

Catholic University College of Ghana (Fiapre)

[Faculty of Information, Communication Sciences & Technology]

Programme for B.Sc, Computer Science (CS)

Mission

The mission of the Faculty of Information and Communication, Sciences and Technology stands on two pillars.

- i. The development of a dedicated and innovative faculty of researchers and engineers, committed to generating and disseminating knowledge in information sciences and technology, working to produce students who are competitive in the job market and comfortable with working in such disciplines as computer engineering, software engineering, business information systems, network engineering, etc.
- ii. Provision of computer/network support service in data processing, communication and technology support for CUCG in areas such as Research and Development, the University Library, University Administration, Student Academic Records, Accounting, Scientific Computing, etc.

Laboratory Facilities

The faculty runs two computer laboratories. Laboratory 1 has 28 workstations and Laboratory 2 has 20 workstations all of which are networked. Laboratory 2 can be used for holding practical classes on computer hardware and assembling of hardware. A video projection facility is available to both laboratories. A third laboratory is planned for construction in 2005.

Objective of Programme

The programme is designed to provide graduates with a strong hands-on foundation in information and communication technology that will equip them to develop solutions to scientific and technology research in industry and business environments.

Practical Training

Students will undertake practical training in industry or business during the vacation period after Level 200 and Level 300.

Enrichment Programme

It is a requirement of the University that all students use 20% of the 4-year degree programme for the Enrichment Programme, under the Centre for Enrichment Studies (CES). Under this programme students will take compulsory courses in

- i. Study Skills
- ii. Language and Communication Skills
- iii. Ethics and Civics and
- iv. General Mathematics

There will also be special courses to broaden the knowledge base of students in other fields of knowledge, and students may choose to take other courses in the University outside Computer Science Department. It is expected that the study of French Language will become part of the Enrichment Programme at a later date.

Admission Requirements

The General University Admission Requirements are the following:

1. SSSCE Applicants
Passes in Core English, Core Mathematics and either Social Studies or Integrated, Science plus three other Elective passes with an aggregate score of 24 points or better.
2. 'A' Level Certificate Applicants
At least five credit passes, including English and Mathematics and 'A' Level passes in two subjects, one with grade D or better and a General Paper.
3. Mature Applicants
Applicants 30 years or older who do not satisfy the regular requirements may be accepted on the basis of work experience or other qualifications. They will write an entrance examination and attend an interview.
4. Additional Requirements for ICST Faculty
Passes at grade C or better in Elective Mathematics, an Elective Science subject preferably Physics or Applied Electricity and total aggregate 20 points or better.

B.Sc Computer Science Course Structure

Year One Programme

Discipline/Course	Sem.1	Sem.2
CES 101: Study Skills	2 units	
CES 102: Introduction to Logic		2 units
CES 105: Introduction to Mathematics I	3 units	
CES 106: Introduction to Mathematics II		3 units
CES 107: Language & Communication Skills I	3 units	
CES 108: Language & Communication Skills II		3 units
CES 111: Introduction to Social Ethics	2 units	
CES 112: Civics & Government		2 units
CS 101: Introduction to Physics I	3 units	
CS 102: Introduction to Physics II		3 units
CS 103: Introduction to Information Technology	3 units	
CS 104: Programming With C++		3 units
CS 107: Introd. to Structured Program Design	3 units	
CS 112: Data Processing		3 units
Total	19 units	19 units

Year Two Programme

Discipline/Course	Sem.1	Sem.2
CS 203: Electronics	3 units	
CS 204: Electronics & Microprocessors		3 units
CS 205: Mathematics III	3 units	
CS 206: Mathematics IV		3 units
CS 209: Systems Analysis & Design I	3 units	
CS 210: Systems Analysis & Design II		3 units
CS 211: Programming With Visual Basic	3 units	
CS 212: Programming With C++		3 units
CS 213: Assembler Language Programming	3 units	
CS 218: Data Structures		3 units
EBA 221: Introduction to Economics I	3 units	
EBA 222: Introduction to Accounting I		3 units
Total	18 units	18 units

