Introduction to Information & Communication Technologies (ICT)

Credit Hours: 3(3+0)

Course Contents

Basic Definitions & Concepts, Hardware: Computer Systems & Components. Storage Devices, Number Systems, Software: Operating Systems, Programming and Application Software, Introduction to Programming, Databases and Information Systems, Networks, Data Communication, The Internet, Browsers and Search Engines, The Internet: Email, Collaborative Computing and Social Networking, The Internet: E-Commerce, IT Security and other issues, IT Project.

Required Skills

These basic competencies are assumed on the first day of class. Students must assume responsibility for learning these skills if he/she does not already possess them. If an instructor finds that you do not have the required skills and knowledge, you may be asked to withdraw from the course.

1. Basic Knowledge of Computers

- Understand basic computer hardware components and terminology
- Understand the concepts and basic functions of a common computer operating system
- Start up, log on, and shut down a computer system properly
- Use a mouse pointing device and keyboard
- Use Help and know how to troubleshoot routine problems
- Identify and use icons (folders, files, applications, and shortcuts/aliases)
- Minimize, maximize and move windows
- Identify common types of file extensions (e.g. doc, docx, pdf, html, jpg, gif, xls,ppt, pptx, rtf, txt, exe)
- Check how much space is left on a drive or other storage device
- Backup files
- Download and install software on a hard disk
- Understand and manage the file structure of a computer
- Check for and install operating system updates

2. Proficiency in Using Productivity Software

- Create documents of various types and save in a desired location

- Retrieve an existing document from the saved location
- Select, copy, and paste text in a document or desired location
- Print a document
- Name, rename, copy and delete files
- Understand and know how to use the following types of software programs:
- Word processing (example: MS Word, Google Doc, Writer)
- Presentation (example: PowerPoint, Impress)
- Spreadsheet (example: Excel, Calc)
- PDF reader (example: Acrobat Reader, Preview)
- Compression software (example: WinZip, StuffIt, 7-Zip)

3. Electronic Communication Skills

- Email, using a common email program (example: MS Outlook, Gmail, Apple Mail)
- Compose, Send, Reply, Forward messages
- Add attachments to a message
- Retrieve attachments from an email message
- Copy, paste and print message content
- Organize email folders
- Understand what an electronic discussion list is and how to sign up and leave one (example: Listserv, Listproc)

4. Internet Skills

- Set up an Internet connection and connect to the Internet
- Have a working knowledge of the World Wide Web and its functions, including basic site navigation, searching, and installing and upgrading a Web browser
- Use a browser effectively, including bookmarks, history, toolbar, forward and back buttons
- Use search engines and directories to find information on the Web
- Download files and images from a Web page
- Understand and effectively navigate the hyperlink structure of the Web
- Understand how keep your information safe while using the Internet

5. Moving Files

- Transfer files by uploading or downloading
- View and change folder/document security settings
- Copy files from hard disk to storage devices and vice versa

Recommended Readings

- Bruce J. McLaren, *Understanding and Using the Internet*, West Publishing Company, 610 Opperman Drive, P. 0. Box 64526, St. Paul, MN 55164.
- *Computer Applications for Business,* 2nd Edition, DDC Publishing, 275 Madison Avenue, New York,
- Nita Hewitt Rutkosky, *Microsoft Office Professional*, Paradigm Publishing Company, 875 Montreal Way,St Paul, MN 55102.
- Robert D. Shepherd, *Introduction to Computers and Technology,* Paradigm Publishing Inc., 875 Montreal Way, St. Paul, MN 55102.
- Shelly Cashman Waggoner, *Discovering Computers 98,* International Thomson Publishing Company, One Main Street, Cambridge, MA 02142.
- V. Wayne Klemin and Ken Harsha, *Microcomputers, A Practical Approach to Software Applications,*McGraw-Hill Book Company, New York, NY 10016.

