DEPARTMENT OF COMPUTER SCIENCE & INFORMATION TECHNOLOGY

SYLLABI OF COURSES

FOR

**BACHELOR OF SCIENCE IN
COMPUTER SCIENCE AND INFORMATION TECHNOLOGY**

BATCH: 2016-2017 Onward

**NED UNIVERSITY OF ENGINEERING & TECHNOLOGY,
KARACHI-75270, PAKISTAN**

BACHELOR OF SCIENCE IN
COMPUTER SCIENCE & INFORMATION TECHNOLOGY
SCHEME OF STUDIES

Subject to changes and modifications by the University, the courses of studies for the present batch are as follows:

FIRST YEAR – Fall Semester

S. No.	Course Code	Title	Credit Hours
1	CT - 153	Programming Languages	3 (2+1)
2	CT - 174	Fundamentals of Information Technology	3 (2+1)
3	MT - 171	Differential & Integral Calculus	3 (3+0)
4	EL - 134	Basic Electronics	4 (3+1)
5	HS - 205	Islamic Studies OR	2 (2+0)
	HS - 209	Ethical Behaviour	

FIRST YEAR – Spring Semester

S. No.	Course Code	Title	Credit Hours
1	CT - 157	Data Structure Algorithms & Applications	4 (3+1)
2	CT - 162	Discrete Structures	3 (3+0)
3	CT - 251	Object Oriented Programming	4 (3+1)
4	HS - 104	Functional English	3 (3+0)
5	HS - 105	Pakistan Studies OR	2 (2+0)
	HS - 127	Pakistan Studies (for Foreigners)	

SECOND YEAR – Fall Semester

S. No.	Course Code	Title	Credit Hours
1	CS - 251	Logic Design & Switching Theory	4 (3+1)
2	CT - 258	Financial & Cost Accounting	3 (3+0)
3	CT - 352	Computer Graphics	4 (3+1)
4	CT - 259	System Analysis & Design	3 (3+0)
5	MT - 273	Differential Equations & Linear Algebra	3 (3+0)

SECOND YEAR – Spring Semester

S. No.	Course Code	Title	Credit Hours
1	CS - 252	Computer Architecture & Organization	4 (3+1)
2	CT - 257	Database Management Systems	4 (3+1)
3	CT - 362	Web Engineering	4 (3+1)
4	HS - 208	Business Communications & Ethics	3 (3+0)
5	MT - 331	Probability & Statistics	3 (3+0)

THIRD YEAR – Fall Semester

S. No.	Course Code	Title	Credit Hours
1	CT - 360	Visual Programming	4 (3+1)
2	CS - 353	Microprocessors & Their Applications	4 (3+1)
3	CT - 363	Design & Analysis of Algorithms	3 (3+0)
4	CT - 353	Operating Systems	4 (3+1)
5	CT - 462	Distributed Computing	4 (3+1)

THIRD YEAR – Spring Semester

S. No.	Course Code	Title	Credit Hours
1	CS - 351	Computer Communication Networks	4 (3+1)
2	CT - 365	Software Engineering	3 (3+0)
3	CT - 364	Theory of Automata & Formal Languages	3 (3+0)
4	CT - 361	Artificial Intelligence & Expert Systems	4 (3+1)
5	CT - 366	E-Commerce	3 (3+0)

FINAL YEAR – Fall Semester

S. No.	Course Code	Title	Credit Hours
1	CT - 460	Network & Information Security	4 (3+1)
2	CT – 463	Data Warehousing & Mining	4 (3+1)
3	CT - 464	Modeling & Simulation	3 (3+0)
4	MT - 442	Numerical Methods	3 (3+0)
5	CT - 499	*Software Based Project	-

* Duration one academic year: Literature survey and preliminary work to be done during this Semester.

FINAL YEAR – Spring Semester

S. No.	Course Code	Title	Credit Hours
1	CS - 451	Parallel Processing	4 (3+1)
2	CT - 465	Compiler Design	3 (3+0)
3	HS - 403	Entrepreneurship	3 (3+0)
4	CT - ###	Elective Course	4 (3+1)
5	CT - 499	Software Based Project	6 (0+6)
		Elective Courses: CT - 481 Wireless Network & Mobile Computing CT - 482 Bio-Informatics CT - 483 System Administration	

FIRST YEAR

CT-153   PROGRAMMING LANGUAGES   Credit Hours: 2,1

Language: Definition, structures, survey of some programming languages, special and general purpose languages, data types. Comparative study by means of primitive and composite data structures, Control structures by means of expression of algorithms.

Recommended Books:
1. *"Turbo C"*, Robert Lafore, Financial Times Prentice Hall, Rev Sub Edition, 1988.
2. *"Let us C"*, Yashwant P. Kanetkar, Jones & Bartlett Publishers, 8th Edition, 2008.

CT-157   DATA STRUCTURE ALGORITHMS & APPLICATIONS   Credit Hours: 3,1

A detailed study of the basic data structures commonly used in data processing; Techniques for data manipulation in structures such as stacks, queues, linked lists trees and graphs, management of memory space and overflow, sorting, and hash table methods; Searching and merging files, implementation and evaluation of various programming assignments.

Recommended Books:
1. *"Data Structures and Algorithms"*, Alfred V. Aho, John E. Hopcroft and Jeffrey D. Ullman, Pearson Education Inc., Fourth Impression, 2009.
2. *"Data Structure"*, D. Samanta, Prentice Hall, 2003.
3. *"Theory and Problems of Data structures"*, Seymour Lipschutz, Schaum's Outline Series, McGraw Hill Book Co., 1986.

CT-162   DISCRETE STRUCTURES   Credit Hours: 3,0

Mathematical logic, Sets, Functions, Algorithms, Complexity of Algorithms, Mathematical reasoning, Induction, Recursion, Sequences and Sums, Recursive Definitions, Recursive Algorithms, Counting, The Pigeonhole Principal, Permutations and Combinations, Binomial Coefficients, Discrete Probability, Expected Value and Variance, Recurrence Relations, Solving Recurrence Relations, Divide-and-Conquer Relations, Generating Functions, Inclusion-Exclusion Relations and their Properties, Representing Relations, Closures of Relations, Equivalence Relations, Partial Ordering, Introduction to Graphs, Graph Terminology, Representing Graphs and Graph Isomorphism, Connectivity, Euler and Hamilton Paths, Shortest Path Problems, Introduction to Trees, Applications of Trees, Tree Traversal, Spanning Trees, Minimum Spanning Trees, Boolean Algebra, Boolean Functions, Representing Boolean Functions, Logic Gates, Minimization of Circuits, Modeling Computation, Languages and

Grammars, Finite-State Machines with output, Finite-State Machines with no output, Language Recognition.

Recommended Books:
1. *"Discrete Mathematics and its Applications"*, Kenneth H. Rosen, McGraw Hill Science/Engineering/Math, 6th Edition, 2006.
2. *"Mathematical Structures for Computer Science"*, Judith L. Gersting, W. H. Freeman, 6th Edition, 2006.

CT-174   FUNDAMENTALS OF INFORMATION TECHNOLOGY   Credit Hours: 2,1

Introduction to IT, recent advances in IT, IT systems, Development of the modern Computer. Introduction to Software, data structures, coding. Programming and problem solving algorithms. Data types and representation. Basic organization of Computer, Number systems. Introduction to Data Communication, Database, Information Systems and MIS, Networks & Internet concepts.