Year Three Programme

Discipline/Course	Sem.1	Sem.2
CS 301: Operating Systems	3 units	
CS 304: Computer Graphics		3 units
CS 305: Computer Hardware	3 units	
CS 306: Data Comm. & Computer Networks I		3 units
CS 307: Software Engineering I	3 units	
CS 308: Software Engineering II		3 units
CS 309: Operations Research I	3 units	
CS 310: Operations Research II		3 units
CS 311: Programming With JAVA I	3 units	
CS 312: Programming With JAVA II		3 units
CES 211: Introduction to Philosophy	2 units	
CES 311: Catholic Social Teaching		2 units
Total	17 units	17 units

Year Four Programme

Discipline/Course	Sem.1	Sem.2
CS 401: Introduction to Artificial Intelligence	3 units	
CS 402: Internet Techn. & Wireless Networks		3 units
CS 403: Data Comm. & Computer Networks II	3 units	
CS 404: Microprocessors		3 units
CS 405: Database & Information Systems I	3 units	
CS 406: Database & Information Systems II		3 units
CS 407: Web Programming	3 units	
CS 408: Introduction to Compilers		3 units
CS 409: Project I	3 units	
CS 410: Project II		4 units
CES 411: Interfaith Encounter & Rel. Dialogue	2 units	
CS Elective		2 units
Total	17 units	18 units

COURSE DETAILS – LEVEL 100

CES 101: Study Skills 2[1,1,-]

CES 102: Introduction to Logic 2[1,1,-]

CES 107/108: Language and Communication Skills I/II 6[4,2,-]

CES 105: Introduction to Mathematics I 3[2,1,-]

[Pre-requisite: SSSCE Core Mathematics or equivalent]

Elementary properties of real numbers, indices, surd and logarithms. Idea of a function and its graph; polynomial and circular functions. Equations and inequalities in one and two variables. Arrangement and selections, binomial expansion. Intuitive treatment of limits. Arithmetic and Geometrical progression.

CES 106: Introduction to Mathematics II 3[2,1,-]

[Pre-requisite – CES 106]

Arithmetic of complex numbers, Argand diagram, Notion of a Scalar and Vector, Algebra of Vectors Scalar product; applications of Geometry. Linear transformations and matrices; determinants; applications to systems of linear equations. Techniques of differentiation and integration of rational, exponential and logarithmic functions. Simple ordinary differential equations partial differentiation. Introduction to Statistics, data collection, analysis and interpretation. Applications to Business Management and Economics.

CS 101: Introduction to Physics I 3[2,1,3]

The objective of courses CS 101 and CS 102 is to introduce the student to the broad principles of physics that underlie much of modern technology and instrumentation. The courses provide background preparation for studying electronics and future work on microprocessors and computer hardware.

Content:

Waves: General properties of waves; mechanical oscillations-simple harmonic motion (SHM), electrical oscillations-general wave equation, phase angles amplitude, intensity frequency, wavelength; energy in a wave.

Acoustics waves: Sound detection, production, recording (the ear, loudspeaker, telephone and earpiece, sound recording and reproduction), sound track pitch, musical intervals, intensity and loudness.

Ultrasonic wave: Production, properties and applications. Electromagnetic wave: UV, visible, IR; Radio waves sources and general properties. Productions and detection of EM waves. Measurement of light, fundamental parameters and units.

Laser: Basic principles, properties, types and applications.

Electricity: Change and matter: electric field, potential, capacitance and dielectrics, current electricity, DC circuits, resistors, etc. AC circuits. Network theorems: Kirchoff's Law, Norton and Thevenin Theorems. Thermionic Emission: work function, space charge, photon emission, Cathode ray tube (CRT) principles and construction. Uses of CRT.

Semiconductors devices: PN junction formation and properties. Semiconductor diodes-characteristics and application; power supplies and filters, regulated power supplies, voltage multipliers.

CS 102: Introduction to Physics II 3[2.1.3]

[Pre-requisite – CS 101: Introduction to Physics I]

Junction Transistor fabrication: Biasing techniques: AC and DC loadlines; characteristics of CB, CE, and CC configurations. Introduction to amplifiers: Small signal amplifiers. Field effect transistors: Small signal analysis of common source, gate and drain amplifiers. Quantitative treatment of positive and negative feedback and their applications in amplifier design. Integrated devices: Introduction to the applications of linear ICs: Timers, operational amplifiers, etc.

