# University of Bahrain
# College of IT
# Department of Computer Science
## BSc. In COMPUTER SCIENCE PROGRAM CURRICULUM (2013-2015)
## (2010 Modified Program)

### Semester I

<table>
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<tr>
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### ELECTIVE COURSES

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**Free Elective Courses** Any UOB course excluding:  
(1) courses offered for special students,  
(2) courses covered in the B.Sc. curriculum,  
(3) courses equivalent or lower than those already taken in the curriculum. Note: Approval of department is required.

**HU/SS Courses - Humanities and Social Science Component:** Any course from the following:  
**Humanities:** Fine Arts, History, American Studies, Classics, Communications, English, (Foreign Language) French, Music, Philosophy, Theatre, Literature (Arabic), Religion (comparative).  
**Social Science:** Anthropology, Economics, Education, Geography, History, Psychology, Sociology, Women's Studies, Political Science.

**Graduation Requirements**

1. Passing the B.Sc. Program with overall GPA at least 2.0.  
2. The GPA of the major courses ITXX should be at least 2.0 (only the best grade of the repeated major courses will be counted.)
ITIS 102 Fundamentals of Information Systems (3-2-3)
Prerequisite: none
Course Description
Providing the foundation for understanding the business implications and roles that IS/IT play in providing solutions to business problems, and in providing opportunities for companies. Topics covered: Information Systems in global business today: global E-business, how business use information systems, organizations, and strategy; ethical and social issues in Information system: achieving operational excellence and customer intimacy; E-commerce.

ITCS 111 Computer Programming I (3-2-3)
Prerequisite: none
Course Description
Introduction to computers and numbering systems; Algorithmic problem solving principles; Introduction to a modern programming language (e.g. C++); Input/Output, conditional statements, iteration, files, strings, functions and arrays; Lab assignments to practice programming.

ITCS 112 Computer Programming II (3-2-3)
Prerequisite: ITCS 111
Course Description
Advanced language elements; data types and structures; recursion and recursive algorithms; Abstract data types; Pointer manipulation, structures, and classes; Recursion and Recursive Algorithms; Programming applications to business and scientific problems.

ITCS 215 Data Structures (3-2-3)
Prerequisite: ITCS 112
Course Description
Implementation and manipulation of data structures; Concept of abstract data types; Implementation and use of different data structures such as lists, stacks, queues, arrays and their linked implementations; Use of trees and graphs; Hash tables; Introduction to algorithms; Applications using C++ or another current language.

ITCS 242 Assembly Language Programming (3-2-3)
Prerequisite: ITCS 112 & ITCE 250
Course Description

ITCE 250 Logic Design (3-2-3)
Prerequisite: ITCS 111
Course Description
Introduction to digital logic design. Number systems. Combinational logic circuits; Boolean algebra; logic minimization; combinational network design. Decoders; encoders; multiplexers; comparators; ROMs; PLAs. Sequential circuits analysis and design; latches; flip flops; analysis and design of synchronous sequential networks; counters; registers.
ITCS 252 Discrete Structures I (3-2-3)
Prerequisites: ITCS 111 & MATHS 101
Course Description
Introduction to discrete structures and associated mathematical tools; Propositional calculus; Predicate calculus; Sequences and Summations; Inequalities; Proof techniques; Sets; Relations; Functions; Partial and Total Orderings; Graphs; Applications to computer science.

ITCS 253 Discrete Structures II (3-2-3)
Prerequisites: ITCS 252
Course Description
Graphs and Trees; Recurrence relations: homogenous and inhomogeneous; Solving recurrence relations. Combinatorics: counting, permutations, combinations, binomial coefficients; Algebraic structures: groups, semi groups, monoids; Discrete probability.

ITCS 314 Formal Languages and Automata (3-2-3)
Prerequisite: ITCS 215 & ITCS 253
Course Description
Formal languages and their relation to automata; the Chomsky hierarchy of classes of grammars; recognition of languages; finite state automata; push down automata. Context-free grammars and normal forms. The standard Turing machine; Turing machines as acceptors and transducers; Turing's thesis and incomutability.

