year Project (Phase – 1)	3(0+9)
		18

Semester 8:

Course Code	Course Title	Credit Hours
CSC603	Multimedia Technologies	3(2+1)
PRJ602	Final Year Project (Phase – II)	3(0+9)
		6

BS COMPUTER SCIENCE MAJOR IN SOFTWARE SYSTEMS

Elective Courses

Course Code	Course Title	Credit Hours
SSE501	Data Warehousing	3
SSE502	Data Mining	3
SSE503	Software Design and Architecture	3
SSE504	Software Requirement Engineering	3
SSE505	Object Oriented Software Engineering	3
SSE506	Computer Graphics	3
SSE507	Distributed Computing	3
SSE508	Grid and Cloud Computing	3
SSE601	Software Quality Engineering	3
SSE602	Software Project Management	3
AIE501	Digital Signal Processing	3
AIE503	Digital Image Processing	3
SSE605	Usability Engendering	3
SSE606	Advanced Programming	3
SSE607	Software Measures and Metrics	3
SSE608	Software Engineering Processing	3
SSE609	Multimedia Information Systems	3
SSE610	E – Commerce	3

BS COMPUTER SCIENCE MAJOR IN COMMUNICATION & NETWORKS

Elective Courses

Course Code	Course Title	Credit Hours
CNE501	Network Security	3
CNE502	Mobile Communication & Networks	3
CNE504	Network Management	3
CNE505	Telecommunication Policies & Regulations	3
CNE506	Optical Communication Networks	3
CNE507	Advance Computer Networks	3
TNE508	Telecommunication Network Protocol - I	3
CNE508	Inter – Networking Architecture and Protocols	3
CNE509	Traffic Forecasting & Network Planning	3
CNE601	Wireless Networks	3
CNE602	Wireless Network Security	3
TNE602	Telecommunication Network Protocol - II	3
CNE604	Network Modeling and Simulation	3
CNE605	Intelligent and Active Networks	3
CNE606	Communication & Network Protocols	3
CNE607	Network Analysis & Design	3
CNE608	Satellite Communication	3
CNE609	Network Programming	3
CNE610	Routing & Switching Protocols	

BS COMPUTER SCIENCE MAJOR IN TELECOMMUNICATION

Elective Courses

Course Code	Course Title	Credit Hours
TNE501	Signals and Systems	3
CNE502	Mobile Communication and Networks	3
TNE503	AC & DC Circuits	3
TNE504	Digital Signal Processing	3
TNE505	Wave Propagation & Antenna Theory	3
CNE505	Telecommunication Policies and Regulations	3
TNE506	Numerical and Symbolic Computation	3
TNE507	Wireless Communication	3
TNE508	Telecommunication Network Protocol – I	3
CNE509	Traffic Forecasting & Network Planning	3
TNE510	Communication Systems	3
TNE601	Digital Communication	3
TNE602	Telecommunication Network Protocol – II	3
TNE603	Telecommunication Systems	3
TNE604	Optical Fiber Communication	3
CNE605	Intelligent and Active Networks	3
TNE606	Microwave Communication	3
TNE607	Satellite Communication	3
TNE608	Radar Systems	3
TNE609	Integrated Services Over Packet Networks	3
TNE610	Routing and Switching Principles	3

BS COMPUTER SCIENCE MAJOR IN ARTIFICIAL INTELLIGENCE

Elective Courses

Course Code	Course Title	Credit Hours
AIE501	Digital Signal Processing	3
AIE502	Advance Signal Processing	3
AIE503	Digital Image Processing	3
AIE504	Machine Learning	3
AIE505	Artificial Neural Networks	3
AIE506	Speech Processing	3
AIE507	Speaker and Speech Recognition	3
AIE508	Computer Vision	3
AIE509	Robotics	3
AIE510	Decision Support System	3
AIE601	Genetic Algorithm	3
AIE602	Fuzzy Logic	3
AIE603	Design of Intelligent System	3
AIE604	Virtual Reality	3
AIE605	Modeling and Simulation	3
AIE606	Intelligent & Active Networks	3

M. SC. (COMPUTER SCIENCE) (72 CREDIT HOURS)

Semester – 1:

Course Code	Course Title	Credit Hours
CS501	Programming Fundamentals	3(2+1)
CS502	Database Management Systems	3(2+1)
CS503	Digital Logic Design	3(2+1)
CS504	Discrete Structures	3(3+0)
CS505	Computer Communication & Networks	3(3+0)
GE501	Technical Business Writing	3(3+0)
		18

Semester – 2:

Course Code	Course Title	Credit Hours
CS506	Object Oriented Programming	3(2+1)
CS507	Data Structures and Algorithms	3(3+0)
CS508	Automata Theory	3(3+0)
CS509	Software Engineering	3(3+0)
CS510	Computer Organization & Assembly Language	3(3+0)
CS511	Advanced Database Systems	3(2+1)
		18

Semester – 3:

