# KADUNA STATE UNIVERSITY

## DEPARTMENT OF COMPUTER SCIENCE

## B.Sc. COMPUTER SCIENCE CURRICULUM

**Main Campus, Tafawa Balewa Way, PMB 2339, Kaduna, Nigeria**
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## COURSES

| **100 LEVEL FIRST SEMESTER** | | | |
|---|---|---|---|
| **COURSE INFORMATION** | | | |
| **CODE** | **TITLE** | **UNITS** | **PRE-REQUISITES** |
| **Core** | | | |
| CSC101 | Fundamentals of Computing | 3 | “O” Level Math |
| MTH105 | Trigonometry & Coordinate Geometry | 2 | ,, |
| MTH107 | Sets and Number Systems | 2 | ,, |
| MTH109 | Differential & Integral Calculus | 2 | ,, |
| PHY101 | General Physics Lab I | 1 | “O” level Physics |
| PHY103 | Mechanics, Thermal Physics and waves | 3 | ,, |
| STA103 | Introduction to Statistics | 2 | |
| **General** | | | |
| GST101 | Communication Skills in English I | 2 | Nil |
| GST103 | Nigerian People & Culture | 2 | Nil |
| **Elective** | | | |
| BIO101 | General Biology I | 2 | |
| CHM101 | Introduction to General Chemistry | 2 | |

| **100 LEVEL SECOND SEMESTER** | | | |
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| **COURSE INFORMATION** | | | |
| **CODE** | **TITLE** | **UNITS** | **PRE-REQUISITES** |
| **Core** | | | |
| CSC102 | Introduction to Problem Solving | 3 | “O” Level Math |
| MTH106 | Algebra | 2 | ,, |
| MTH112 | Vectors and Dynamics | 2 | ,, |
| MTH114 | Conic sections and application of calculus | 2 | ,, |
| STA104 | Probability I | 2 | ,, |
| **General** | | | |
| GST102 | Use of Library Skills and Information | 2 | Nil |
| GST104 (Or 106) | Communication in French (Or Arabic) | 2 | Nil |
| **Elective** | | | |
| CHM104 | Introductory Organic Chemistry | 2 | |
| CHM108 | Introduction to Physical Chemistry | 2 | |
| PHY102 | Electricity, Magnetism & Modern Physics | 3 | |

| **200 LEVEL FIRST SEMESTER** | | | |
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| **COURSE INFORMATION** | | | |
| **CODE** | **TITLE** | **UNITS** | **PRE-REQUISITES** |
| **Core** | | | |
| CSC201 | Computer Programming 1 | 3 | CSC101 |
| CSC203 | Operating System I | 3 | CSC101 |
| CSC205 | Computer Architecture & Organization | 3 | |
| MTH201 | Mathematical Methods | 3 | MTH 103 |
| MTH209 | Logic & Axiomatic Set Theory | 3 | MTH 107 |
| MTH203 | Linear Algebra I | 3 | MTH 107 |
| **General** | | | |
| GST201 | Communication in English II | 2 | |
| GST203 | History and Philosophy of Science | 2 | |

| **200 LEVEL SECOND SEMESTER** | | | |
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| **COURSE INFORMATION** | | | |
| **CODE** | **TITLE** | **UNITS** | **PRE-REQUISITES** |
| **Core** | | | |
| CSC202 | Computing Programming II | 3 | CSC102 |
| CSC204 | Fundamentals of Data Structures | 3 | |
| CSC206 | Computer Hardware | 3 | CSC103 |
| MTH210 | Differential Equations | 3 | |
| MTH204 | Linear Algebra II | 3 | MTH 106 |
| **General** | | | |
| GST202 | Logic, Philosophy and Human Existence | 2 | |
| GST204 | Peace Study and Conflict Resolution | 2 | |
| **Elective** | | | |
| MTH214 | Introduction to Numerical Analysis | 3 | MTH 109 |