Programming Fundamentals

Credit Hours: 3 (2+1)

Course Outline:

This course covers overview of Computer Programming, Principles of Structured and Modular Programming, Overview of Structured Programming Languages, Algorithms and Problem Solving, Program Development: Analyzing Problem, Designing Algorithm/Solution, Testing Designed Solution, Translating Algorithms into Programs, Fundamental Programming Constructs, Data Types. Basics of Input and Output, Selection and Decision (If, If-Else, Nested If-Else, Switch Statement and Condition Operator), Repetition (While and For Loop, Do-While Loops), Break Statement, Continue Statement, Control Structures, Functions, Arrays, Pointers, Records, Files (Input-Output), Testing & Debugging.

Reference Materials:

1. *C How to Program* by Paul Deitel and Harvey Deitel, Prentice Hall; 7 edition (March 4, 2012). ISBN-10: 013299044X

2. *Programming in C* by Stephen G. Kochan, Addison-Wesley Professional; 4 edition (September 25, 2013). ISBN-10: 0321776410

3. *Java How to Program* by Paul Deitel and Harvey Deitel, Prentice Hall; 9th edition (March, 2011)

4. *C++ How to Program* by Paul Deitel and Harvey Deitel, Prentice Hall; 9th edition (February, 2013)

Data Structures and Algorithms

Credit Hours: 3(2+1)

Course Outline:

Introduction to Data Structures and Algorithms; Complexity Analysis; Arrays; Sorting Algorithms: Insertion Sort, Selection Sort, Bubble Sort, Shell Sort, Heap Sort, Quick Sort, Merge Sort, Radix Sort, Bucket Sort; Linked Lists: Singly Linked Lists, Doubly Linked Lists, Circular List; Stacks, Queues, and Priority Queue; Recursion: Function call and Recursion Implementation, Tail Recursion, Non-tail Recursion, Indirect Recursion, Nested Recursion, Backtracking. Trees: Binary Trees, Binary Heap, Binary Search. Tree Traversal, Insertion, Deletion, and Balancing a Tree; Heap; B-Tree; Spanning Tree, Splay Trees; Graphs: Representation, Traversal, Shortest Path, and Cycle Detection; Isomorphic Graphs; Graph Traversal Algorithms; Hashing; Memory Management and Garbage Collection.

Reference Materials:

1. *Data Structures and Algorithm Analysis*, Mark Allen Weiss, Florida International University, Addison-Wesley (latest Edition)

2. *Algorithms*, Robert Sedgewick, Princeton University Publisher: Addison- Wesley Professional (latest Edition)

3. *Data Structures: Abstraction and Design Using Java*, Koffman and Wolfgang, Wiley; 2nd Edition (or latest Edition), 2010

Object Oriented Programming

Credit Hours: 3(2+1)

Course Outline:

Evolution of Object Oriented Programming (OOP), Object Oriented concepts and principles, problem solving in Object Oriented paradigm, OOP design process, classes, functions/methods, objects and encapsulation; constructors and destructors, operator and function/method overloading, association, aggregation, composition, generalization, inheritance and its types, derived classes, function/method overriding, abstract and concrete classes, virtual functions, polymorphism, exception handling.

Reference Materials:

1. *An Introduction to Object-Oriented Programming with Java*, C. Thomas Wu (2010). 5th Edition.McGraw-Hill. ISBN: 9780073523309

2. *Java: How to Programme*, 5/e, Deitel and Deitel, Prentice Hall, 0131016210/ 0131202367 International Edition.

3. *Ivor Horton's Beginning Java*, 7/e, Ivor Horton

4. *C++: How to Programme*, Deitel and Deitel, 5/e, Pearson.

5. *Object Oriented Programming in C++*, 3rd Edition, RobertLafore

Operating Systems

Credit Hours: 3(2+1)

Course Outline:

History and Goals, Evolution of operating systems. Operating System: Services, Structure, User Interface. Virtual Machines concept, System Boot, System Calls, Types of System Calls. Processes: Concept, Scheduling, Operations on Processes, Inter-process Communication. Threading: Multithreading Models, Thread Libraries, Threading Issues, processor scheduling; deadlock prevention, avoidance, and recovery; main-memory management; virtual memory management (swapping, paging, segmentation and page-replacement algorithms); Disks management and other input/output devices; file-system structure and implementation; protection and security. Case studies: Linux/Windows Operating Systems. *Lab assignments involving different single and multithreaded OS algorithms.