CS 105: Introduction to Information Technology 3[3,-,2]

Data versus information. Information as a resource for society and organizations. Sources of data, data processing cycle. Data and information needs through and organization. Characteristics of information. Evaluation of computer and development of data processing. Classification of computers. Characteristics and functional parts of the digital computer. Processing. Storage. Input/output and telecommunication hardware. Computer systems. Types and applications of computer software. Data: Hierarchy, logical versus physical representation. Types of file organization and processing methods. Introduction to searching and sorting. Laboratory work.

CS 104: Introduction to Visual Basic 3[2,-,2]
Overview of software development. Translating the basic control structures to Visual Basic; data types and expressions, assignment statements, input and output statements, procedural abstraction and functions, arrays. Sorting and searching methods. Introduction to object oriented programming.

CS 107: Introd. to Structured Programme Design 3[2,-,3]
Algorithms – definition, properties and classification. Development of algorithms using top-down design and a structured pseudo code language, flowcharts and input, process, and output (IPO) diagrams. The basic control structures; sequence control structure, decision making or conditional transfers and loop structures. The different data types. Brief introduction to the different programming languages (interpreters, assembler and compilers); high level, assembly and machine. Translation of algorithms into computer codes through the following features: expression evaluation, assignment statement, control structures, input-output, built-in functions, user-defined functions and subroutines, and file handling. Problems will be drawn from Mathematics, Statistics, and Business emphasizing structured design.

CS 112: Data Processing 3[2,-,2]
Data Versus Information. Information as a resource for society and organization. Data processing cycle: external factors. Data and information needs through an organization. Characteristics of information. Data Processing Methods.
Data hierarch (bit, character, field, record); logical and physical representation. Types of File Organisation and File Processing Methods.

LEVEL 200

CS 203: Electronics 3[2,1,3]
Analogue Electronics, cathode ray oscilloscope, solid state devices, transistors, pn junction and diodes. Design of regulated power supply. Bipolar junction transistor, field effect transistor, Feedback amplifier, operational amplifiers, integrated circuits.

CS 204: Electronic & Microprocessors 3[2,1,3]
[Pre-requisite – CS 102, CS 203]
Digital electronics: Basic logic gates, binary number systems, Boolean functions and truth tables. Integrated circuits development as a way of understanding microcomputer. Binary data input and output, analogue to digital and design of sequential circuit. Introduction to microprocessors. Student will design and build circuits from circuit diagrams.

CS 205: Mathematics III 3[2,1,-]
[Pre-requisite – CS 106]
Logical reasoning and Mathematical proof; Mathematical induction. Set theory, binary and equivalence relations. Idea of a function and its inverse. Complex numbers, Argand diagram, de Moivre's theorem and applications, vector algebra. Matrices and determinants, application to systems of linear equations.

CS 206: Mathematics IV 3[2,1,-]
[Pre-requisite – CS 205]
Introductory probability calculus, applications to chance and uncertainty. Conditional probability and independent Random variables, discrete and continuous distributions and applications to sample data.
Linear regression and applications. Use of electronic spreadsheets. Statistical inference; standard errors and confidence intervals. Test of hypothesis and significance level.

CS 209: Systems Analysis & Design I 3[2,1,-]
[Pre-requisite 0 CS 104, CS 107]
Objectives:

- To introduce students to general systems theory and methods and techniques of finding, recording and analysis of information processing systems.
- To acquaint students with the problems inherent in transition from one from one information processing system to another and to highlight the human factor in the use of computing facilities.
- To familiarize students with the current trends in the subject area.

Content: General systems theory and its application. The system Development Life Cycle. Fact finding methods. Charting Methods System Flowcharts, HIPO charts and DFDs including business process modeling. Decision tables and trees. Forms design. Output-Input design. Design of Coding Systems. Storage media and devices. Data files (types, organization and processing).

CS 210: System Analysis & Design II 3[2,-,2]

[Pre-requisite – CS 209]

Objectives:

- To introduce students to methods and techniques of data analysis, design and implementation of information processing systems.
- To acquaint students with the problems inherent in transition from one information processing system to another and to highlight the human factor in the use of computing facilities.
- To familiarize students with current trends in the subject area.