| **300 LEVEL FIRST SEMESTER** | | | |
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| **COURSE INFORMATION** | | | |
| **CODE** | **COURSE TITLE** | **CREDIT UNITS** | **PRE-REQUISITES** |
| CSC301 | Algorithm & Complexity Analysis | 3 | CSC201 |
| CSC307 | System Analysis & Design | 3 | CSC201 |
| CSC311 | Theory of Computing | 3 | |
| CSC313 | Object Oriented Programming | 3 | |
| CSC315 | Data Management | 3 | |
| ENT 301 | Entrepreneur and Innovation | 2 | |
| MTH 325 | Introduction to Operation Research | 3 | MTH203 |

| **300 LEVEL SECOND SEMESTER** | | | |
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| **COURSE CODE** | **COURSE TITLE** | **CREDIT UNITS** | **PRE-REQUISITES** |
| CSC350 | SIWES | 6 | 1. Students must be at 300 level<br>2. Carryover or outstanding lower-level second semester courses must be less than 6 units if any. |
| *Note: The placement is for six months and students are required to produce satisfactory reports on their work throughout the period of industrial training. A supervisor will be assigned to each student. The supervisor will be a member of academic staff in the department.* | | | |

| **400 LEVEL FIRST SEMESTER** | | | |
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| **COURSE INFORMATION** | | | |
| **CODE** | **TITLE** | **UNITS** | **PRE-REQUISITES** |
| **Core** | | | |
| CSC401 | Software Engineering | 4 | |
| CSC403 | Net-centric Computing | 3 | |
| CSC405 | Org. of Programming Languages | 3 | |
| CSC423 | Compiler Construction I | 3 | |
| CSC415 | Computer Modeling and Simulation | 3 | |
| **Elective** | | | |
| CSC413 | Computer Graphics | 3 | |
| CSC417 | Project Management | 3 | |
| *Note: In addition to all core courses, a minimum of three (3) credit units should be chosen from any of the elective courses listed above. Also, the maximum courses to be registered is (24) credit units* | | | |

| **400 LEVEL SECOND SEMESTER** | | | |
|---|---|---|---|
| **CODE** | **TITLE** | **UNITS** | **PRE-REQUISITES** |
| **Core** | | | |
| CSC400 | Project | 6 | |
| CSC402 | Human Computer Interface | 2 | |
| CSC404 | Computer Networks & Communication | 3 | |
| CSC412 | Artificial Intelligence | 3 | |
| **General** | | | |
| ENT402 | Business Creation and Growth | 2 | |
| **Elective** | | | |
| CSC416 | Information Technology Law | 3 | |
| CSC408 | Computer Systems Performance Evaluation | 3 | |
| *Note: In addition to all core courses, a minimum of three (3) credit units should be chosen from any of the elective courses listed above. Also, the maximum courses to be registered is (24) credit units* | | | |

## COURSE SYNOPSIS

**CSC 101: Fundamentals Computing (3 credit units)**

This course is designed to provide students with the appreciation of computing, computer systems and skills in the use of internet communications technologies and information services. The course covers: overview of different fields of computing; Introduction to the development of computers, hardware and software components of computer systems and their functions. Application of computers, data representation and processing, the Internet and Computer ethics. The Internet, e-mail, the social web, green computing and security, computer ethics, centralized computing and distributed computing. Introduction to Computer Programming using Python; syntax, data types, control structures

**Lab work**

Exposure to the use of Python programming language IDE, writing programs to demonstrate understanding of Python syntax, data types, control and looping structures etc.

**CSC 102: Introduction to Problem Solving (3 credit units)**

This course is designed to provide students with skills of analysis a problem to device a solution. The course covers: Problem solving methods; problem specification, devising, implementing and evaluating a solution. Problem solving approach using structural design, modular and object-oriented design, top-down design and stepwise refinement. Algorithms and design; the concept and properties of algorithms, the role of algorithms in the problem-solving process. Problem-solving strategies, Divide-and-conquer strategies, algorithm implementation strategies, concepts and properties; flowcharts and pseudocode. Sequential, branching and looping structures. Problem solving using Python programming.

**Lab work**

Case studies to enable students identify and solve problems using algorithms. Exposure to the use of Python programming to solve problems.