Reference Materials:

1. *Operating System Concepts* by Abraham Silberschatz, Peter B. Galvin,and Greg Gagne, Wiley; 9th edition (December 17, 2012). ISBN-10:1118063333

2. *Operating Systems: Internals and Design Principles* by William Stallings,Prentice Hall; 7 edition (March 10, 2011). ISBN-10: 013230998X

3. *Applied Operating Systems Concepts* by Silberschatz A., Peterson, J.L., &Galvin P.C. Wiley; 8th Edition (2011). ISBN-10: 1118112733

4. *Modern Operating Systems* by Tanenmaum A.S., Prentice Hall; 3rd Edition(2007). ISBN-13: 978-01360066

Database Systems

Credit Hours: 3 (2+1)

Course Outline:

Basic database concepts, Database Architecture, DB Design Life Cycle, Schema Architecture, Conceptual, Logical and physical database Modelling and design, Entity Relationship diagram (ERD), Enhanced ERD ,Relational data model, mapping ERD to relational model, Functional dependencies and Normalization, Relational Algebra, Structured Query language (SQL), Transaction processing, concurrency control and recovery techniques, Query optimization concepts.

Reference Material:

1. *Database Systems A Practical Approach to Design, Implementation, and Management*, 4th Edition, Thomas Connolly, Carolyn Begg, Addison Wesley, 2005.

2. *Modern Database Management by Fred McFadden, Jeffrey Hoofer*, Mary Prescott, Prentice Hall; 11th Edition (July 26, 2012). ISBN-10: 0132662256

3. *Fundamentals of Database Systems* by R. Elmasri and S. Navathe. 6thEdition, Addison-Wesley (2010). ISBN-10: 0136086209.

4. *Database Design and Relational Theory: Normal Forms and All That Jazz* by C. J. Date, O'Reilly Media; 1st Edition (April 24, 2012). ISBN-10:

Calculus-I **Credit Hours: 3+0**

Specific Objectives of the Course:

Calculus is serving as the foundation of advanced subjects in all areas of mathematics. The course, equally, emphasizes the basic concepts and skills needed for mathematical manipulation. This Calculus focus on the study of functions of a single variable.

Course Outline:

Functions, upper and lower bounds of variables and functions, inverses of exponential, circular, hyperbolic and logarithmic functions, one sided and two sided limits of functions, continuity of functions and their graphical representations, properties of continuous function on closed bounded intervals, discontinuity of function and its types. Derivatives: Definition, techniques of differentiation. Derivatives of polynomials and rational, exponential, logarithmic and trigonometric functions, Inverse functions and their derivatives. The chain rule. Implicit differentiation. Rates of change in natural and social sciences. Related rates. Linear approximations and differentials. Higher derivatives, Leibnitz's theorem. Applications of derivatives: Increasing and decreasing functions. Relative extrema and optimization. First derivative test for relative extrema. Convexity and point of inflection. The second derivative test for extrema. Indeterminate forms and L'Hopitals rule. Anti-derivatives and integrals. Riemann sums and the definite integral. Properties of Integral.

Recommended Books:

- J. Stewart, Calculus (5th edition or latest edition), 2002, Brooks/Cole
- H. Anton, I. Bevens, S. Davis, Calculus: A New Horizen (8th edition or latest), 2005, John Wiley, New York
- G. B. Thomas, A. R. Finney, Calculus (11th edition or latest edition), 2005, Addison-Wesley, Reading, Ma, USA

Calculus-II **Credit Hours: 3+0**

Specific Objectives of the Course:

Analytical geometry is serving as the foundation of advanced subjects in all areas of mathematical analysis. The sequence, equally, emphasizes the basic concepts and skills needed for mathematical manipulation. As continuation of Calculus, it focuses on the study of foundation of plane and one, two dimensional geometry.