Recommended Books:
1. *"Introduction to Computers"*, Peter Norton, Glencoe/McGraw-Hill, 5th Edition, 2002.
2. *"Computer Communication Information"*, Sarah E. Hutchinson and Stacey C. Sawyer, McGraw-Hill Book Co., 7th Edition, 1999.

CT-251   OBJECT ORIENTED PROGRAMMING   Credit Hours: 3,1

What is an Object, Benefits of OOP; Object Oriented Environment; Class Object; Approach to Object Oriented Programming (from C to C++); Constructor; Destructor; Program Style; Functions; Inheritance, I/O streams, Overloading operations, Programming Examples.

Recommended Books:
1. *"Understanding Object Oriented Programming"*, Timothy Budd, Addison Wesley, 3rd Edition, 1998.
2. *"C++: How to Program"*, Paul Deitel and Harvey Deitel, Pearson, 7th Edition, 2010.
3. *"Object Oriented Programming in C++"*, Robert Lafore, Sams Publishing, 4th Edition, 2002.
4. *"C++ Programming: From Problem Analysis to Program Design"*, D.S. Malik, Course Technology, 5th Edition, 2010.

EL-134   BASIC ELECTRONICS   Credit Hours: 3,1

Semiconductor Diodes: Donor and Acceptor Impurities, Zero biased, Forward biased and Reverse biased junction Diodes, Junction Diode Current Equation. Depletion barrier width and junction capacitance, diffusion capacitance, Zener and Avalanche breakdown, Hall effect.

Power Supply Circuits: Half-wave and Full wave rectification, smoothing capacitor and filters, Ripple, Regulation and Regulated Power Supplies.

Bipolar and Field Effect Transistors: Bipolar & FET Principles, Basic circuit configuration, Voltage, Current and Power gains, Concept of input and output impedance, Low Frequency High Frequency small signal models, h-pattern Bandwidth. Introduction to amplifier coupling and feedback.

Oscillators: Principle of oscillation. Transistors and IC oscillators. Stability in oscillation.

Recommended Books:
1. *"Electronic Devices"*, Thomas L. Floyd, Prentice Hall, 8th Edition, 2007.
2. *"Electronic Devices and Circuits"*, Jacob Millman and Christos C. Halkias, McGraw Hill Inc., 1967.

MT-171 DIFFERENTIAL AND INTEGRAL CALCULUS   **Credit Hours: 3,0**

Vectors: Review of vectors, Vector derivatives. Line and surface Integrals. Gradient of a Scalar.

Complex Number: Argand diagram, De Moivre formula, root of polynomial equations, curve and regions in the complex plane, standard functions and their inverses (exponential, circular and hyperbolic functions).

Limits and Continuity: Bounds and bounded sets, Limit point of sets, Sequences, Convergence of sequences monotonic sequences, Functions and their graph, limit of function and continuous functions.

Differential Calculus: Differentiation and Successive differentiation and its application; Leibnitz theorem, Taylor and Maclaurin theorems with remainders in Cauchy and Lagrange form, Taylor and Maclaurin series, L' Hopitals rule, extreme values of a function of one variable using first and second derivative test, asymptotes of a function, curvature and radius of curvature of a curve, partial differentiation, exact differential and its application in computing errors, Multivariate functions, Maxima and Minima for multivariate functions, Maxima Minima under certain conditions (Lagrange Multiplier).

Integral Calculus: Indefinite integrals and their computational techniques, reduction formulae definite integrals and their convergence, Beta and Gamma functions and their identities, double and triple integration with applications (Area, volume, centroid, inertia, arc length).

Vector Algebra: Scalar and Vector quantities, physical and geometrical meanings. Algebra of vectors. Scalar and Vector triple products.

Recommended Books:

1. *"Engineering Mathematics"*, Anthony Croft, Robert Davison and Martin Hargreaves, Pearson Education Limited, 3rd Edition, 2001.
2. *"Calculus"*, George B. Thomas and Ross L. Finney, 9th Edition, Addison Wesley Longman, 2002.
3. *"Engineering Mathematics"*, K. A. Stroud and Dexter J. Booth, 6th Edition, Industrial Press, 2007.
4. *"Calculus and Analytical Geometry"*, Howard Anton, John Wiley & Sons Inc, 5th Edition, 1998.
5. *"Complex Analysis for Mathematics and Engineering"*, John H. Mathews, Jones and Bartlett Publishers Inc., 5th Edition, 2006.

HS-104   FUNCTIONAL ENGLISH   Credit Hours: 3,0

Listening: types of listening, problems in listening and coping strategies, listening skills, sub skills, practice in listening, note taking: techniques for taking notes from lectures, from books, note taking in different forms paragraphs, points, figures, processes, tables, graphs etc. vocabulary development: enhancing current vocabulary to reflect a better usage of words in spoken and written language, tips/ strategies in vocabulary enhancement, practice in vocabulary development. Reading: reading skills, sub skills, reading comprehension levels, reading strategies, reading practice through variety of reading texts and comprehension exercises, beyond reading (outline, précis, speech and presentation). Writing: process of writing, informal writing strategies, writing correctly: sentence structure and punctuation, error correction, paragraphs: structure, types, topic and the topic sentence, and unity, adequate development and coherence in paragraphs, essays: types, five paragraphs long essays, and structure (thesis statement and the paragraphs), short reports: structure, format, and types (informational and analytical), letters: elements, style, formatting (digital letter writing), organization and structure of the letter, and types (routine requests and intimation, invitation, thank you and condolence letters etc.).

Recommended Books:

1. "Cambridge vocabulary for IELTS", Pauline Cullen, Cambridge University Press. 2008
2. "English Vocabulary in Use (upper intermediate)", Michael Mcarthy & Felicity O'Dell Cambridge University Press. 2008
3. "Academic Listening Encounters: Human Behaviour", (Cambridge University Press), 2004
4. "Study Listening", by Lynch(Cambridge University Press). 2nd Edition, 2007
5. "Themes for Listening and Speaking Teacher's",Carole Robinson and Helen parker (Oxford university Press), 2nd Edition, 1986
6. "Making Connections: A strategic Approach to Academic Reading", Kenneth J Pakenham (Cambridge University Press), 2nd Edition, 2004
7. "Study Reading", Glendining and Holmstrom.(Cambridge University Press), 2nd Edition, 2007

8. "Writing and the Writer", Frank Smith, Heinemann Educational Books.1994
9. "Connections – A Guide to basics of writing", Peter Dow Adams, Little Brown and Company,1987
10. "College Writing skills", John Langan, Irwin McGraw Hill, 5th Edition, 1984
11. "The Elements of International Style: A Guide to writing correspondence, reports, Technical Documents, and internet pages for a global Audience" by Edmond H Weiss. Prentice Hall.

HS-105   PAKISTAN STUDIES   Credit Hours: 2,0

Historical and Ideological Perspective of Pakistan Movement
Two Nation Theory: Definition - Claim of Muslims of being a separate nation from Hindus based upon cultural diversity significance. Cultural diversity and threats posed to Muslims' rights and interests led to the demand of Pakistan – The Lahore Resolution.