**CSC 201: Computer Programming I (3 credit units)**

This course is design to provide students with the skills of developing programs to solve problems. The course covers introduction to programs and programming languages. Computing using object-oriented design. Introduction to object-oriented programming language. Topics include variables and primitive data types (e.g., numbers, characters, Booleans), expressions and assignments, I/O operations including file I/O, conditional and iterative control structures, functions and parameter passing operations, strings, arrays, objects, classes (fields, methods, and constructors), privacy and visibility of class members, inheritance and polymorphism. A widely used programming language should be used in teaching the above such as Java Visual Basic.Net.

**Lab work**

Developing programs to solve simple to intermediate problems. Developing programs that involve object-oriented concepts such as classes, inheritance and polymorphism. Lab manuals for hand-on practice are available.

### CSC 202: Computer Programming II (3 credit units)

This course covers advanced principles of good programming, structured and object-oriented programming concepts. Topics include list, recursion, stack, queue, threads, the use of abstract classes, secure coding, exception handling, input validation and data sanitization, enumeration and interfaces, and organizing programs using packages. GUI using IDEs. Advanced programming elements should be covered to ensure mastery of programming by students.

**Lab work**

Developing programs to solve problems involving all the topics covered in the syllabus. Laboratory exercises in an OOP language.

### CSC 203: Operating Systems (3 credit units)

This course is designed to provide students with the knowledge of operating systems, writing software routines and implementing various concepts of operating systems. The course covers overview of operating system; role and purpose, functionality to support client-server and distributed models, hand-held devices, security, networking, and multimedia. Operating system principles; structuring methods (monolithic, layered, modular, micro-kernel models), abstractions, processes, and resources, concepts of application program interfaces (APIs). Concurrency and context switching; interrupts; concurrent execution; mutual exclusion problem and some solutions. Deadlock; models and mechanisms (semaphores, monitors, etc), producer-consumer problems and synchronization. Memory management and virtual memory; overlays, swapping and partitions, paging and segmentations. Introduction to virtualization and virtual machines; Types of virtualizations systems (Software, OS and Server) and Hypervisors.

**Lab work**

Exposure to the use of Unix-based, Windows operating systems, Android and IOS systems and virtualization systems (Major Hypervisors). Implementing programs using Bash shell and PowerShell programming.

### CSC 204: Data Structures and Algorithms (3 credit units)

Fundamental data structures; arrays and records, implementation of stacks, queues, lists, heap, hash tables, trees, graphs and graph algorithms, hash tables. Sequential and binary search algorithms (selection, insertion), sorting algorithms (quicksort, heapsort, mergesort, parallel MergeSort). Recursion: concept of recursion, simple recursive procedures, recursive backtracking, implementation of recursion.

**Lab work**

Developing programs to demonstrate the use of data structures covered in the content using Java, Python, C++, C# or Visual Basic .Net programming languages.

### CSC 205: Computer Architecture and Organization

Assembly level organisation: basic organisation of the Von Neumann machine, control unit, instruction fetch, decode and execution, instruction sets and types (data manipulation, control, I/O), assembly/machine language programming, instruction formats, addressing modes, subroutine call and return mechanisms' I/O and interrupts. Memory system organization and architecture; storage systems and their technology, memory hierarchy: importance of temporal and spatial locality, main memory organization and operations, latency, cycle time, bandwidth, and interleaving, cache memories (address mapping, block size, replacement and store policy). Interfacing and communication: I/O fundamentals, handshaking, buffering, programmed I/O, interrupt-driven I/O. Interrupt structures; vectored and prioritised, interrupt acknowledgement, external storage; physical organisation and drives, buses; bus protocols, arbitration, Direct Memory Access (DMA). RISC processing and parallel processing.

### CSC 206: Computer Hardware (3 credit units)

Introduction to numeric data representations such as bit, byte, hexadecimal, ASCII, signed and unsigned numbers, twos complement, binary arithmetic, overflow. Boolean algebra and switching theory, manipulation, minimization of Boolean functions, Karnaugh map. Logic gates and combinational logic circuits design using multiplexers, decoders, comparators and adders. Sequential logic circuit, shift registers, Integrated circuits and switches, diodes, PLAs PAL, LSI, FPGA, VLSI. Microprocessor, memory system; primary and secondary memories. Magnetic devices; disks, tapes, video disks, etc. Peripheral devices and operational amplifiers; analog-to-digital, digital-to-analog converters.