Course Code	Course Title	Credit Hours
CS601	Operating Systems	3(3+0)
CS602	Advanced Software Engineering	3(2+1)
CS603	Visual Programming	3(2+1)
CS604	Web Programming	3(2+1)
CS605	Artificial Intelligence	3(2+1)
CS606	Compiler Construction	3(3+0)
		18

Semester – 4:

Course Code	Course Title	Credit Hours
CS607	Simulation and Modeling	3(2+1)
CS608	Computer Graphics	3(2+1)
CS609	Network Security	3(3+0)
CS610	Digital Image Processing	3(3+0)
FP601	Final Project	6(0+18)
		18

PGD (COMPUTER SCIENCE) (30 CREDIT HOURS)

(Offered only in Evening Program)

Semester – 1:

Course Code	Course Title	Credit Hours
DCS201	Introduction to Computing	3(2+1)
DCS202	Programming Fundamentals	3(2+1)
DCS203	Data Structures and Algorithms	3(2+1)
DCS204	Computer Communication & Networks	3(3+0)
DCS205	Linear Algebra	3(3+0)
		15

Semester – 2:

Course Code	Course Title	Credit Hours
DCS206	Introduction to Database Systems	3(2+1)
DCS207	Introduction to Software Engineering	3(3+0)
DCS208	Multimedia Systems and Design	3(2+1)
DCS209	Web Systems and Technologies	3(2+1)
DCS210	Human Compute Interaction	3(2+1)
		15

DETAILED COURSE OUTLINE

Course Name: Introduction to Computing

Course Structure: Lectures: 3, Labs: 1 **Credit Hours: 4**

Prerequisites: None

Objectives: This course focuses on a breadth-first coverage of computer science discipline, introducing computing environments, general application software, basic computing hardware, operating systems, desktop publishing, Internet, software applications and tools and computer usage concepts; Introducing Software engineering and Information technology within the broader domain of computing, Social issues of computing.

Course Outline: Number Systems, Binary numbers, Boolean logic, History computer system, basic machine organization, Von Neumann Architecture, Algorithm definition, design, and implementation, Programming paradigms and languages, Graphical programming, Overview of Software Engineering and Information Technology, Operating system, Compiler, Computer networks and internet, Computer graphics, AI, Social and legal issues.

Reference Material:

1. Computers: Information Technology in Perspective, 9/e by Larry Long and Nancy Long,
2. Prentice Hall, 2002 / ISBN: 0130929891
3. *An Invitation to Computer Science*, Schneider and Gersting, Brooks/Cole Thomson Learning, 2000
4. *Computer Science: An overview of Computer Science*, Sherer,

Course Name: Programming Fundamentals

Course Structure: Lectures: 3, Labs: 1 **Credit Hours: 4**

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

Course Name: Basic Electronics

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:

1. Freedman and Young, *University Physics,* (10^{th} and higher editions).
2. Resnick, Halliday and Krane, *College Physics* (6^{th} and higher edition).

Course Name: Calculus and Analytic Geometry

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:

1. Swokowski, Olinick and Pence, Calculus and Analytical Geometry, 6th edition, 1994, Brooks/Cole Publishers.
2. Howard Anton, Calculus, 7th edition. 2002, John Wiley and Sons (WIE).
3. William E. Boyce Richard C. Diprima, *Calculus*, John Wiley & Sons, ISBN: 0471093335.
4. Thomas Finny, Calculus and Analytical Geometry, 10th edition, John Wiley and Sons.
5. Erwin Kreyzig, Advanced Engineering Mathematics, 7th edition, 1993, John Wiley & Sons Inc.

Course Name: ENGLISH – I (COMMUNICATION SKILLS)

Course Structure: Lectures: 3, Labs: 0 **Credit Hours:** 3

Prerequisites: None

Objectives:

Enable the students to meet their real life communication needs.

Course Contents

Paragraph writing: Practice in writing a good, unified and coherent paragraph, **Essay writing:** Introduction, **CV and job application:** Translation skills, Urdu to English, **Study skills:** Skimming and scanning, intensive and extensive, and speed reading, summary and précis writing and comprehension, **Academic skills:** Letter/memo writing, minutes of meetings, use of library and internet, **Presentation skills:** Personality development (emphasis on content, style and pronunciation)

Recommended books:

Communication Skills

a) Grammar

1. Practical English Grammar by A.J. Thomson and A.V. Martinet. Exercises 2. Third edition. Oxford University Press 1986. ISBN 0 19 431350 6.

b) Writing

1. Writing. Intermediate by Marie-Chrisitine Boutin, Suzanne Brinand and Francoise Grellet. Oxford Supplementary Skills. Fourth Impression 1993. ISBN 019 435405 7 Pages 45-53 (note taking).
2. Writing. Upper-Intermediate by Rob Nolasco. Oxford Supplementary Skills. Fourth Impression 1992. ISBN 0 19 435406 5 (particularly good for writing memos, introduction to presentations, descriptive and argumentative writing).

c) Reading

1. Reading. Advanced. Brian Tomlinson and Rod Ellis. Oxford Supplementary Skills. Third Impression 1991. ISBN 0 19 453403 0.
2. Reading and Study Skills by John Langan
3. Study Skills by Riachard Yorky.