Content: Overview of Information Systems Department, Organizational Chart, Management of the Information Systems Department including outsourcing. The review of System Development Life Cycle (SDLC), Prototyping, Data Analysis, Logical and Physical Design, Documentation of Computerized Systems. Security of Computerized Systems Evaluation and Maintenance, case studies of real existing systems.

CS 211: Programming With Visual Basic 3[2,-,3]

[Pre-requisite – CS 104, CS 107]

Programming with Visual Basic – Menu designs; Dialog Boxes; Keyboard and Mouse Input; Functions; Debugging; Creating Controls on-the-fly; Using Windows API; OOP with VB; Active X Controls with VB; Databases and Data Control; Using Advance Data Controls

CS 212: Programming With C++ 3[2,-,3]

Variables and Constants; programme control structures, Expressions and Statements; user defined functions (void functions, call-by-value and call-by-reference); Arrays and Strings. File handling-creation and file update. Output file format manipulators. File variables as function arguments.

CS 213: Assembler Language Programming 3[2,-,2]

[Pre-requisite – CS 103]

Introduction to Assembly Language Programming Creation, editing, loading, execution and online debugging of assembler language programmes. Topics include addressing schemes, assembler directives and macros, subroutine linkages and assembler processing.

CS 215: Advance C++ Programming 3[2,-,3]

[Pre-requisite – CS 212]

User defined data types; structure, union and classes (member names and functions, constructors and destructors). Polymorphism:- Function Overloading, Advance Inheritance; Steams; Namespaces; Templates; Exceptions and Error Handling. Pointers, Linked Lists. Introduction to Visual C++:- menu design, dialogue boxes and creation of objects. Menu driven programmes.

The course covers Visual C++ Development Environment. It will consider applications that allow user interaction, work with timers, getting user feed back-adding dialog boxes to applications – creating menus, working with text an fonts, adding flash that incorporate graphics, drawing and bitmaps.

Applications that add Active-X controls\, create single document interface and multiple document interface, save and restore work – file Access-retrieve data from ODBC Database, update and add Data Base Records through ADO, create classes and updates modules. Other areas to be covered include sharing Functionality with other applications – creating DDLs, doing multiple Tasks at one Time-Multitasking-building Widgets – Active X controls, Internet Applications, Network Communications and adding Web Browsing Functionality to Applications.

CS 218: Data Structures 3 units

[Pre-requisite – CS 104, CS 107]

The course covers Basic Data Structures and Algorithm Analysis. Starting with the art and science of analyzing algorithms, the aims of the course is to learn various techniques for organizing data so that computer programmes can access, modify, and delete data efficiently. Topics covered include basic data structures, e.g. lists, stacks and queues; trees' hashing; heaps; disjoint sets, and graphs. Self-adjusting data structures; worst-case, average-case, and amortized

analysis; and basic problem solving techniques will be introduced. Introduction to Sorting: factors affecting the choice of sorting method, binary tree and merge sorting methods; analysis and comparison of sorting methods.

Algorithms will be implemented in BASIC (or any appropriate programming language) with emphasis on top down design.

LEVEL 300

CS 301: Operating Systems **3[2,-,2]**

[Pre-requisite – CS 105]

This course studies software systems that provide the interface between the computer system hardware resource and the users of the system. This interface is composed of a large collection of programmes that provide simplified and uniform access to information storage (data and programmes on tape, disk, and in memory, processing elements CPUs and remote computers), input-output devices (telecommunications, keyboards, mice, video displays, printers, etc.), and data acquisition and equipment control devices.

Topics include, processes and threads of execution, concurrent process synchronization, concurrent access to hardware resources, file systems, memory management and virtual memory, job scheduling, system modeling and performance evaluation, network communication protocols, and computer and network security.

A variety of example operating systems of different types will be examined and their characteristics compared.

CS 304: Computer Graphics **3[2,-,2]**

[Pre-requisite – CS 215, CS 218, Co-requisite – CS 312]

The course will consider: Graphics Package Standards, Two-dimensional graphics, straight line, circles, transformations, clipping, and windowing algorithm. Interactive graphics, input devices and interrupt and event handling. Examples: Scientific, management and design use. Graphical User Interface and Human-Computer Interface Design issues and technology. JAVA will serve as vehicle to test concepts.