ITCS 315 Human-Computer Interaction (3-2-3)
Prerequisite: ITCS 215
Course Description
Human-Computer Interaction (HCI) and User Interface Design; Alternative Interface Design methods (e.g., user-centered design, prototyping, and design principles and rules); Methods for interface evaluation (e.g., software logging, user observation, benchmarks and experiments); Human capabilities (e.g., visual and auditory perception, memory, mental models, and interface metaphors); Interface technology (e.g., input and output devices, interaction styles, and common interface paradigms); Implementation of interfaces.

ITCE 315 Computer Networks (3-2-3)
Prerequisites: ITCS 215
Course Description
Concepts of computer networks; the architecture of data communication systems. The seven layer model of a network (application, presentation, session, transport, network, data link, physical). Protocol algorithms; resource-sharing. Network performance, using computer network languages and software.

ITCE 321 Computer Architecture (3-2-3)
Prerequisite: ITCS 242
Course Description
General Purpose Machine, Machine language and digital logic, Real machines, RISC versus CISC, CISC Processor example, RISC processor example, Processor Design, The design process, 1-bus micro-architecture, data path implementation, Control unit, 2 and 3 bus architecture design, machine exception and reset, pipe-lining, instruction level parallelism.

ITCS 323 Operating Systems (3-2-3)
Prerequisites: (ITCS 215 & ITCS 242) or (ITCS 216 & ITCE 341)
Course Description
Machine structure and the functions of an operating system. Operating system’s structure. Process management, storage management and virtual memory. File system and I/O device handling. Protection and security. Case studies using different operating systems.
ITCS 332 Concepts of Programming Languages (3-2-3)
Prerequisite: ITCS 314
Course Description

ITCS 341 Object-Oriented Systems (3-2-3)
Prerequisite: ITCS 215
Course Description
Introduction to the problems of developing large software applications. Object-oriented concepts: classes, objects, relationships between classes including association, inheritance and aggregation. Object-oriented analysis and design. UML. Implementation of oo based system using an oo programming language. Comparison between different oo programming languages and oo design methodologies.

ITCS 346 Analysis and Design of Algorithms (3-2-3)
Prerequisites: ITCS 215 & ITCS 253
Course Description
Definition, criteria, implementation and empirical analysis of Algorithms; Asymptotic notations, Complexity; Best, Worst, and Average case analysis; Analysis of Non-recursive and Recursive algorithms; Brute Force, Greedy, Divide and conquer, Transform and conquer, Backtracking, Branch and Bound, and Dynamic programming Techniques for designing efficient algorithms. Limitations of algorithms; P, NP, and NP-complete problems.

ITCS 385 Database Management Systems (3-2-3)
Prerequisite: ITCS 215
Course Description

ITCS 390 Software Engineering I (3-2-3)
Prerequisite: ITCS 385
Course Description

ITCS 399 Professional Issues and Ethics (3-2-3)
Prerequisite: ENGL 219
Course Description:
Introduction to skills needed by IT professional and software developers including: research methods, IT report writing skills, presentation skills, and communications skills. Survey of professional certification and IT careers. Interview and CV preparation. Professional ethics including exposure to codes of conduct in IT and software engineering; legal IT issues and IT regulations. Global impact of IT and globalization. The course also includes a weekly seminar series.
ITCS 412 Cryptography and Data Security (3-2-3)
Prerequisites: ITCS 346
Course Description

ITCS 413 Advanced Operating Systems (3-2-3)
Prerequisite: ITCS 323
Course Description
Algorithms for process and thread scheduling, memory management; file systems, resource allocation, process synchronization and security in time-sharing, multiprogramming, and distributed operating systems; implementation details and trade-offs that have been made in contemporary operating systems and development of system level utilities and applications.

ITCS 423 System Software (3-2-3)
Prerequisites: ITCS 215 & ITCS 242
Course Description
Basic algorithms of operating system software; linkage editors, loaders, assemblers, macros, and compilers; Practical systems programming projects such as a simple linkage editor, a stand-alone executive, a file system etc.