**Lab work**

Exposure to the use of Computer-aided design tools that process hardware and architectural representations. Circuit construction and implementation using digital trainer kit or digital design tools such as ICs, breadboard, transistors, capacitors, batteries, etc. construction of Half/full adder and subtractor, binary to gray and gray to binary converter, seven-segment decoder etc.

**CSC 301: Algorithm and Complexity Analysis (3 credit units)**

Basic algorithmic analysis: Asymptotic analysis of upper and average complexity bounds, standard complexity classes time and space tradeoffs in algorithms, analysis recursive algorithms. Algorithmic strategies. Fundamental computing algorithms: numerical algorithms, sequential and binary search algorithms, sorting algorithms, binary search trees, hash tables, graphs and its representation.

**CSC 307: System Analysis and Design (3 credit units)**

Systems level considerations, i.e., the interaction of software with its intended environment, introduction to software process models (e.g., waterfall, incremental, agile) and evaluation of software process models. Software development life cycle: conception, business case, business context, system requirements, requirements analysis, systems analysis, design, implementation, testing, deployment, maintenance and security (secure software specifications and requirements, secure software development practices). The Unified Modeling Language (UML): models, use case diagrams, activity diagrams and state chart diagrams, sequence and collaboration diagrams, class diagrams, component diagrams. Managing the process: customers, organization types, project management, teams and team dynamics, computer assisted software engineering (CASE) tools, documentation.

**Lab work**

Exposure to the use of UML and Case tools. Exercises and project on system design. Lab manuals for hand-on practice on are available.

**CSC 311: Theory of Computing**

Alphabets,Strings,operations on strings, ordering of strings. Formal languages, the universal language, operations on languages. Grammers, hierarchy of grammars. Derivations, derivation graphs. Programs, deterministic programs computations, non-deterministic programs, guessing in programs, configuration of programs. Problems, partial solvability and solvability, reducibility among problems. Regular expressions, regular languages,finite-state automata.

**CSC 313: Object Oriented Programming**

Review of Object-Oriented Programming concepts: classes, object, inheritance, polymorphism, data abstraction, tools for developing, compiling, interpreting and debugging programs. Java programs: java syntax exceptions, applets, Object Linking and Embedding (OLE), persistence, window toolkit, laboratory exercises in an OOP language.

**CSC 315: Database Design and Management (3 credit units)**
This course is designed to provide students with a basic understanding of database system technology in general, theoretical and practical knowledge of relational database systems in particular and skills to design and implement a database system. The course covers information storage and retrieval, information management applications, information capture and representation, analysis and indexing, search retrieval, information privacy, integrity, security, scalability, efficiency and effectiveness. Introduction to database systems; concepts, components of database systems, DBMS functions, database architecture and data independence and use of database query language. Types of database system, relational algebra, relational data model, data representation, conceptual, logical and physical design. Database implementation using Structural Query Languages (SQL), query processing and optimization, concept of functional & multi-valued dependencies. Introduction to database transaction management: database recovery, concurrency control and deadlock and resolutions. Introduction to Big data and NoSQL and distributed databases.

**Lab work**

Exposure to database design using computer assisted software engineering (CASE) tools, relational database Management System (RDBMS) such as Oracle, Microsoft SQL and MySQL, and learning SQL. Exposure to NoSQL DBMS such as MongoDB. Group project to design a relational database system conceptually, logically and physically and queries using SQL. Lab manuals for hand-on practice on are available.

**CSC 400: Software Project (6 credit units)**
Students should embark on work that will lead to substantial software development under the supervision of a member of staff.

**CSC 401: Software Engineering (4 Credit Unit)**
Software design: system design principles; levels of abstraction (architectural design and detailed design), separation of concerns, information hiding, coupling and cohesion, re-use of standard structures. Design paradigms such as structured design (top-down functional decomposition), object-oriented analysis and design, event driven design, component-level design, data-structured centered, aspect oriented, function oriented, service oriented. Structural and behavioral models of software designs and design patterns. Relationships between requirements and designs: transformation of models, design of contracts, invariants. Software architecture concepts and standard architectures (e.g. client-server, n-layer, transform centered, pipes-and-filters). Refactoring designs using design patterns. The use of components in design. Software construction; coding practices, standards and integration strategies. Software verification and validation concepts. Testing types, including human computer

interface, usability, reliability, security, conformance to specification. Testing fundamentals (cross-reference SDF/Development Methods), unit, integration, validation, and system testing, test plan creation and test case generation, black-box and white-box testing techniques. Software evolution and reliability.