Course Name: ISLAMIC STUDIES

Course Structure: Lectures: 3, Labs: 0 **Credit Hours:** 3

Prerequisites: None

Objectives:

This course is aimed at:

1 To provide Basic information about Islamic Studies

2 To enhance understanding of the students regarding Islamic Civilization

3 To improve Students skill to perform prayers and other worships

4 To enhance the skill of the students for understanding of issues related to faith and religious life.

Course Outlines

Introduction to Quranic Studies

1) Basic Concepts of Quran
2) History of Quran
3) Uloom-ul -Quran

Study of Selected Text of Holly Quran

1) Verses of Surah Al-Baqra Related to Faith(Verse No-284-286)
2) Verses of Surah Al-Hujrat Related to Adab Al-Nabi (Verse No-1-18)
3) Verses of Surah Al-Mumanoon Related to Characteristics of faithful (Verse No-1-11)
4) Verses of Surah al-Furqan Related to Social Ethics (Verse No.63-77)
5) Verses of Surah Al-Inam Related to Ihkam(Verse No-152-154)

Study of Selected Text of Holly Quran

1) Verses of Surah Al-Ihzab Related to Adab al-Nabi (Verse No.6,21,40,56,57,58.)
2) Verses of Surah Al-Hashar (18,19,20) Related to thinking, Day of Judgment
3) Verses of Surah Al-Saf Related to Tafakar,Tadabar (Verse No-1,14)

Seerat of Holy Prophet (S.A.W) I

1) Life of Muhammad Bin Abdullah (Before Prophet Hood)
2) Life of Holy Prophet (S.A.W) in Makkah
3) Important Lessons Derived from the life of Holy Prophet in Makkah

Seerat of Holy Prophet (S.A.W) II

1) Life of Holy Prophet (S.A.W) in Madina
2) Important Events of Life Holy Prophet in Madina
3) Important Lessons Derived from the life of Holy Prophet in Madina

Introduction To Sunnah

1) Basic Concepts of Hadith
2) History of Hadith
3) Kinds of Hadith
4) Uloom –ul-Hadith
5) Sunnah & Hadith
6) Legal Position of Sunnah

Selected Study from Text of Hadith

Introduction To Islamic Law & Jurisprudence

1) Basic Concepts of Islamic Law & Jurisprudence
2) History & Importance of Islamic Law & Jurisprudence

3) Sources of Islamic Law & Jurisprudence
4) Nature of Differences in Islamic Law
5) Islam and Sectarianism

Islamic Culture & Civilization

1) Basic Concepts of Islamic Culture & Civilization
2) Historical Development of Islamic Culture & Civilization
3) Characteristics of Islamic Culture & Civilization
4) Islamic Culture & Civilization and Contemporary Issues

Islam & Science

1) Basic Concepts of Islam & Science
2) Contributions of Muslims in the Development of Science
3) Quranic & Science

Islamic Economic System

1) Basic Concepts of Islamic Economic System
2) Means of Distribution of wealth in Islamic Economics
3) Islamic Concept of Riba
4) Islamic Ways of Trade & Commerce

Political System of Islam

1) Basic Concepts of Islamic Political System
2) Islamic Concept of Sovereignty
3) Basic Institutions of Govt. in Islam

Islamic History

1) Period of Khlaft-E-Rashida
2) Period of Ummayyads
3) Period of Abbasids

Social System of Islam

1) Basic Concepts of Social System of Islam
2) Elements of Family
3) Ethical Values of Islam

Reference Books:

1) Hameed ullah Muhammad, "Emergence of Islam" , IRI, Islamabad

2) Hameed ullah Muhammad, "Muslim Conduct of State"

3) Hameed ullah Muhammad, 'Introduction to Islam

4) Mulana Muhammad Yousaf Islahi,"
5) Hussain Hamid Hassan, "An Introduction to the Study of Islamic Law" leaf Publication Islamabad, Pakistan.

6) Ahmad Hasan, "Principles of Islamic Jurisprudence" Islamic Research Institute, International Islamic University, Islamabad (1993)

7) Mir Waliullah, "Muslim Jrisprudence and the Quranic Law of Crimes" Islamic Book Service (1982)

8) H.S. Bhatia, "Studies in Islamic Law, Religion and Society" Deep & Deep Publications New Delhi (1989)

9) Dr. Muhammad Zia-ul-Haq, "Introduction to Al Sharia Al Islamia" Allama Iqbal Open University, Islamabad (2001)

Course Name: Object Oriented Programming

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 Object 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: Digital logic Design

Course Structure: Lectures: 2, Labs: 1 **Credit Hours:** 3

Prerequisites: None

Objectives: The course aims to establish the concepts of digital logic and design fundamentals.