Creation of Pakistan: Factors leading to the creation of Pakistan. Quaid-e-Azam and the demand of Pakistan.

Land of Pakistan: Geophysical conditions. Geopolitical and strategic importance of Pakistan. Natural resources-Minerals, Water and Power.

Constitutional Process: Early efforts to make constitution- problems and issues. Constitution of 1956 and its abrogation. Constitution of 1962 and its abrogation. Constitutional and Political crisis of 1971. Constitution of 1973. Recent Constitutional developments.

Contemporary issues in Pakistan:
Social issues: Literacy and education in Pakistan. State of science and technology with special reference to IT education. Pakistani society and culture.

A brief survey of Pakistan's Economy: Agricultural and industrial development in Pakistan. Internal and external trade, Economic planning and prospects.

Environmental issues: Hazards of atmospheric pollution. Other forms of environmental degradation and their causes and solution. Pakistan's role in preservation of nature through international conventions/efforts.

Foreign Policy: Relations of Pakistan with neighbours. Relation of Pakistan with Super Powers. Relations of Pakistan with the Muslim World.

Human Rights
Conceptual foundations of Human Rights: What are Human Rights? Definition, significance and importance. Comparative analysis of Islamic and Western Perspective of Human rights.

UN Systems for Protection of Human Rights. An overview: UN Charter. International Bill of Human rights. Implementation mechanism.

Other Important international treaties and conventions: The Convention on the elimination of all forms of discrimination against women. International Convention on the rights of child(CRC). Convention against torture(CAT). Refugee Convention.

Pakistan's response to Human Rights at national and international level: Constitutional Provisions. Pakistan's obligations to international treaties and documents. Minority Rights in Pakistan. Pakistan's stand on violation of Human Rights in the international perspective.

Cultural Development in Pakistan: Definition, Contents and Contributing factors in culture. Development of Art, Philosophy and Literature.

Foreign Policy: Relation with neighbours, Super Powers and the Muslim World.

Recommended Books:
1. *"Pakistan Studies"*, M. R. Kazmi, Oxford University Press, 2007.
2. *"Constitutional and Political History of Pakistan"*, Hamid Khan, Oxford University Press, 2nd Edition, 2009.
3. *"Pakistan's Foreign Policy"*, Abdul Sattar, Oxford University Press, USA, Illustrated Edition, 2007.
4. *"Issues in Pakistan's Economy"*, Akbar Zaidi, Oxford University Press, USA, 2nd Edition, 2006.

HS-127   PAKISTAN STUDIES (FOR FOREIGNERS STUDIES   Credit Hours: 2,0

Land of Pakistan: Land and People – Strategic importance, Important beautiful sights, National resources.

A brief Historical Background: A brief historical survey of Muslim community in the sub continent, British rule and its impacts, Indian reaction, Two nation theory, Origin and development factors leading towards the demand of a separate Muslim state, Creation of Pakistan.

Government and politics in Pakistan: Constitution of Pakistan: A brief outline, Government structure Federal and Provisional – Local Government Institution Political History, A brief account.

Language and Culture: Origin of Urdu Language, Influence of Arabic and Persian on Urdu Language and Literature, A short history of Urdu literature.

Recommended Books:

1. *"Pakistan Affairs"*, Ikram Rabbani, Caravan Book House, Lahore, 1997.
2. *"Old Roads, New Highways: 50 Years of Pakistan"*, Victoria Schofield, Oxford University Press, Pakistan, 1997.

HS-205   ISLAMIC STUDIES   **Credit Hours: 2,0**

Thematic Study of Holy Quran

Basic Islamic Beliefs
Tauheed: Al-Ambiya – 22, Al Baqarah – 163 – 164
Prophethood: Al-Imran – 79, Al-Hashr – 7, Al- Madina – 3
Hereafter: Al-Hajj – 5, Al- Baqarah – 48, and two Ahadith.

Basic Islamic Practices: Al-Mu'minun – 1-11

Amer-bil-Ma'roof wa Nahi Anil Munkar: The concept of Good and Evil; Importance and Necessity of Da'wat-e-Deen, Al-Imran – 110; Method of Da'wat-e-Deen. An-Nahl – 125, Al – Imran – 104. and two Ahadith.

Unity of the Ummah: Al-Imran – 103, Al-Hujurat – 10, Al-Imran – 64, Al-An'am – 108, and two Ahadith.

Kasb–e–Halal: Ta ha-81, Al-A'raf-32-33, Al-Baqarah-188, and two Ahadith.

Huquq-ul- Ibad
Protection of Life: Al-Maidah – 32
Right to Property: An-Nisa – 29
Right to Respect & Dignity: Al-Hujurat – 11-12
Freedom of Expression: Al-Baqarah – 256
Equality: Al-Hujurat – 13
Economic Security: Al-Ma'arij – 24-25
Employment Opportunity on Merit: An-Nisa – 58
Access to Justice: An-Nisa - 135

Women Rights: An-Nahl - 97, Al-Ahzab - 35, An-Nisa - 7
Relation With Non-Muslims: Al-Mumtahanah – 8-9, Al-Anfal – 61, and The Last Sermon of Hajj of Holy Prophet (PBUH) at Arafat on 10th Zil Haj – Relevant extracts.

Seerat (life) of the Holy Prophet (PBUH): Birth, life in Makkah, declaration of Prophethood, preaching and its difficulties, migration to Madina, Brotherhood (Mawakhat) and Madina

Charter, the Holy Wars of the Prophet (Ghazwat-e-Nabawi), Hujjat-ul-Wida, the Last Sermon of Khutbat-ul-Wida: Translation and important points.

Islamic Civilisation:
In the Sub-Continent – Pre-Islamic civilization. The political, social and moral impacts of Islamic Civilisation.

In the World - Academic, intellectual, social and cultural impacts of Islam on the world.

Recommended Books:
1. *"Thematic Study of Holy Quran and Hadith"*, Saeedullah Qazi, Reprinted by NED University.
2. *"Life of the Prophet"*, Ibne Ishaq, Alfred Guillaume (Translator), Oxford University Press, 2002.

HS-209   ETHICAL BEHAVIOUR   **Credit Hours: 2,0**

Introduction to Ethics: Definition of Ethics; Definition between normative and positive science; Problem of Freewill; Method of Ethics; Uses of Ethics.

Ethical Theories: History of Ethics - Greek Ethics, Medieval, Modern Ethics. Basic Concept of right and wrong: good and evil; Unilateralism, hedonism, Self-realisation – Egoism, intuitionism; Kant's moral philosophy.

Ethics & Religion: The relation of Ethics to Religion; Basic ethical principles of major religions: Hinduism, Judaism, Buddhism, Zoroastrianism, Christianity, Islam.
Ethics, Society, and moral theory: Ethical foundation of Rights and Duties; Applied Ethics; Society as the background of moral life; Universalism and Altruism; Theories of punishment.

Recommended Books:
1. *"An Introduction to Ethics"*, William Lillie, Barnes & Noble, 3rd Edition, reprinted 1974.
2. *"Philosophy: The Basics"*, Nigel Warburton, Routledge, London, 4th Edition, 2004.

SECOND YEAR

CT-257   DATABASE MANAGEMENT SYSTEMS   **Credit Hours: 3,1**

File structures and file testing methods sequential, random and indexed sequential methods. Relational, Networks and Hierarchical data models, Organization, storage and retrieval methods. Functional dependency and normalization of database. Query processing and manipulation. Practical assignments and a project.