**Lab work**

Software design Exercise and project. Lab manuals for hand-on practice on are available.

**CSC 402: Human Computer Interaction (2 credit units)**

The course is designed to provide students with the knowledge and skills needed to create highly usable software systems. The course covers relevance and context of HCI, interaction models and basics of human variance, usability engineering and user-centred design, User profiles and personas, cognitive and task modelling, dialogue analysis and design. Use of standard APIs for the construction of UIs and display of standard media formats. Designing interactions; principles of graphical user interfaces (GUIs), elements of visual design (layout, color, fonts, labeling), task analysis, including qualitative aspects of generating task analytic models, low-fidelity (paper) prototyping, quantitative evaluation techniques, e.g., keystroke-level evaluation, help and documentation, handling human/system failure, user interface standards.

**CSC 403: Net-Centric Computing (3 credit units)**

Computing models: client/server computing, distributed and parallel computing; Definitions, Distributed Systems, Motivation; Communication Mechanisms: Communication Protocols, RPC, RMI, Stream Oriented Communication; Synchronization: Global State, Election, Distributed Mutual Exclusion, Distributed Transactions and Grid Computing. Cloud Computing; definition, service models, deployment models, characteristics, architecture, major platforms and emerging trends. Introduction to building web applications. Web programming: design, build, and test front-end web pages using HTML5, CSS, JavaScript and adding multimedia contents (images, audio and video). Server-side development using scripting languages, dynamic web design, working with databases, sessions, and cookies. Introduction to web application development using framework and content management systems.

**Lab work**

Exposure to front-end web application development using such as HTML5, CSS 3 and JavaScript and multimedia contents. Exposure to web programming using AJAX; Server-side web development using server-side scripting such as ASP, PHP and database systems such as Microsoft SQL and MySQL. Exposure to the use of Bootstrap, Content Management Systems (Drupal, WordPress, Joomla), PHP (e.g., Laravel) and Java (e.g., Spring) frameworks such as CodeIgniter, Laravel and Spring.

**CSC 404: Data Communication and Networks (3 credit units)**
Introduction, wares, Fourier analysis, measure of communication, channel characteristics, transmission media, noise and distortion, modulation and demodulation, multiplexing, TDM, FDM and FCM, parallel and serial transmission (synchronous versus asynchronous). Data transmission media and techniques: cabled and wireless systems. Circuit switching, Packet Switching. Computer networks, Topology: Tree, Bus, Star, Ring and Hybrid. Intra-nets and Extra-nets Technology. Physical pieces of a network, including hosts, routers, switches, ISPs, wireless, LAN, access point, and firewalls. Computer Network Architecture: Open System Interconnection (OSI) layered architecture: Application layer: DNS, SMTP, FTP, WWW, socket programming, Session, Transport layer: TCP and UDP, congestion control; Network layer: internetworking, addressing and routing algorithms and protocols; Data link layer: framing, flow and error control protocols, PPP and MAC; Physical layer. Routing, principles of cellular networks, 802.11 networks, issues in supporting mobile nodes. Introduction to programming using sockets.

**Lab work**

Exposure to network devices and socket programming, switch and router configuration. Develop simple network and configure various servers such as DHCP and DNS. Configuring IIS and Apache Servers on Windows Linux platforms respectively. Develop client/server network applications using sockets. Using packet capture, network monitoring and analysis tools, using network commands and measure network utilization. Lab manuals for hand-on practice on are available.

**CSC 405: Organization of Programming Languages (3 credit units)**
Language definition structure. Data types and structures, review of basic types including lists and trees control structure and data flow, run-time consideration, interpretative languages, lexical analysis and parsing. Programming language concepts, syntax and semantics, grammars, Backus Naur form, parsing, regular expressions and their relationship to state diagrams. Lexical analysis, tokens, more regular expressions and transition networks.