Review of Number systems: Base-N number system, signed, unsigned, integers and their arithmetic functions, **Switching functions:** Theorems and postulates of Boolean algebra, sum of products and product of sum representation of logic functions, simplification of switching functions using graphical and tabular methods, Fundamental of Boolean Algebra. **Minimization techniques:** algebraic, K-maps, QM method, **Combinational Logic Circuits:** Implementation of switching functions and design of arithmetic and logic circuits, adders and subtractors, encoders and decoders and their implementation using basic and universal logic gates and modules i.e., multiplexers, ROM, PAL and PLA, **Sequential Logic Circuits:** Basic components of sequential circuit design; flipflops and latches, Design and analysis of algorithmic and finite state machines(Moore and Mealy machine concepts) , synchronous and asynchronous sequential machines.

LAB: Laboratory work will be concentrating on the implementation of the concepts of logic design using both hardware experiments and hardware description languages i.e., EWB or Verilog and/or VHDL

Reference Material:

1. Floyd T. L, Digital Fundamentals, 9th Edition, Pearson Education International, ISBN: 0-13-197255-3

Course Name: Discrete Structures

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:

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

Course Name: Probability and Statistics

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:

1. Ronald Walpole, Myers, Myers, Ye, "Probability & Statistics for Engineers & Scientists", 8th edition, 2008, **Prentice Hall** Publisher.
2. Lay L. Devore, Probability and Statistics for Engineering and the Sciences, 2003, Duxbury Publishers.
3. G. Cowan, *Statistical Data Analysis*, 1998, Clarendon, Oxford.

Course Name: English – II (Technical and Business Writing)

Course Structure: Lectures: 3, Labs: 0 **Credit Hours:** 3

Prerequisites: English – I (Communication Skills)

Objectives:

Enhance language skills and develop critical thinking

Course Contents

Presentation skills

Essay writing

Descriptive, narrative, discursive, argumentative

Academic writing

How to write a proposal for research paper/term paper

How to write a research paper/term paper (emphasis on style, content, language, form, clarity, consistency)

Technical Report writing

Progress report writing

Recommended books:

Technical Writing and Presentation Skills

a) Essay Writing and Academic Writing

1. Writing. Advanced by Ron White. Oxford Supplementary Skills. Third Impression 1992. ISBN 0 19 435407 3 (particularly suitable for discursive, descriptive, argumentative and report writing).
2. College Writing Skills by John Langan. Mc=Graw-Hill Higher Education. 2004.
3. Patterns of College Writing (4th edition) by Laurie G. Kirszner and Stephen R. Mandell. St. Martin's Press.

b) Presentation Skills

c) Reading

The Mercury Reader. A Custom Publication. Compiled by norther Illinois University. General Editiors: Janice Neulib; Kathleen Shine Cain; Stephen Ruffus and Maurice Scharton. (A reader which will give students exposure to the best of twentieth century literature, without taxing the taste of engineering students).

Course Name: Pakistan Studies

Course Structure: Lectures: 3, Labs: 0 **Credit Hours:** 3

Prerequisites: None

Objectives

- Develop vision of historical perspective, government, politics, contemporary Pakistan, ideological background of Pakistan.
- Study the process of governance, national development, issues arising in the modern age and posing challenges to Pakistan.

Course Outline

1. **Historical Perspective**

    a. Ideological rationale with special reference to Sir Syed Ahmed Khan, Allama Muhammad Iqbal and Quaid-i-Azam Muhammad Ali Jinnah.

    b. Factors leading to Muslim separatism

    c. People and Land
        i. Indus Civilization
        ii. Muslim advent
        iii. Location and geo-physical features.

2. **Government and Politics in Pakistan**

    Political and constitutional phases:

    a. 1947-58
    b. 1958-71
    c. 1971-77
    d. 1977-88
    e. 1988-99
    f. 1999 onward

3. **Contemporary Pakistan**

    a. Economic institutions and issues
    b. Society and social structure
    c. Ethnicity
    d. Foreign policy of Pakistan and challenges
    e. Futuristic outlook of Pakistan

Books Recommended

1. Burki, Shahid Javed. *State & Society in Pakistan,* The Macmillan Press Ltd 1980.
2. Akbar, S. Zaidi. *Issue in Pakistan's Economy.* Karachi: Oxford University Press, 2000.
3. S.M. Burke and Lawrence Ziring. Pakistan's Foreign policy: An Historical analysis. Karachi: Oxford University Press, 1993.
4. Mehmood, Safdar. *Pakistan Political Roots & Development.* Lahore, 1994.
5. Wilcox, Wayne.*The Emergence of Banglades.,* Washington: American Enterprise, Institute of Public Policy Research, 1972.
6. Mehmood, Safdar. *Pakistan Kayyun Toota,* Lahore: Idara-e-Saqafat-e-Islamia, Club Road, nd.
7. Amin, Tahir. *Ethno - National Movement in Pakistan,* Islamabad: Institute of Policy Studies, Islamabad.
8. Ziring, Lawrence. *Enigma of Political Development.* Kent England: WmDawson & sons Ltd, 1980.
9. Zahid, Ansar. *History & Culture of Sindh.* Karachi: Royal Book Company, 1980.
10. Afzal, M. Rafique. *Political Parties in Pakistan,* Vol. I, II & III. Islamabad: National Institute of Historical and cultural Research, 1998.
11. Sayeed, Khalid Bin. *The Political System of Pakistan.* Boston: Houghton Mifflin, 1967.
12. Aziz, K.K. *Party, Politics in Pakistan,* Islamabad: National Commission on Historical and Cultural Research, 1976.
13. Muhammad Waseem, Pakistan Under Martial Law, Lahore: Vanguard, 1987.
14. Haq, Noor ul. *Making of Pakistan: The Military Perspective.* Islamabad: National Commission on Historical and Cultural Research, 1993.