Recommended Books:
1. *"Database Systems"*, Thomas M. Connolly, Addison Wesley, 4th Edition, 2004.
2. *"An Introduction to Database Systems"*, C. J. Date, Addison Wesley, 8th Edition, 2003.

CT-258   FINANCIAL & COST ACCOUNTING   Credit Hours: 3,0

Structure of accounting, classification of accounting frameworks, Accounting principles, Accounting Cycle, Preparation and use of worksheet, the concept and procedures of adjusting, reversing and closing entries, preparation and analysis of classified and incorporated financial statements.

Basic concepts of Cost Accounting, types of cost, cost assignments, costing methods, budgeting and planning, standard cost and variance analysis. Job order costing, process costing, ABC and JIT techniques, material, labour and overhead costing.
Includes a practical component of 1 Credit Hour.

Recommended Books:
1. *"Accounting: The Basis for Business Decisions"*, Robert Meigs and Mary Meigs, McGraw-Hill Co., 10th Edition, 1996.
2. *"Fundamentals of Cost Accounting"*, William N. Lanen, Shanon W. Anderson and Michael Maher, McGraw-Hill/Irwin, 3rd Edition, 2010.
3. *"Cost Accounting: Planning and control"*, Adolph Matz and Milton F. Usry, Wadsworth Publishing Co. Inc., 9th Revised Edition, 1989.

CT-259   SYSTEM ANALYSIS & DESIGN   Credit Hours: 3,0

Study of conventional and structured techniques, Objectives, investigations, system models, etc. Physical models; Data models; Project dictionary. System design and implementation; tools and techniques; Prototyping; Preparation and handling of data, File organization design, documentation; Implementation and evaluation of information systems, Problems of systems analysis and design; Project management tools and techniques: A case study as assignment.

Recommended Books:
1. *"Modern Systems Analysis & Design"*, Jeffrey A. Hoffer, Joey F. George and Joseph S. Valacich, Prentice Hall, 5th edition, 2007.
2. *"Systems Analysis & Design"*, Allan Dennis, Barbara H. Wixom and Roberta M. Roth, Wiley, 4th Edition, 2008.

CT-352   COMPUTER GRAPHICS   Credit Hours: 3,1

Architecture and implementation of display interactive devices; Functional capabilities of graphics package. 2D and 3D viewing, clipping and transformation, human factors; Raster

graphics scan conversion algorithms; Hidden surface and edges removal algorithms; Shading and texturing techniques; Application using commercial packages.

Recommended Books:
1. *"Computer Graphics using OpenGL"*, Francis S. Hill and Stephen M. Kelley, Prentice Hall, 3rd Edition, 2006.
2. *"Schaum's Outline Series of Computer Graphics"*, Zhigiang Kiang and Roy A. Plastock, McGraw-Hill, 2nd Edition, 2000.
3. *"Computer Graphics"*, Francis S. Hill, Prentice Hall, 3rd Edition, 2006.
4. *"Computer Graphics"*, Roy A. Plastock, McGraw-Hill, 2nd Edition, 2000.

CT-362   WEB ENGINEERING   **Credit Hours: 3,1**

WWW Technology: Internet and WWW History; The Internet and Intranets; Web Browsers & Web Servers; Web Application; URLs and navigation; TCP/IP and ports; HTTP Interaction; Client Request and Server Response; MIME; The Dynamic HTTP Protocol; Static vs. Dynamic Content; 3-Tier / n-Applications.

Web Site - Planning and Development: Web-site Goals; Planning Stages; Content Development; Site Map Development; Web-Site Design Principles; Making the site easy to navigate; Style Guides; Web-Site Hosting; Web-Site Design Tools; Web Page Programming Tools; Data Processing Tools; Maintaining and Monitoring the Web-Site.

Client Side Programming: HTML and DHTML – Tags, Linking, Forms, Event, Dynamic Style, Positioning; Document Object Model; Client Side Scripting Language - Data, Loops, Objects, Methods, Events; Java Script / VBScript; Browsers Variations; Java Script / VBScript Samples; Embedding Multimedia in Web Pages; Using ActiveX in Web.

Server Side Programming: Server Side Scripting Language; Web Server Configuration; Java / Active Server – Page Processing, Cookies, Built-in Objects; Web database access; ODBC and JDBC; Active Data Objects; Database Queries – SQL; Data Exchange and Interoperability – XML.

Concepts of Multimedia: Multimedia Hardware – Input and Capturing Devices, Output Devices Communication Devices; Multimedia Elements- Text Image Animation, Sound and Video; Text in Multimedia – Fonts. Its Attributes, Character Set, Mapping, Fonts Files: TTF, OTF; Image in Multimedia – Color Types, Compression File Formats: BMP, JPEG, GIF; Sound in Multimedia – Recording Sound, Quality, MIDI, Digital Sound, File Formats: WAV, MP3; Video in Multimedia – Broadcast Standards, Digital Video, Compression, Recording Formats, File Format: AVI, MPEG, MOV.

Web Tools: Site Builders- Dreamweaver: Introduction, Working with Layers, Tables, Images, Forms and Frames, CSS, Site Navigation, Working with Layers, Behaviour; Web Animation – Flash: Drawing and Coloring tool, Animation in Flash, Treeing, Getting Interactive, Flash Scripting; File Transference – Cute FTP: Configuring web-site, Logs, Searching Transferring files, Stopping and Resuming, Scheduling.

Multimedia Tools
Font Editing Tools – Fontlab: Creating Font, Encoding Glyphs, Transformation, Hinting, Editing Font Metrics, Exporting.
Image Drawing and Editing Tools - Photoshop: Layers in Photoshop, Image Modifying and Adjusting, Using Channels, Masks and Action, Working with Filters.
Sound Editing Tools – Sound Forge: Sampling, Features, Mixing Sound Files, Recording, Filters.
Video Editing Tools – Premier: Video Clipping Joining, Slicing, Manage Timeline.

Recommended Books:
1. *"Web Enabled Commercial Application Development Using, HTML, DHTML, Java Script, Perl, CGI"*, Ivan Bayross, BPB Publications, 2009.
2. *"Principles of Web Design"*, Joel Sklar, Course Technology, 1st Edition, 2000.
3. *"Web Engineering: The Discipline of Systematic Development of Web Applications"*, Gerti Kappel, Birgit Proll and Seigfried Reich, John Wiley & Sons, 2006.

CS-251   LOGIC DESIGN & SWITCHING THEORY   Credit Hours: 3,1

Truth Functions: Binary connectives, Evaluation of Truth Functions, Physical realisations, Sufficient set of connectives. Truth Functional calculus. Boolean Algebra, Duality, Fundamental Theorems of Boolean Algebra, Switches and Relays, Logic Circuits, Speed and Delays in Logic Circuits. Minimization of Boolean Functions: Minterm and Maxterm, Karnaugh map, Simplification of Boolean Functions, POS and SOP expressions. Tabular Minimization: Prime Implicants. Sequential Networks: Latches, Fundamental Mode, Synthesis of Sequential Networks, Minimization of the number of states, Clocked networks, Special realizations and codes: Binary adders, Coding of numbers, Decoders and code conversion. ROMS, NAND and NOR Implementation, Parity Checkers.