Course Outline:

Curves and their representation in cartesian, polar and parametric forms, tangents and normal, maxima, minima and points of inflection, convexity and concavity, asymptotes and curve tracing, translation and rotation of axes in one dimension, general equation of the second degree and the classification of conic sections, conic in polar coordinates, tangents and normal, rectangular coordinate system, translation and rotation of axes in two dimension, direction cosines, ratios and angles between two lines, standard forms of equations of planes and lines, intersection of planes and lines, distance between points, lines and planes, shortest distance between lines, symmetry, intercepts and sections of a surface, spherical, polar and cylindrical coordinate systems, standard form of the equations of sphere, cylinder, cone, ellipsoid, parabolid and hyperboloid.

Recommended Books:

- J. Stewart, Calculus (5th edition or latest edition), 2002, Brooks/Cole
- H. Anton, I. Bevens, S. Davis, Calculus: A New Horizen (8th edition or latest), 2005, John Wiley, New York
- G. B. Thomas, AR Finney, Calculus (11th edition or latest), 2005, Addison-Wesley, Reading, Ma, USA

Linear Algebra **Credit Hours: 3 + 0**

Specific Objectives of the Course:

This is a course in abstract linear algebra. The majority of follow up courses in both pure and applied mathematics assume the material covered in this course.

Course Outline:

Algebra of matrices, determinants, matrix of a linear transformation, row and column operations, rank, inverse of matrices, solution of homogeneous and non-homogeneous equations, orthogonal transformation. Vector spaces, subspaces, linear dependence and independence, linear span of a subset of a vector space, bases and dimensions of a vector space, sums and direct sums of subspaces of a finite dimensional vector space, dimension theorem, linear transformation, null space, image space of linear transformation, rank and nullity of a linear transformation, relation between rank, nullity and dimension of the domain of a linear transformation, matrix of linear transformation, change of basis, inner product spaces, orthogonal and orthonormal basis, similar matrices and diagonalization of a matrix, Home (V,W), dimension and basis of Home (V,W), dual space and dual basis, annihilators, Eigen values and Eigen vectors and minimal polynomials.

Recommended Books:

- S. J. Axle, Linear Algebra Done Right, Undergraduate Texts in Mathematics, 1996, Springer, New York, Schaum's outlines series
- G. Birkhoff, S. Maclane, A Survey of Modern Algebra (4th edition), AKP
- W. L. C. Perry, Elementary Linear Algebra, 1988, McGraw-Hill, New York

Ordinary Differential Equations **Credit Hours: 3+0**

Specific Objectives of the Course:

This course will provide the foundation for all advanced subjects in Mathematics. Strong foundation and applications of Ordinary Differential Equations is the goal of the course.

Course Outline:

Basic definition of differential equations, formation of differential equations, initial and boundary value problems, differential equations of the first order and first degree, equations with separable variable, homogeneous differential equations, equations reducible to homogeneous form, exact differential equations, integrating factors, rules for determinations of integrating factors, linear equations of the first order, Non-linear equations of the first order, linear differential equations of high order, solution of homogeneous linear equations, principle of superposition and Wronksian, determination of particular integral, short methods for finding particular integral, orthogonal trajectories, Cauchy-Euler equations, 2nd order linear differential equations, reduction of order method, undetermined Coefficient method, variations of parameters method.

Recommended Books:

- D.G. Zill, M.R, Cullen, Differential Equations with Boundary-Value Problems, (latest Edition), PWS Publishing Company
- D.G. Zill, Advanced Engineering Mathematics, Jones and Bartlett Publishers, 2005
- Erwin Kreyszig, Advanced Engineering Mathematics, John Wiley and Sons (9th edition)
- G.E. Andrews, R. Askey, and R. Roy, Special Functions, Cambridge University Press