ITCS 424 Geographical Information Systems (3-2-3)
Prerequisite: ITCS 215
Course Description
Introduction to GIS terminology and definitions; application needs, technical requirements and communication environments; interpreting geophysical, geological and related data; accessing database; data translators: extracting and converting data from other sources to GIS data models; spatial data handling concepts and techniques; storage capabilities of a GIS system; object-oriented programming and GIS: GIS macro language; survey of major GIS system; integrated GIS solutions; future GIS potential; a project in GIS applications.

ITCS 426 Practical Aspects of Operating Systems (3-2-3)
Prerequisite: ITCS 323
Course Description
Current operating systems in industry; Comparison of various operating systems including interoperability, hardware requirements, file systems, networking features, and GUIs; System administration, job control, and available utilities; Experiment with different types of editors, learning the use of the shell, and create shell scripts; OS capabilities in the network environment and on the Internet.

ITCS 427 Parallel Processing (3-2-3)
Prerequisites: ITCE 321 & ITCS 323
Course Description
Theory of parallelism: parallel computer models (SIMD; MIMD; Data Flow; Neural Networks); Interconnection Networks Parallel Hardware Technology: Super-Scalar and Vector Processors; Pipelined Processors. Parallel and Scalable Architecture’s. Network of workstations. Software for parallel programming; operating systems; languages; compilers and algorithms. Programming applications.

ITCS 428 Artificial Intelligence (3-2-3)
Prerequisites: ITCS 346 & ITCS 332
Course Description
Topics include heuristic search; knowledge representation and expert systems; natural language processing; pattern recognition; games and robotics. Desirable features of Artificial Intelligence languages. Applications in different areas using suitable language such as PROLOG or LISP.

**ITCS 438 Computer Graphics (3-2-3)**
**Prerequisites:** ITCS 215 & MATHS 211
**Course Description**
Theories and applications of the computer graphics system; Technical and conceptual aspects of computer drawing using standard computer graphics tools; Introduction to graphics hardware, output primitives, clipping algorithms, two- and three-dimensional geometric transformations, three-dimensional object representation and viewing, illumination models and surface-rendering methods; Graphics software tools.

**ITCS 439 Optimization Techniques (3-2-3)**
**Prerequisite:** ITCS 215 & MATHS 211
**Course Description:**
Optimization Modeling; Linear Programming: Models; Examples; Formulation; Geometry Linear programming; Simplex method to solve Linear Programming example; Duality and Sensitivity Analysis. Linear Programming: Special cases: transportation and Assignment problems. Network flow optimization: shortest path, Minimum spanning tree, maximum flow and minimum cost flow; Techniques for solving Integer Linear programming.

**ITCS 442 Compiler Design (3-2-3)**
**Prerequisite:** ITCS 332
**Course Description**
Compiler techniques methodology; Organization of compilers, lexical and syntax analysis; semantics; object code generation and optimization; Detection and recovery from errors; Contrast between compilers and interpreters; Tools for generating compilers.

**ITCS 447 Java Programming (3-2-3)**
**Prerequisite:** ITCS 341
**Course Description**
Overview of Java application and Applets basics; Object Oriented programming; graphics and Animation; Managing Events and Interactivity; Abstract Windows Tools; Threads, Exception, Networking; Programming Projects.

**ITCS 450 Graph Theory with Application to CS (3-2-3)**
**Prerequisite:** ITCS 346
**Course Description**
Directed and undirected graphs; paths, trees, coloring planar graphs, partitioning; Computer representation of graphs and graph algorithms; Applications in software complexity metrics: program testing and compiling; Applications in interconnection networks for parallel and distributed systems; Random graphs and complex networks.

**ITCS 452 Multimedia and Hypermedia Systems (3-2-3)**
**Prerequisite:** ITCS 215
**Course Description**
Survey of recent advances in multimedia systems: applications, authoring tools, information retrieval, network and operating system support, and management. Its impact on society. Multimedia hardware and standards. Techniques for authoring multimedia projects using a variety of digital media tools.

**ITCS 453 Visual Programming (3-2-3)**
**Prerequisites:** ITCS 315
**Course Description**
Concepts and techniques in designing and writing programs using a graphical user interface to implement sophisticated applications. Creating Object-Oriented Programs, building multi-tier programs,
multiple document interface (MDI), Graphics, Animation, Sound, Drag and Drop, database access methods including client/server systems, and Visual Web development.