Recommended Books:
1. *"Digital Logic and Computer Design"*, Morris M. Mano, Prentice Hall, 3rd Edition, 2003.
2. *"Digital Fundamentals"*, Thomas Floyd, Prentice Hall, 10th Edition, 2008.

CS-252   COMPUTER ARCHITECTURE & ORGANIZATION   Credit Hours: 3,1

Computer Evolution, Historical developments, System Buses, RAM, Access Methods, Performance Parameters, Cache Memory, Replacement Algorithms, Mapping Functions, Input &

Output, I/O Modules. DMA, Computer Automatic Instruction sets: Characteristics and Function, RISC Control Unit Operation.

Recommended Books:
1. *"Computer Organization & Architecture"*, William Stallings, Prentice Hall, 8th Edition, 2009.

MT-273 DIFFERENTIAL EQUATIONS & LINEAR ALGEBRA   Credit Hours: 3,0

Linear Algebra: Linearity and Linear dependence of vectors, basis, dimension of a vector space, field matrix and types of matrices (singular, non-singular, symmetric, non-symmetric, upper, lower, diagonal tridiagonal matix), Rank of a matrix using row operations and special method, echelon and reduced echelon forms of a matrix, determination of consistency of a system of linear equation using rank, transitions matrix. Geometric representation of vector, norm of vector, Euclidean inner product, projections and orthogonal projections, Euclidean n spaces n properties Cauchy-Schwartz inequality, Euclidean transformations, apply geometric transformations to plane figure, composition of transformations. Eigen value and Eigen space.

Ordinary Differential Equations: Definitions (differential equation, general solution, particular solution, initial condition, boundary condition, initial homogenous and non-homogenous linear differential equations with constant coefficients, solutions of Euler differential equation, computation of particular integral of non-homogenous differential equations with problems.

Partial Differential Equations: Formation of partial differential equations, Solutions of first order linear and special types of second and higher order differential equation. Homogenous partial differential equations of order one. Lagrange multiplier.

Recommended Books:
1. "Elementary Linear Algebra: Application Version", Howard Anton and Chris Rorres, John Wiley & Sons Wiley, 10th Edition, 2010.
2. "Differential Equations with Boundary Value Problems:, Dennis G. Zill and Michael R. Cullen, Thomson Brooks/Cole Publishing, 7th Edition, 2009.
3. *"Advanced Engineering Mathematics"*, Erwin Kreyszig, John Wiley & Sons, 9th Edition, 2006.
4. *"Differential Equations with Boundary Value Problems"*, Dennis G. Zill and Michael R. Cullen, Thomson Brooks/Cole Publishing, 7th Edition, 2009.
5. *"Differential Equations: A modeling Perspective"*, Robert L. Borelli and Courtney S. Coleman, Wiley, 2nd Edition, 2004.

MT-331   PROBABILITY & STATISTICS   Credit Hours: 3,0

Statistics
Introduction, Types of data & variables, presentation to data, object, classifications, Tabulation, Frequency distribution, Graphical representation, Simple & Multiple Bar diagrams, Sartorial & Pie-Diagram, Histogram, Frequency Polygon, Frequency Curves & their types.

Measures Of Central Tendency And Dispersion
Statistics Averages, Median Mode, Quartiles, Range, Moments, Skew ness & Kurtosis, Quartile Deviation, Mean Deviation, Standard Deviation, Variance & its coefficient, Practical Significance in related problems.

Curve Fitting
Introduction, fitting of a first and second degree curve, fitting of exponential and logarithmic curves, related problems. Principle of least squares, Second order Statistics & Time series not in bit detail.

Simple Regression & Correlation
Introduction, Scatter diagrams, Correlation & its Coefficient, Regression lines, Rank Correlation & its Coefficient, Probable Error (P.E), Related problems.

Sampling And Sampling Distributions
Introduction, Population, Parameter & Statistic, Objects of sampling, Sampling distribution of Mean, Standard errors, Sampling & Non-Sampling Errors, Random Sampling, Sampling with & without replacement, Sequential Sampling, Central limit theorem with practical significance in related problems.

Statistical Inference And Testing Of Hypothesis
Introduction, Estimation, Types of Estimates, Confidence interval, Tests of Hypothesis, Chi-Square distribution/test, one tails & two tails tests. Application in related problems.

Probability
Basic concepts, Permutation & Combination, Definitions of probability, Laws of probability. Conditional probability, Baye's Rule. Related problems in practical significance.

Random Variables
Introduction, Discrete & Continuous random variables, Random Sequences and transformations. Probability distribution, Probability density function, Distribution function, Mathematical expectations, Moment Generating Function (M.G.F.), Markove random walks chain/ Related problems.

Probability Distributions
Introduction, Discrete probability distributions, Binomial Poisson, Hyper geometric & Negative

binomial distributions.Continuous probability distribution, Uniform, Exponential & Normal distributions & their practical significance.

Recommended Books:
1. *"Probability & Statistics for Engineers and Scientists"*, Ronald E. Walpole and Raymond H. Myers, Sharon L. Myers and Keying Ye, Prentice Hall, 8th Edition, 2006.
2. "*Applied Statistics & Probability for Engineers*", Douglas C. Montgomery, 4th Edition, 2006.

HS-208 BUSINESS COMMUNICATION & ETHICS   Credit Hours: 3,0

Writing formal and business letters; Writing formal memos; Drafting notices and minutes of meetings; Drafting tender notice; Theoretical knowledge and comprehension of contracts and agreements; Preparing proposals and technical reports; Conducting and writing a project report on a mini research (sessional work); Conducting seminars and interviews; Writing and presenting conference papers; Solving IELTS type papers.

Communication Skills
Ways and means communicating; Using English for describing objects, procedures etc. oral and written language; Importance and elements of effective communication in business (oral and written communication).

Practice in report writing (business reports, documentation related to software engineering); Practice in conducting meetings and writing minutes; Practice in making effective presentations; Writing business letters and memos.

Ethics
Introduction: Objectives of the course; Definitions of (i) a code, (ii) ethics; Defining needs for a code of ethics.

Need for a Code of Ethics: For who and why; Review of Code of Ethics of other professional bodies of Pakistan. Summative analysis of ethics for professionals in general.

Recommended Books:
1. *"Business Communication"*, Mary Ellen Guffey, South-Western College Pub, 6th edition, 2007.
2. *"Business Communication"*, Kitty Locker, McGraw-Hill/Irwin, 4th Edition, 2008.

THIRD YEAR

CT-353   OPERATING SYSTEMS   **Credit Hours: 3,1**

Introduction to Operating System, Operating System Structure; Concurrent Processes; CPU Scheduling; Deadlocks, Memory Management; Virtual Memory; File System; Emphasis on Character Base OS (i.e., Dos and UNIX).

Recommended Books:
1. *"Operating Systems Concepts"*, Abraham Silberschatz, Peter B. Galvin and Greg Gagne, John Wiley & Sons, 8th Edition, 2008.
2. *"Operating Systems: Internals and Design principles"*, William Stallings, Prentice Hall, 6th Edition, 2008.
3. *"Modern Operating Systems"*, Andrew S. Tanenbaum, Prentice Hall, 3rd Edition, 2007.

CT-360   VISUAL PROGRAMMING   **Credit Hours: 3,1**

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.