Course Name: Data Structure and Algorithms

Course Structure: Lectures: 2 / Labs: 1 **Credit Hours:** 3

Prerequisites: None

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, and Graphs. Recursion, sorting and searching 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 Abstraction and Problem Solving with C++, 2nd ed, Frank M. Carrano, Paul Helman, Robert Verof, Addison-Wesley, 1998.
2. Data Structures and Algorithms (SAMS teach yourself), Lafore, Sams Publishing, 1999.
3. Fundamentals of Data Structures in C++, Horowitz, Sahni, and Mehta, Computer Science Press, 1995. Data Structures in JA VA, Standish, Addison Wesley, 2000

Course Name: Computer Organization and Assembly Language

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:

1. Stallings, "Computer Organization & Architecture", 7th ed, Prentice HALL, 2006.
2. Irvine, Assembly Language for Intel-based Computers, 5th ed, Prentice Hall, 2007.
3. Computer Organization and Design, The Hardware/Software Interface, 4th ed, by David A. Patterson and John L. Hennessy, 2008. Elsevier Publishers.

Course Name: Database Management Systems

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

Course Outline:

Basic database concepts; Logical database Modelling and design: Entity Relationship diagram (ERD), Enhanced ERD Relational data model: mapping ERD to relational model, Functional dependencies and Normalization: 1st -3rd Normal Form and BCNF, Relational Algebra; Structured Query language (SQL);

Fundamental knowledge about Transaction processing, concurrency control recovery techniques and query optimization concepts.

Reference Material:

1. C. J. Date, Database Systems, Addison Wesley Pub. Co.
2. R. Elmasri and S. Navathe. Fundamentals of Database Systems, Benjamin/Cummings.
3. Abraham Silberschatz, Henry F. Korth S. Sudarshan. “Database System Concepts”.
4. T.Connolly and C.Begg . “Database Systems, a Practical Approach to Design, Implementation and Management”, Pearson education,.

Course Name: Differential Equations

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:

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

Course Name: Visual Programming

Course Structure: Lectures: 2 / Labs: 1 **Credit Hours:** 3

Prerequisites: Data Structures, Data and Network Security

Objectives: To development applications using various tools and APIs in visual programming.

Course Outline: Introduction to Windows programming, Use of Windows API, MFC Class hierarchy, Class Wizard, Application Wizard and Application Studio, Graphics Device Interface, Menus, document view architecture, Multiple Views, files and archiving mechanisms, converting Windows programmes to MFC, Sub-classing controls.

Reference Material:

1. MFC from the Ground Up.
2. Windows 98 API Programming. VC++, A complete References.

Course Name: Advanced Databases

Course Structure: Lectures: 3/Labs: 0 **Credit Hours:** 3

Prerequisites: None

Course Outline: Review of relational databases SQL in the real world: embedded SQL, data passing, status, cursor, connection, transaction, stored procedure; dynamic SQL, parameter, descriptor; JDBC; SQLJ; ODBC. Relational calculus: Object databases, Object-relational databases, objects in SQL:1999. ODMG standard, CORBA: IDL, ORB, dynamic invocation, DB services XML databases, description and query of semi-structured, nested, complex data; XML basics, XML Schema, XSLT, stylesheet, templates, evaluation. XQuery: FLWR expression, evaluation, built-in functions, user-defined functions, aggregation, quantification. More XQuery: data and types; XQuery and XML Schema; proj, sel, construction, group, join, recursive function, wildcard types, XqueryX; XPath and XQuery, laws. Query processing, Query optimization, OLAP, vs OLTP, Vs data mining; multidimensional model, star schema; aggregation, drilling, rolling, slicing, dicing; CUBE, ROLLUP. Materialized views, ROLAP and MOLAP; data mining, associations, priori algorithm, other kinds, machine learning; data warehouse, ETL tools, metadata, incremental updates.

Reference Material:

Database and Transaction Processing: An Application-Oriented Approach by Philip M. Lewis, Arthur Bernstein, and Michael Kifer. Addison Wesley, 2002.

Course Name: Operating Systems

Course Structure: Lectures: 3, 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:

1. *Applied Operating Systems Concepts,* 7th Edition, Silberschatz A., Peterson, J.L., & Galvin P.C. 2004.
2. *Modern Operating Systems,* 3rd Edition, Tanenmaum A.S., 2008.

Course Name: Computer Architecture

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:

1. *Computer Architecture: A Quantitative Approach* by Hennessy & Patterson, Morgan & Kauffman Series (2006) Fourth Edition.
2. *Computer Organization & Design* : *The Hardware/Software Interface* By Patterson & Hennessy, Morgan & Kauffman Series (2008) Fourth Edition.