ITCS 456 Distributed Systems (3-2-3)
Prerequisite: ITCS 323
Course Description
Introduction to distributed systems; distributed computing; Inter-process communication and remote invocation; distributed naming; distributed file systems; data replication; distributed transaction mechanisms, and distributed shared objects, secure communication, authentication and access control, mobile code, transactions and persistent storage mechanisms; Project to construct working distributed applications using contemporary languages, tools, and environments.

ITCS 460 Heuristic Methods for Optimization (3-2-3)
Prerequisite: ITCS346
Course Description
NP and NP problems; Heuristic search methods including greedy search, simulated annealing, tabu search, genetic algorithms, derandomized evolution strategy, and random walk developed for optimization of combinatorial- and continuous-variable problems; Approximation algorithms; Advantages and disadvantages of heuristic search methods for both serial and parallel computation are discussed in comparison with other optimization algorithms, Application project.

ITCS 462 Advanced Database Management Systems (3-2-3)
Prerequisite: ITCS385
Course Description
Query processing and Query optimization, Concurrency control, Active, temporal, and multimedia databases, distributed databases and client-server architecture, Data warehouse, data mining, emerging database technologies.

ITCS 473 Internet Software Development (3-2-3)
Prerequisite: ITCE 315 & ITCS 385
Course Description
Key technology underlying the World-Wide Web. Web architecture, including server design, Internet protocols standards (e.g. HTTP, TCP/IP, SMTP, POP3, MIME, FTP), Client-Server data processing; Web design using HTML/XHTML/CSS that include techniques for text, images, links and forms; XML based Applications, DTD, XSL/XSLT, and RSS; Client and Server-side programming languages, JavaScript and PHP; Web-based Programming Project.

ITCS 474 Information Retrieval (3-2-3)
Prerequisite: ITCS 473
Course Description

ITCS 479 Mobile Computing (3-2-3)
Prerequisite: ITCS473
Course Description
Introduction to mobile computing; mobile computing platforms; wireless networks; architectures; security and management; mobile computing applications such as mobile messaging, mobile agents, and sensor applications.

ITCS 480 Natural Language Processing (3-2-3)
Prerequisite: ITCS 332
Course Description
The state of the art and current topics in Natural-Language; Implementation Issues; Natural communication between person and computer, Parsing; Knowledge representation; Inference and
Learning in a computer model; Context Recognition in Language Comprehension Reminding and Memory Organization; Procedural Semantics.

**ITCS 482 Industrial Training (0-3-1)**
Prerequisite: Pass 85 credits
Course Description
Each student is required to spend a minimum of eight weeks in some related computer training. A report followed by discussion is submitted to a departmental committee for evaluation. The student is expected to do a heavy practice in programming, using and modifying packages.

**ITCS 490 Software Engineering II (3-2-3)**
Prerequisites: ITCS341 & ITCS 390
Course Description

**ITCS 491 Numerical Computations (3-2-3)**
Prerequisite: ITCS 253 & MATHS 211
Course Description:

**ITCS 493 Selected Topics in Computer Science (3-2-3)**
Prerequisite: Department Approval
Course Description
A course in advanced topics from various areas of computer science. The aim of this course is to make students familiar about an advanced topic in computer science which is not covered in their syllabus.

**ITCS 495 Physical Implementation of DBMS (3-2-3)**
Prerequisite: ITCS 385
Course description
Practical aspects of database programming on major DBMS packages such as ORACLE. The course covers SQL programming, programming FORMS and REPORTS on the selected package. Creating database tables. Creating and interrogating databases. Selecting, updating and querying databases. Writing programs to interrogate the database. Designing and programming GUI Forms. Using Triggers. Designing and programming reports.

**ITCS 499 Senior Project (0-6-3)**
Prerequisite: English 219 & Pass 85 credits
Course Description
The student will work under the supervision of a faculty member on a field project involving advanced concepts not covered in the curriculum. The student is expected to make a final project presentation before a committee made up of external as well as internal members. As much as possible the project entails the development of an actual information system and the submission of a project report.