Recommended Books:
1. *"Professional C# 2008"*, Christian Nagel, Bill Evjen, Jay Glynn, Morgan Skinner and Karli Watson, Wrox, 2008.
2. *"C# 3.0: The Complete Reference"*, Herbert Schildt, McGraw-Hill Osborne Media, 3rd Edition, 2008.

CT-361   ARTIFICIAL INTELLIGENCE & EXPERT SYSTEMS   **Credit Hours: 3,1**

Introduction to Artificial Intelligence, Branches of AI Application of AI knowledge, types of knowledge, acquisition of knowledge, Knowledge engineering. Problem representation and problem solving strategic, state spaces, searching techniques. Blind search techniques. Informed search techniques. Knowledge representation techniques. Frames, Scripts, Semantic networks. Implementation of knowledge representation using PROLOG. Fundamental of Expert System. Component of Expert System Developments, Cycle of Expert System. Case studies Elize, Mycin. Natural language processing, Speech processing, Introduction to Robotics, Computer vision, Neural Networks, and Machine learning.

Recommended Books:
1. "*Artificial Intelligence: Structures and Strategies for Complex Problem Solving*", George F. Lugar, Addison Wesley, 5 Edition, 2004.

2. *"Artificial Intelligence: A Modern Approach"*, Stuart Russel and Peter Norvig, Prentice Hall, 3rd Edition, 2009.

CT-363   DESIGN AND ANALYSIS OF ALGORITHMS   Credit Hours: 3,0

Introduction; Asymptotic notations; Recursion and recurrence relations; Divide-and-conquer approach; Sorting; Search trees; Heaps; Hashing; Graph algorithms; Shortest paths; Network flow; Disjoint Sets; Polynomial and matrix calculations; Classes of Efficient Algorithms; Divide and Conquer, Dynamic Programming, Greedy Algorithms, Branch and Bound, String Matching algorithms; NP complete problems; Approximation algorithms.

Recommended Books:
1. Introduction to Algorithms, T. H. Cormen, C. E. Leiserson, and R. L. Rivest, MIT Press, McGraw-Hill, 3rd Edition, New York, NY, 2010.
2. Algorithms, Robert Sedgewick, Princeton University Publisher: Addison-Wesley Professional (latest Edition)

CT-364   THEORY OF AUTOMATA & FORMAL LANGUAGES   Credit Hours: 3,0

Finite State Models, Formal Languages, Regular Expressions, Regular languages, Finite automata (FAs), Transition graphs (TGs), Deterministic and Non-Deterministic Finite automata , Kleene's theorem, Transducers (automata with output), Pumping lemma and non regular language Grammars, Pushdown Automara (PDA), Context free grammars, Derivations, ambiguity in grammars, Parse Trees, Normal form grammars, Decidability, Context sensitive languages, Chomsky's hierarchy of grammars, Turing Machines.

Recommended Books:
1. An Introduction to Formal Languages and Automata, By Peter Linz, 4th edition, Jones & Bartlett Publishers.
2. Introduction to Automata Theory, Languages, and Computation, John Hopcroft and Jeffrey Ullman, Addison-Wesley.

CT-365   SOFTWARE ENGINEERING   Credit Hours: 3,0

Evolving role of Software, Definition and need of Software Engineering, Software Development Process, Software Process Models, Project Management concepts – People, Problem and Process, Software project estimations concepts & techniques. Metrics concepts types and their role, Software Quality Assurance, Introduction to Software testing concepts, Brief comparison of conventional methods for Software Engineering and new methods such as Object Oriented Software Engineering.

Recommended Books:

1. *"Software Engineering: A Practitioner's Approach"*, Roger S. Pressman, McGraw-Hill, 7th Edition, 2009.
2. *"Software engineering"*, Ian Sommerville, Addison Wesley, 9th Edition, 2010.
3. *"Software Engineering"*, Gregory W. Jones, Wiley, 1990.

CT-366   E-COMMERCE   **Credit Hours: 3,0**

Introducing E-Commerce: E-commerce overview, concepts and business models.

Internet Hardware, Software and Communication
Internet and World Wide Web servers, storage and communication Technologies. Cloud Computing, Software as a Service (SaaS).

E-Commerce Technologies
Generic Trade Cycles. Electronic Markets, Electronic Data Interchange, Internet Commerce.

E-Commerce with Business Perspective
The Value Chain, Competitive Strategy, Inter-Organizational Transactions, Consumer Trade Transactions, the Trade Cycle e-Commerce Sales. SWOT Analysis, Enterprise Resource Planning (ERP), Supply Chain Management (SCM), Customer Relationship Management (CRM).

The Elements of E-Commerce
E-Visibility, Online Information, Customer Registration, Order Processing, Online Payments, E-fulfillment, After-Sales Services.

Internet Marketing: Basis Marketing concepts, internet traffic patterns, On-site marketing techniques

Online Monetary Transaction: Web Payment Systems, standards and taxation issues.

Internet Security: Security Issues and Threats; Security Procedures; Encryption; Digital Certificates; Digital Signature; Security Protocol - SSL and SET Technologies; Authentication and Identification; Security Providers; Privacy Policies; Legal Issues.

Customer Service: Customer Service Issues; Frequently Asked Question (FAQ) Pages; E-Mail Support; Telephone Support; Live Help Service; Customer Discussion Forums; Value-Added Options.

Legal, Social and Global Issues
E-commerce impact on society, Legal, Policy and Ethical issues.

Recommended Books:
1. *"e-Business and e-Commerce How to Program"*, Harvey M. Deitel, Paul J. Deitel and Tem R. Neito, Prentice Hall, 2000.
2. *"The Complete E-Commerce Book"*, Janice Reynolds, CMP Books, 2nd Edition, 2004.

CT-462 DISTRIBUTED COMPUTING   Credit Hours: 3,1

Advantages and disadvantages of Distributed Database (DDB); Database Security Issue; Design Approach of DDB; Internet Addressing, Low-level Communication using UDP; Connecting to Server using TCP; Connecting to an SMTP Mail Server; Connecting to an HTTP Web Server; WWW support via Class URL; Writing Server Programs using Server Socket.

Recommended Books:
1. *"Principles of Distributed Database Systems"*, M. Tamer Ozsu, Brooks/Cole Cengage Learning, 3rd Edition, 2003.
2. *"Distributed Database Manaement Systems: A Practical Approach"*, Saeed K. Rahimi and Frank S. Haug, Wiley- IEEE Computer Society, 2010.

CS-351 COMPUTER COMMUNICATION NETWORKS   Credit Hours: 3,1

Introduction to Networking. Networks ISO/OSI reference Model. Performance Models of communication Networks. Design Protocols, Virtual circuit/ datagram. Routing congestion control. Flow control local Networks satellite protocols, Broadcast Networks.

Recommended Books:
1. "*Computer Networks*", Andrew S. Tanenbaum and David J. Wetherall, Prentice Hall, 5th Edition, 2010.

CS-353 MICROPROCESSORS & THEIR APPLICATIONS   Credit Hours: 4

MPU Architecture and Instrumentation Set: Introduction, MPU Architecture, Control Signals Instruction set.

The Instruction Set: Introduction, Instruction set coding schemes, Addressing Modes, Various Institution Groups.