CS 305: Computer Hardware **3[2,-,2]**

A brief overview of some theoretical ground work *[Finite State Automata and Turing Machines]* followed by general design concepts (the von Neumann and Harvard models). Review of Boolean Algebra, and Introduction to Logic Design and a look at logic gate

implementation from mechanical switches to Very Large Scale Integration (VLSI).

Sequential Machine, minimal Central Processing Unit (CPU). Students will design their own instruction set architecture, a processor and implement their design in low-level logic. There will be weekly assignments, a Semester project and half Semester project.

CS 306: Data Comm. & Computer Networking I **3[2,-,2]**

[Pre-requisite CS 193]

Basic Data Communication – transmission, transmission media, error detection and correction, synchronization, link management, and flow control. L Protocols – the ISO 7-layer model, the TCP/IP model, design and efficiency. Routing Strategies – gateway routing, multicast, etc. Remote Access – dial up modem, cable modem, ISDN.

CS 307: Software Engineering I **3[2,-,1]**

[Pre-requisite – CS 210, CS218, CS 303]

This course introduces the major principles used in the development of software. General principles and methods should be identified, and their applications located in various phases and models of software engineering. The focus should be on understanding the organizing power inherent in the underlying concepts, principles, and processes, rather than any particular development method or model. Techniques used in large scale scientific or technical software development should be looked at.

Topics should include: the nature and qualities of software; Types and Qualities of Software Specifications; Objectives of software design; Software Verification Approaches; Software Production Process Models; Software development standards; Software Documentation and Testing; Software Development Life Cycle Standards.

CS 308: Software Engineering II **3[2,-,2]**

[Pre-requisite – CS 307]

Software Implementation and/or Deployment strategies; and Classification of software supporting tools and environments. Reusability and maintainability of software; Software issues of portability, extendibility, and interpretability; Software Project Management; Concepts and applications of object oriented software development; Basic principles of software design and architecture; the role of middleware in software design; CASE tools.

CS 309: Operations Research I 3[2,-,2]
[Pre-requisite – CS 206, CS 211, CS 303]
The nature and purpose of operations research. Brief outline of the development of operations research and its uses. Formulation of mathematical models (blending, production and transportation problems). Linear programming, simplex method, primality, duality and post-optimality (sensitivity) analysis. Integer programming. Transportation problem and the application of the algorithm to the assignment problem.

CS 310: Operations Research II 3[2,-,2]
[Pre-requisite – CS 309]
Overview of important prototype problems – inventory control, single and multi server queuing problems, critical path analysis, project management, simulation and mathematical programming. Use of (self-developed) computer programmes in solving linear programming problems, queue problems, etc. A typical case study. Game theory.

CS 311: Programming With JAVA I 3[2,-,3]
[Pre-requisite - CS 215]
Introduction to JAVA Programming: Programming languages, OO programming. Variables and Operators: Strings, variables, identifiers, statements, initialization, operators and operator precedence. Decisions: Algorithms, Stepwise refinements. Decisions (if, if-else, switch). Iteration and Programme Testing: Repetitions (for loops). Classes: Writing simple classes. Arrays, Methods and Parameters: Arrays, methods and parameters, simple applets. Inheritance: Inheritance, Method overloading and overriding. Dynamic Binding and Polymorphism: Polymorphism, modifiers, etc. Abstract Classes, Interfaces and Arrays: Exceptions: Data Structures: Files:

CS 312: Programming With JAVA II 3[2,-,3]
[Pre-requisite – CS 312]
Dynamic Data Structures. Using the Vector Structure, Self-referential Structures. Data Storage and Retrieval: Linear and Binary search, Bubble sort, Selection sort and Insertion sort. Hash Tables: Introduction, Linear probing: addition, collision resolution, retrieval code, deletion code, table pollution and Chaining Hash Tables.

Introduction to Graphics: Java's GUI, Swing Basics. Graphical user interfaces, Part I: Developing a GUI. Graphical user interfaces, Part II: Event driven programming. Resources: Prescribed Text Books (Computing Concepts with JAVA Essential, by CAY Horstmann, 3rd Edition, Willey, 2003, ISBN 0-471-24371-X, JAVA, How to Programme, by Deitel and Deitel, Prentice Hall – latest edition)

CS 313: Computer & Communication Security 3[2,1,1]
Cryptosystems, symmetric-key and public-key cryptography, cryptanalysis, authentication, message digests, digital signatures, and random number generation. Access controls and firewalls. Applications such as certificate authorities, electronic commerce, smartcards, and digital cash.