Course Name: Data Communication

Course Structure: Lectures: 3, Labs: 0 **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: Network Security

Course Structure: Lectures: 3 / Labs: 0 **Credit Hours: 3**

Prerequisites: Data Communication and Networks

Mathematical Methods, Introduction To Number Theory, Complexity, Information Theory, Conventional Encryption Models, Classical Encryption Techniques, Types of Attacks, Symmetric Algorithms, DES, asymmetric Algorithms, Public Key Cryptosystems, RSA, Key Management, Authentication Requirements, Elementary Methods of Message Authentication, Authentication
Functions, Cryptographic Checksums, Digital Signatures, Digital Signatures Standards, Method Digest Algorithm, Hash Functions and Hash Algorithm, International Data Encryption Algorithm, AES, Linear Feed Back Shift Register, One Way Cipher and Password, Smart Cards and Information Cards, UnForgeable ID Cards Using Smart Cards, Pretty Good Privacy (PGP), Privacy Enhanced Mail (PEM), PGP Random Number Generation, Text / Data Embedded in Images

Suggested Text:
Applied Cryptography by Bruce Scheneir
Network and Inter Network Security — Principals and Practices by William Stallings, Prentice Hall 1995

Course Name: Software Engineering

Course Structure: Lectures: 3 / Labs: 0 **Credit Hours: 3**

Prerequisites: Data Structures and Algorithms

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: A Practioner's Approach, Roger Pressman, McGraw-Hill, 2001.
Object-Oriented Software Engineering, Stephan Schach, Irwin, 1999.

Course Name: Linear Algebra

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:

1. Bernard Kolman, David Hill, Elementary Linear Algebra with Applications, 9th edition, Prentice Hall PTR, 2007.
2. Gilbert Strang, Strang, Brett Coonley, Andy Bulman-Fleming, Andrew Bulman-Fleming, Strang's Linear Algebra And Its Applications, 4th edition, Brooks/Cole, 2005
3. Howard Anton, Chris Rorres, Elementary Linear Algebra: Applications Version, 9th edition, Wiley, 2005.
4. David C. Lay, Linear Algebra and Its Applications, 2nd edition, Addison-Wesley, 2000.

Course Name: Computer Communication and Networks

Course Structure: Lectures: 2, Labs: 1 **Credit Hours:** 3

Prerequisites: None

Objectives: To introduce students to the concept of computer communication. Analogue & digital transmission. Network Layers, Network models (OSI, TCP/IP) and Protocol Standards. Emphasis is given on the understanding of modern network concepts.

Course Outline: Analogue and digital Transmission, Noise, Media, Encoding, Asynchronous and Synchronous transmission, Protocol design issues. Network system architectures (OSI, TCP/IP), Error Control, Flow Control, Data Link Protocols (HDLC, PPP). Local Area Networks and MAC Layer protocols (Ethernet, Token ring), Multiplexing, Switched and IP Networks, Inter-networking, Routing, Bridging, Transport layer protocols TCP/IP, UDP. Network security issues. Programming exercises, labs or projects involving implementation of protocols at different layers.

Reference Material:

1. Introduction to Computer Networks /4, A. S. Tanenbaum, Prentice Hall 2003
2. Computer Networks and Internets, 5/E, 2008
   Douglas E. Comer, Purdue University ISBN-10: 0136061273 ISBN-13: 9780136061274 Publisher: Prentice Hall
3. Data and Computer Communications By William Stallings Published by Macmillan Pub. Co., 8th Edition 2006

Course Name: Design and Analysis of Algorithms

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:

1. *Introduction to Algorithms /2E,* T. H. Cormen, C. E. Leiserson, and R. L. Rivest, MIT Press, McGraw-Hill, New York, NY, 2001.
2. Algorithms in C++; Robert Sedgewick

Course Name: Artificial Intelligence

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. Problem-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:

1. Artificial Intelligence: Structures and Strategies for Complex Problem Solving: International Edition By George F. Luger, 6th edition: Pearson Education, 2008.
2. Artificial Intelligence: A Modern Approach, By Stuart Jonathan Russell, Peter Norvig, John F. Canny, 2nd Edition, Prentice Hall, 2003.

Course Name: Theory of Automata and Formal languages

Course Structure: Lectures: 2 Labs: 1 **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:

1. An Introduction to Formal Languages and Automata, By Peter Linz, 4th edition, Jones & Bartlett Publishers, 2006
2. 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.
3. John Hopcroft and Jeffrey Ullman, *Introduction to Automata Theory, Languages, and Computation*, 2nd edition, 2001, Addison-Wesley.
4. Introduction to Languages and the Theory of Computation, By John C. Martin3rd edition, 2002, McGraw-Hill Professional.

Course Name: Advance Data Base Systems

In-depth study of the classical distributed database management issues such as distribution design, distributed query processing and optimization, and distributed transaction management.