System Capabilities: Interrupt Structure Pooling, Vectoring, Memory Mapped and Isolated I/O, Interrupt Handling and Considerations in the implementation of interrupts Address Decoding DMA & DMA chips, Parallel & Serial I/O.

Interfacing: Programmable Parallel Ports & Hand shake I/O D/A Converter operation. Interfacing and Application, A/D converter Specification, types and interfacing.

Application: Process control systems, Instrumentation, Robotics, DSP & Digital Filters, Introduction to current generation of Microprocessors.

Recommended Books:
1. "*Intel Microprocessors*", Bary B. Brey, Prentice Hall, 8th Edition, 2008.
2. "*The Intel Family of Microprocessors: Hardware and Software Principles and Applications*", James L. Antonakos, Delmar Cengage Learning, 1st Edition, 2006.

FINAL YEAR

CT-460   NETWORK & INFORMATION SECURITY   **Credit Hours: 3,1**

Introduction to simple Cryptosystems and their Cryptanalysis
Shift, Substitution, Affine, Vigenere, Hill, Permutation and stream ciphers.

Shannon's Theory
Elementary Probability theory, entropy, perfect secrecy, unicity distance.

Block Ciphers and Advance Encryption Standard
Chaining; Substitution-permutation networks, Feistel networks; Linear cryptanalysis of an SPN.

Cryptographic hash functions
Security requirements, collisions; Security uses: passwards, message and data integrity, notaries; MD5, SHA; Message authentication codes; Birthday attack.

The RSA Cryptosystems
Primes, GCDs and the Extended Euclidean Algorithm, modular exponentiation and inverses, Euler totient function, Euler's theorem, Introduction to public-key cryptography; RAS: basic implementation details.

Digital signature schemes
E1Gamal, DSA; Elliptic Curve DSA; One-time Signatures, Undeniable Signatures Zero-Knowledge proofs, Bit communication; Pseudorandom number generation.

Network communication concepts.
Network overview, specific networking protocols, transmission media and networking hardware.

Optimizing and fine tuning for performance

Ways to speed up an existing server, Stress testing techniques. Threat of computer crimes.

Network security issues

Techniques to increase security, Internet related security issues.

Trouble shooting and preventive maintenance

Basic element of troubleshooting, hardware troubleshooting tools, Software troubleshooting tools, Diagnosing real world problems, Troubleshooting the physical network, Troubleshooting WANS.

Recommended Books:
1. "*Cryptography Theory & Practice*", Douglas R. Stinson, Chapman & Hall/CRC, 2nd Edition, 2002.
2. "*Network Security Fundamentals*", Peter Norton and Mike Stockman, Sams, 1st Edition, 1999.
3. *"Network Security: A Beginners Guide"*, Eric Maiwald, McGraw-Hill Osbourne, 2nd Edition, 2003.
4. *"Network Security Bible"*, Eric Cole, John Wiley & Sons, 2nd Edition, 2009.

CT-463   DATA WAREHOUSING & MINING   **Credit Hours: 3,1**

Introducing the Data warehouse; The Data warehouse Methods; Quality Data warehouse process; Data warehouse Methodology; Data warehouse Administration; Performance Management, Managing the Data warehouse, Data warehouse Project Management; Data Handling: Distribution and Transformation; Data Integration and Data Semantics; Data Warehouse Architecture; Metadata, Types of Metadata, control change control in the Data warehouse

Recommended Books:
1. *"Data Warehousing Fundamentals"*, M. Tamer Ozsu, Brooks/Cole Cengage Learning, 3rd Edition, 2003.
2. *"Data Mining Concepts and Techniques",* Jiawei Han, Micheline Kamber and Jian Pei, Morgan Kaufman Publishers, 2nd Edition, 2005.

CT-464   MODELING AND SIMULATION   **Credit Hours: 3,0**

Performance Modeling and Evaluation, Bench Marking, Performance Evaluation of High Parallel Systems Architecture. Application of Performance Evaluation.

Measurement Techniques, Hardware Monitoring, Software Monitoring, Hybrid Monitoring

Fundamentals of Queuing Models.

Structure and performance parameters. Operational Analysis of Queuing Models. General features of Queuing Models. Birth and Death process M/M/1 and M/G/1 systems. Dependability Modeling.

Analysis of Reliable, Available and High Assurance systems. Fault-tolerant Techniques. Software Reliability Modeling.

Petri Net-Based Performance Modeling. Classical Petri Nets. Discrete, Timed Petri Nets. Generalised Stochastic Petri Nets. Modeling of multiprocessors systems.

Recommended Books:
1. *"Theory of Modeling and Simulation",* Bernard P. Ziegler, Herbert Praehofer and Tag Gon Kim,Academic Press, 2nd Edition, 2000.
2. *"A First Course in Mathematical Modeling"*, Frank R. Giordano, Cengage/Brooks Publishing, 3rd Edition, 2003.
3. *"Simulation Modeling and Analysis"*, A. M. Law and W. D. Kelton,
4. *"Mathematical Modeling and Simulation: An Introduction for Scientists and Engineers"*, Kai Velten, Wiley-VCH, 2009.
5. *"Distributed Simulation"*, John A. Hamilton, David A. Nash and Udo W. Pooch, CRC Press, 1st Edition, 1997.

CT-465   COMPILER DESIGN   Credit Hours: 3,0

Input and Lexical Analysis; Syntax Analysis. Type Checking. Intermediate Code Generation. Code Generation. Code optimization. Working Problem in Compiler Design.

Recommended Books:
1. "*Compilers: Principles, Techniques and Tools*", Alfred V. Aho, Monica S. Lam, Ravi Sethi and Jeffrey D. Ullman, Addison Wesley, 2nd Edition, 2007.
2. *"Modern Compiler Design"*, Dick Grune, Henri E. Bal, Ceriel J. H. Jacobs and Koen G. Langendoen, Wiley & Sons, 2nd Edition, 2010.

CT-499   SOFTWARE-BASED PROJECT   Credit Hours: 0,6

Market oriented Software Project, spread over two semesters.

CS-451   PARALLEL PROCESSING   **Credit Hours: 3,1**

Parallelism in microprocessor, Architectural classification schemes, Principles of pipelining and vector processing, Array Processors, Multiprocessor Architecture and Parallel algorithms, Introduction to Dataflow computers.

Recommended Books:
1. *"Advanced Computer Architecture: a Design Space Approach"*, Dezso Sima, Terrence Fountain and Peter Karsuk, Pearson Education, 1st Edition, 1997.
2. "*Introduction to Parallel Computing*", Ananth Grama, George Karipis, Vipin Kumar and Ansul Gupta, Addison Wesley, 2nd Edition, 2003.

MT-442   NUMERICAL METHODS   **Credit Hours: 3,0**

Error analysis: types of errors (relative, absolute, inherent, round off, truncation), significant digits and numerical instability, flow chart, use any computational tools to analysis the numerical solutions. linear operators: functions of operators, difference operators and the derivative operators, identities, difference equations: linear homogeneous and non-homogeneous difference equations, solution of non-linear equations: numerical methods for finding the roots of transcendental and polynomial equations (secant, newton – raphsonchebyshev and graeffe's root squaring methods), rate of convergence and stability of an iterative method, solution of linear equations: numerical methods for finding the solutions of system of linear equations (gauss--elimination, gauss-jordan elimination, triangularization, cholesky, jacobi and gauss-seidel), interpolation &- curve fitting lagrange's, newton, hermit, spline, least squares approximation, (linear and non-linear curves), numerical integration & differentiation: computation of integrals using simple trapezoidal rule, 1/3thsimpson's rule, 3/8th simpson's rule, composite simpson's and trapezoidal rules, computation of solutions of differential equations using (Euler method, Euler modified method, Rungekutta method of order 4), numerical solutions of partial differential equations, optimization problem (simplex method), steepest ascent and steepest descent methods.