**CSC 408: Computer System Performance and Evaluation**
Introduction, Computer System performance measurement techniques, simulation techniques; techniques, workload characterization, performance evaluation in selection problems, performance evaluation in design problems, evaluation of programme performance. Parallel performance, parallelization strategies. Super computers and multi core GPU computers. HPC programming and program optimization. Application of high-performance computing to scientific and engineering problems.

**CSC 412: Artificial Intelligence (3 credit units)**

Introduction to artificial intelligence. Fundamental Issues; AI problems, agents and environments, structure of agents, problem solving agents. Basic search strategies; problem spaces, uninformed search (Breadth-First, Depth-First Search, Depth-first with Iterative Deepening), Heuristic Search (Hill Climbing, Generic Best-First, A*), Constraint Satisfaction (Backtracking, Local Search). Basic knowledge representation and reasoning; propositional logic, First-Order Logic, Forward Chaining and Backward Chaining, Introduction to probabilistic reasoning, Bayes theorem. Machine learning; forms of learning, decision trees, nearest neighbor algorithm, statistical-based learning such as Naïve Bayesian Classifier. Expert systems; architectures and implementation, tools for developing expert system, neural networks and genetics algorithm. Introduction of mobile agent system, natural language understanding and robotics. Lisp programming.

**Lab work**

Exposure to the use of Python to solve using machine learning and natural language processing techniques.

**CSC 413: Computer Graphics (3 credit units)**

Hardware aspect, plotters microfilm, plotters display, graphic tables, light pens, other graphical input aids, facsimile and its problems, refresh display huggers, changing images, light pen interaction. Two- and three-dimensional transformation, perspective clipping algorithms. Hidden line removal bolded surface removal. Warnock's method, shading, data reduction for graphical input. Introduction to hand writing and character recognition. Curve synthesis and fitting. Contouring. Ring structures versus doubly linked lists. Hierarchical structures. Data structure: organization for interceptive graphics.

**CSC 415: Computer Modeling and Simulation (3 credit units)**

Basic definitions and uses, simulation process, some basic statistic, distribution theory, model and simulation. Queues: basic components, Kendal notation, queuing rules, little's law, queuing networks, special types of queues. Stochastic processes: discrete state and continuous state processes, Markova processes, birth-death processes, poison processes. Random numbers, types of random number exercises.

**CSC 416: Information Technology Law (3 credit units)**

Data protection act, freedom of information act (FOI), computer misuse act, intellectual property rights, ICT contract law, privacy and information rights, copyrights, patents, trade secrets, trademarks, plagiarism, software piracy, domain names, protection of computer imagers and icons. Data protection law, freedom of movement of personal data, legal foundations of privacy protection, privacy in telecommunication, privacy implications of widespread data collection for transactional databases, data warehouses, surveillance systems and cloud computing. Security policies and laws for cyber and computer crimes; fraud, computer misuse, malicious software; threatening emails; misuse of access, identity theft, etc. Nigeria Cyber Crime Act 2015, National Cyber Security Policy and Strategy 2021 and other reginal and global Information Technology laws.

**CSC 417: Project Management (3 credit units)**
Team management, project scheduling, software measurement and estimation techniques, risk analysis, software quality assurance, project monitoring and control, project audits, project closure, peer review, stress testing, quality planning, defect estimation and quality assurance, project management methods and tools. Software configuration management and project management tools. Creating a project plan for a distributed application, and engage in a project to improve project management capabilities of students.

**CSC 423: Compiler Construction (3 credit units)**
Review of compilers assemblers and interpreters, structure and functional aspects of a typical compiler, syntax semantics and pragmatics, functional relationship between lexical analysis, expression analysis and code generation. Error detection and recovery. Grammars and Languages: recognizers, Top-down and bottom-up language Run-time storage Organization, The use of display in run-time storage Organization. The use of display in run time storage allocation. LR grammars and analysis. Construction of LR table. Organization of symbol tablets. Allocation of storage to run-time variables. Code generation. Optimization/Translator with systems.