Course Structure: Lectures: 2 Labs: 1 **Credit Hours:** 3

Prerequisites: Good knowledge of database management system is required along with computer network principles and students are expected to have the in-depth knowledge of data structures and algorithms.

COURSE LEARNING OUTCOMES:

- Examine the basic components of a Distributed Database System.
- Validate the Types and Properties of Transactions.
- Evaluate Concurrency Control Algorithms.
- Understand reliability concepts and measures in the context of Distributed Databases.
- Construct an interface for a database application.

BOOK:

Title: Principles Of Distributed Database Systems: Second Edition Author: M. Tamer Özsu, Patrick Valduriez

Publisher: Prentice Hall ISBN: 0-13-659707-6

Course Name: Numerical and Symbolic Computing

Course Structure: Lectures: 2 / Labs: 3 **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 non-linear equations.

Reference Material:

1. Numerical Methods in Scientific Computing Germund Dahlquist and Åke Björck .
2. Numerical Methods for Scientific Computing : J.H. Heinbockel
3. Numerical Analysis: I.A. Khubaza
4. Numerical Analysis and Programming : Shan S Kuo
5. Numerical Analysis by Berden Fairs
6. Numerical Analysis by Gerald

Course Name: Web Programming

Course Structure: Lectures: 2, Labs: 1 **Credit Hours:** 3

Prerequisites: programming Fundamentals

Objectives:

This course will extend the WWW Technologies and Web Based Applications architecture, development, deployment and management concepts studied in the course of Fundamentals of Information Technology. The instructor is expected to cover an in-depth treatment of the web technology and applications related topics including web standards, protocols, web applications architecture, web services, search engine architectures, content management, web2, and semantic web, to explore some of the technologies used for display, data access and processing, and to give the students practice in integrating these to produce a functional web-based system.

Course Outline:

In-depth study of World Wide Web architectures, protocols and standards (HTTP, HTML, xHTML, CGI, XML, WML, cHTML, etc.), Web Technologies and Tools (such as scripting tools) for web application development and deployment (web servers, application servers, etc.), Web Based Applications including search engines and content management, management of large scale web based information systems, Web Services, Web2, Semantic Web, and Web3, principles of web site design, practical exercise in web site development.

Suggested Text Books:

1. Nuckles, Craig, Web Applications: Concepts and Real World Design, Wiley 2006
2. Programming the World Wide Web (4th Edition) (Paperback), by Robert W. Sebesta (Author), Paperback: 752 pages, Publisher: Addison Wesley; 4th edition (August 17, 2007), ISBN-10: 0321489691

Reference Material:

1. Gosselin, Dan, et. al., The Web Warrior Guide to Web Design Technologies, Cengage Learning, 2003
2. Zak, Diane, et. al., The Web Warrior Guide to Web Programming, Cengage Learning, 2003
3. Leasure, T., Bob Leasure and James Leasure, The Web Warrior Guide to Web Database Technologies, Cengage Learning, 2003
4. Morrison, Mike and Joline Morrison, Database Driven Websites, 2/e, Cengage Learning, 2002
5. Web Wizard series for various technologies, Addison-Wesley
6. Jackson, J. C., Web Technologies: A Computer Science Perspective, Pearson (LPE), 2008
7. Web Application Architecture: Principles, Protocols and Practices by Leon Shklar and Richard Rosen (Paperback - Oct 31, 2008), Paperback: 420 pages, Publisher: Wiley; 2 edition (October 31, 2008), ISBN-10: 047051860X
8. Web Engineering: The Discipline of Systematic Development of Web Applications by Gerti Kappel, Birgit Prýýll, Siegfried Reich, and Werner Retschitzegger (Paperback - Jul 5, 2006)

Course Name: Human Computer Interaction

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 **Ben Shneiderman**, *University of Maryland* **Catherine Plaisant**, *University of Maryland* ISBN-10: 0321197860 ISBN-13: 9780321197863 Publisher: Addison-Wesley

Course Name: Compiler Construction

Course Structure: Lectures: 2 / Labs: 3 **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:

1. 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
2. Modern Compiler Design, By Dick Grune, Henri E. Bal, Ceriel J. H. Jacobs, Koen G. Langendoen, John Wiley, 2000.
3. Modern Compiler Implementation in C, By Andrew W. Appel, Maia Ginsburg, Contributor Maia Ginsburg, Cambridge University Press, 2004.
4. Modern Compiler Design by Dick Grune, Henri E. Bal, Ceriel J. H. Jacobs, Koen G. Langendoen, 2003, John Wiley & Sons.

Course Name: Multimedia Technologies

Course Structure: Lectures: 2, Labs:1 **Credit Hours:** 3

Prerequisites: None

Objectives: This course is aimed at exposing students to the current and future trends in Multimedia design and development. There is a huge amount of activity going on in this field with a big market all over the world, and new tools and technologies emerge quickly. Students shall learn them and familiarize themselves with the solution development using these tools.