Recommended Books:
1. *"Applied Numerical Analysis"*, Curtis F. Gerald and Patrick O. Wheatley, Pearson Education, 7th Edition, 2003.
2. *"Numerical Methods for Engineers*", Steven C. Chapra and Raymond P. Canale, McGraw-Hill Higher Education, 6th Edition, 2009.
3. *"Advanced Engineering Mathematics"*, Erwin Kreyszig, John Wiley & Sons, 10th Edition, 2011.

HS-403   ENTREPRENEURSHIP   **Credit Hours: 3,0**

Understanding the Entrepreneurship Mind-Set: The Revolutionary Impact of Entrepreneurship, The Individual Entrepreneurship Mind-Set, Corporate Entrepreneurship Mind-Set, The Social and Ethical Perspectives of Entrepreneurship, Launching Entrepreneurial Ventures: Creativity and Innovation, Methods to Initiate Ventures, Legal Challenges in Entrepreneurship, The Search for Entrepreneurship Capital, Formulation of Entrepreneurial Plan: The Assessment Function with Opportunities, The Marketing Aspects of New Ventures, Financial Statements in New Ventures, Business Plan preparation for New Ventures, Strategic Perspectives in Entrepreneurship: Strategic Growth in Entrepreneurship, Valuation Challenge in Entrepreneurship, Final Harvest of a New Venture

Recommended Book:
1. *"Introduction to Entrepreneurship"*, Donald F. Kuratko, South Western College, 8th Edition, 2009.
2. *"The Entrepreneurial Mindset"*, Rita G. McGrath and Ian C. MacMillan, Harvard Business School Press, 2000.
3. *"Startup: A Silicon Valley Adventure"*, Jerry Kaplan, Replica Books, 2001.
4. *"A Good Hard Kick in the Ass: Basic Training for Entrepreneurs"*, Rob Adams, Crown Business, 2002.
5. *"Technology Ventures: From Ideas to Enterprise"*, Thomas H. Byers, Richard C. Dorf and Andrew J. Nelson, McGraw-Hill, 3rd Edition, 2010.

ELECTIVE COURSES
Choice of one of the following three courses: CT-481, CT-482 or CT-483.

CT- 481 WIRELESS NETWORKS & MOBILE COMPUTING   Credit Hours: 3,1

- Introduction to wireless communication system
- First, second and third generation wireless networks.
- Network layer issues and protocols-Mobile IP, addressing & routing for mobile system.
- Wireless LANs: safety, security, cost IEEE802.11 and ETSI Hyper LAN Physical layer: spread spectrum and infrared. High speed wireless LAN developments. Bluetooth technology and applications.
- Transport and Application layer protocols: WAP and beyond
- Mobile agents, architectures and configurations.
- OS for mobile devices.
- APIs for mobile devices. APIs for mobile communications.
- UML design and patterns for mobile applications.
- Software architectures and middleware for mobile enabled distribution systems.
- Project management and testing strategies.
- Security and maintenance of mobile computing system.

Recommended Books:
1. *"Wireless Communication: Principles and Practice"*, Theodore S. Rappaport, Prentice Hall, 2nd Edition, 2002.
2. *"Mobile Communications"*, Jochen Schiller, Addison Wesley, 2nd Edition, 2003.

CT-482   BIO-INFORMATICS   **Credit Hours: 3,1**

Pre-requisites
Biological knowledge: Biochemistry, Molecular Biology.
Mathematical: Single Variable Calculus, Probability and Statistics.
Computing Knowledge: Basic Programming Skills (Java, SQL) Database, Windows and Unix operating systems.

Fundamentals of Bioinformatics
Aim: To provide an overview of bioinformatics (what it is, why it is needed, and what it promises to deliver).

- Information to bioinformatics.
- Biological database – developing, implementing and querying database system, mining   data using SQL.
- Protein structure – 3D structure, sequence patterns and characteristics, protein structure prediction and comparison.
- Analysis of gene sequence.

Statistical methods in bioinformatics
Aim: To provide students with the mathematical knowledge and skills required to understand and implement bioinformatics algorithms.

- Revision of basic mathematics.
- Vectors and matrices.
- Multivariate statistics – particularly exploratory methods and pattern recognition.

Bioinformatics Algorithms and Tools
Aim: To introduce the most important bioinformatics software tools, and explain the algorithms that underpins them.

- Visualisation of sequence data
- Pair wise and Multiple sequence alignment.
- Homology searching – including BLAST.
- Gene expression informatics.
- Introduction to gene finding.

Applications and Commercial Aspects of Bioinformatics
Aim: to outline the current and potential applications of bioinformatics and the legal, ethical and commercial aspects of using biological data.

- Visualisation of sequenced data.
- Drug discovery.
- Genetic basis of disease.
- Personalised medicine and gene-based diagnostic.
- Legal, ethical and commercial ramification of bioinformatics.

PERL Programming
Aim: To provide students with the ability to program in PERL, the most popular programming language in the bioinformatics community.

PERL Programming for:
- Data manipulation.
- File maintenance.
- Pipelining.
- Packaging and interfacing system facilities.

Analysis of Microarray Data
Aim: Massive amounts of data are generated from Microarray data. Analytical and Statistical methods required to explore the relationship between genes and to reveal patterns of expression.

- Experimental design and normalization.
- Differential Expression, Filtering and Clustering.
- Functional Analysis and Visualisation.

Recommended Books:
1. *"Introduction to Bioinformatics"*, Arthur M. Lesk, Oxford University Press, 3rd Edition, 2008.
2. *"Bioinformatics"*, T. Charlie Hodgman, Andrew French and David R. Westhead, T & F Books, UK, 2nd Edition, 2010.
3. *"Bioinformatics for Dummies"*, John Wiley & Sons, Inc., 2007.
4. *"Bioinformatics: The Machine Learning Approach"*, Pierre Baldi and Soren Brunak, MIT Press, 2001.

CT-483   SYSTEM ADMINISTRATION   **Credit Hours: 3,1**

Course outline: A survey of the tools and techniques used in the administration of computing system, System installation, booting and halting the system, file systems and directory permission structures, print and disk quotas, device configuration and management, user account

administration, security, client administration, disk maintenance, remote access, remote administration, the use of schedulers, and the use of advanced scripting to ease system administration tasks.

Recommended Books:
1. *"The Practice of System and Network Administration"*, Thomas S. Limoncelli, Christina J. Hogan and Strata R. Chalup, Addison Wesley, 2nd Edition, 2007.
2. *"Principles of Network and System Administration"*, Mark Burgess, John Wiley & Sons Ltd., 2nd Edition, 2004.
3. *"Handbook of Network and System Administration"*, Jan Bergstra and Mark Burgess, Elsevier, 1st Edition, 2007.