LEVEL 400
CS 401: Introduction to Artificial Intelligence 3[2,-,2]
[Pre-requisite – CS 215, CS 305]

Artificial Intelligence (AI) is the branch of computer science that studies how to programme computer to reason, learn, see and understand. The course will survey some basic concepts and techniques of artificial intelligence, including knowledge representations and inference mechanisms. Additional topics cover LISP programming language, theorem proving, game playing, rule-based systems, probabilistic reasoning systems, machine learning and computer vision. Applications will be in domains such as medicine, robotics and computer security.

CS 402: Internet Technologies & Wireless Networks 3[2,-,2]
[Pre-requisite – CS 306]

Accessing information, anywhere, anyplace, and anytime, will be key in future information systems. This course will study various technical aspects of wireless communications and network systems. The course will also cover a selection of the following topics: Communications, including, Spectrum allocation and characteristics propagation characteristics, coding, frequency and time division multiplication; Satellite Systems; Network Systems including, Cellular Telephony, GSM System, TDMA System, Network Protocols (1G, 2G, 2.5G and 3G) mobile IP and ad-hoc networks, and applications, including, browsing through wireless devices, WAP and WEP.

CS 403: Data Comm. & Computer Networking II **3 units**

[Pre-requisite – CS 306]

Modern Computer Network fundamentals and transmission media. Network and its association with the Internet. Connectivity devices, Architectures of computer networks. Particular emphasis will be given to application layer, transport layer, and network layer (physical and data link). Applications in multi-media networking and network management. Network security.

CS 404: Microprocessors **3[2,-,3]**

[Pre-requisite – CS 204, CS 213]

Practical aspects of digital hardware as applied to microprocessor systems. Topics include digital logic circuits, microprocessors organization, microprocessor interfacing and aspects of digital logic families. The 8086 will be used as the example of a microprocessor, both in lectures and in laboratory work. Interfacing will cover aspects of memory, serial I/O, analog I/O, interrupts, direct memory access and flexible diskette I/O.

CS 405: Database & Information Systems I **3 units**

[Pre-requisite – CS 210]

Components of data systems. Physical and logical data organization. Data models-hierarchical, network and relational.

Query language design, reliability, security, integrity and concurrency. Use and comparison of some actual database.

Introduction to information storage and retrieval. Societal implications of large data banks: privacy and security issues, data protection and legislation.

Information and management, data and knowledge management, the nature and types of information systems, business strategy and Information Technology Alignment, strategic role of information organizations, capital budgeting models, approaches to analysis and design of information processing systems, special topics: electronic commerce, internet computing.

CS 406: Database & Information Systems II **3[2,1,2]**

[Pre-requisite – CS 405]

Design and practice, relational database features, Internet-based distributed databases. Assignment could include writing part of a database, and all aspects of setting up and using SQL. Mini-course-Getting Started with Microsoft SQL Server (2000)

CS 407: Web Programming & Computer Graphics **3 units**

[Pre-requisite – CS 211, CS 215, CS 302]

Techniques for creating interactive documents or web pageHTML, Scripting languages, interaction techniques, data mining, incorporating sound and images in documents.

Graphics Package Standards, Two-dimensional graphics, straight line, circles, transformation, clipping, and windowing algorithm. Interactive graphics, input devices and interrupt and event handling. Graphics User Interface and Human-Computer Interface design issues and technology.

JAVA will serve as vehicle to test concepts.

CS 408: Introduction to Compilers **3[2,-,2]**

[Pre-requisite – CS 104, CS 107, CS 215]

Overview of the internal structure of modern compilers, with emphasis on implementation techniques. Topics covered include Textual Scanning, simple parsing techniques, symbol-table manipulation, type-checking routines, code generation, and simple optimizations. The course entails a compiler implementation project.

CS 409: Project I **3[-,-,4]**

Project – problem definition, conceptualization of a solution, project planning and the first phase of implementation. A mid-project progress report must be submitted at the end of the Semester.

CS 410: Project II **3[-,-,4]**

Continuation of the project in CS 411: Project I. This part consists of project completion, testing and evaluation, documentation and reporting.

2nd June 2005.