Course Outline: Introduction to Multimedia Programming, Scope of Multimedia Programming, convention and trends, Media types used in current applications (including digital video, audio, and graphics). System level issues of performance synchronization, storage and server schemes, dynamic interactivity, hyper linking, multimedia device control, distributed media development and delivery, non-standard media and programming frame works. Introduction to Multi-media Networks.

Reference Material:

Multimedia Systems Design,1/e, Andleigh, P.K. and Thakrar, K., Prentice Hall.

Course Name: Advanced Software Engineering

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

Prerequisites: Software Engineering-I

Objectives: This consummates the knowledge and skills learnt in first Software Engineering course. The complete software engineering cycle is covered with current methodologies and techniques. Student shall also learn the key industrial standards and practices in software engineering today.

Course Outline: System Development using Formal Techniques, Algebraic specification, Abstract model specification, Verification: Proof Systems, Proof Techniques, Proof obligations, Design: Data refinement, operation refinement, Design decomposition. Software Reliability and Metrics. Macro models: productivity, effort. Defect models: Software reliability, Failures and fault, Software reliability modelling. Simple model, Markov modelling, Parameter estimation, Comparison of models.

Reference Material:

Developing Software with UML, Bernd Oesterich, Addison-Wesley.

Developing Object Oriented Software, OOTC, Prentice Hall. http://www.directtextbook.com/editions/prices/0321245628*Unified Modeling Language Reference Manual, The (2nd Edition)*, James Rumbaugh, Ivar Jacobson, Grady Booch, Pearson Higher Education 2004. ISBN: 0321245628.

Course Name: Simulation and Modeling

Course Structure: Lectures: 2 / Labs: 3 **Credit Hours:** 3

Prerequisites: Probability and Statistics, Calculus

Objectives: This course emphasizes the development of modeling and simulation concepts and analysis skills necessary to design, program, implement, and use computers to solve complex systems/products analysis problems regarding software engineering discipline. The key emphasis is on problem formulation, model building, data analysis, solution techniques, and evaluation of alternative designs/processes in complex systems/products. Overview of modeling techniques and methods used in decision analysis, including Monte Carlo simulation and systems dynamics modeling are presented.

1. To apply modern software packages to conduct analysis of real world data.
2. To understand the technical underpinning of modern computer simulation software.
3. The ability to apply the appropriate analytical technique to a wide variety of real world problems and data sets.
4. To summarize and present the analysis results in a clear and coherent manner.

Course Outline: Introduction to Simulation and Modeling, Discrete-Event Simulation, Simulation of a Single-Server Queueing System, Alternative Approaches to Modeling and Simulations; Review of Basic Probability and Statistics; Estimation of Means, Variances, and Correlations, Confidence Intervals and Hypothesis Tests for the Mean, The Laws of Large Numbers; Random number generators; Simulation of discrete, continuous probability distributions and empirical distributions; tests on simulated distributions, rejection method, simulation of multivariate distributions, correlations, and stochastic processes, simulation of models of arrival processes, Poisson Processes, Nonstationary Poisson Processes, Batch Arrivals, tests on generators, Markov- Chain Monte-Carlo simulations; Variance-Reduction Techniques.

Resources:

1. A.M. Law and W.D. Kelton, “Simulation Modeling and Analysis”, McGraw Hill, 2000.
2. J. Banks, J.S. Carson and B.L. Nelson, “Discrete-event System Simulation”, Prentice Hall International, 1994.
3. Mitrani, “Probabilistic Modeling”, Cambridge University Press, 1998.
4. Sheldon M. Ross, “Simulation and Modeling”, 2002.
5. Brian Ripley, “Stochastic Simulations”.

Course Name: Digital Image Processing

Course Structure: Lectures:3 Labs: 0 **Credit Hours:** 3

Prerequisites:

Objective:

The aim of this module is to understand the main terms & concepts of Information Systems & their applications in everyday business. The main objectives of this module are to make business students aware of the increasing importance of IT, computers and telecom and to manage IT systems in modern organisational structure. Another important objective of this module is to learn about various information systems used in industries and select the appropriate information system for the required application. Restoration in the Presence of Noise Only–Spatial Filtering, Mean Filters, Order-Statistics Filters, Adaptive Filters, Periodic Noise Reduction by Frequency Domain Filtering, Bandreject Filters, Bandpass Filters, Notch Filters. Estimating the Degradation Function, Estimation by Image Observation, Estimation by Experimentation, Estimation by Modeling, Inverse Filtering, Minimum Mean Square Error (Wiener) Filtering. Image Segmentation, Detection of Discontinuities, Point Detection, Line Detection, Edge Detection, Edge Linking and Boundary Detection, Local Processing, Global Processing via the Hough Transform.

Thresholding, The Role of Illumination, Basic Global Thresholding, Basic Adaptive Thresholding, Local Thresholding, Thresholds Based on Several Variables.

Region-Based Segmentation, Region Growing, Region Splitting and Merging

Book:

- Digital Image Processing by Gonzalez & Woods, 3rd edition, prentice Hall, 2008.
- Digital Image Processing using Matlab by Gonzalez, Woods, and Eddins, 2nd edition, Prentice Hall, 2009.