V e r i t a s U n i v e r s i t y , A b u j a
(The Catholic University of Nigeria)
Bwari Area Council, FCT
Website: http://www.veritas.edu.ng

DEPARTMENT OF COMPUTER AND INFORMATION TECHNOLOGY
COLLEGE OF NATURAL AND APPLIED SCIENCES

BSc COMPUTER SCIENCE REVISED CURRICULUM 2018

COURSE STRUCTURE AND SYNOPSES OF BSc COMPUTER SCIENCE PROGRAMME

1.0 PHILOSOPHY, AIMS AND OBJECTIVES OF THE BSC. COMPUTER SCIENCE DEGREE

The aims and objectives of Bachelors honours degree programme in Computer Science include:

i. Create in students the awareness of and enthusiasm for computer science and its capabilities;
ii. Involve the students in an intellectually stimulating and satisfying experience of learning and studying;
iii. Provide a broad and balanced foundation in computer science knowledge and practical skills;
iv. Develop in students through an education in computer science a range of transferable applicable skills of information technology to all aspects of human endeavours;
v. Generate in students an appreciation of the importance of computer in an industrial, economic, technological and social context; and
vi. Provide students with knowledge and skills base for further studies in computer science or multi-disciplinary studies involving computer science.

2.0 LEARNING OUTCOMES

i. **Regime of Subject Knowledge:** It is expected that students are conversant with core areas of computer science.
ii. **Competencies and Skills:** Students are expected to develop a wide range of different abilities, dynamism, and skills. These may be divided into three categories, viz: cognitive abilities and skills, practical skills, and general skills.
iii. **Behavioural Attitudes:** General skills relating to non-subject specific competencies, communication, interpersonal, and organizational skills.

3.0 ATTAINMENT LEVELS

Graduates of Computer Science are expected to have the ability to apply knowledge and skills to solving theoretical and practical problems in Computer Science, development of relevant ICT for national development and societal needs.

4.0 COURSE STRUCTURE

100 LEVEL

FIRST SEMESTER

S/N	Course Code	Course Title	Units	Status	LH	PH
1	CSC101	Introduction to Computer Science	3	C	30	45
2	CSC 103	Introduction to Information Systems I	3	R	30	45
3	CHM101	General Chemistry I	2	R	30	-
4	MTH101	General Mathematics I	3	R	45	-
5	PHY101	General Physics I	2	R	30	-
6	PHY107	Experimental Physics I	1	R	-	45
7	GES111	Communication in English I	2	C	30	-
8	GES 113	Nigerian Peoples and Culture	2	R	30	-
9	GES 115	History and Philosophy of Science	2	R	30	-
10	GES 121	Use of Library, Study Skills and ICT	2	R	30	-
11	*** ***	Elective	2	E		
12	Total		24			

ELECTIVES

S/N	Course Code	Course Title	Units	Status	LH	PH
1	BIO 101	General Biology I	2	E	30	-
2	PHY 181	Heat and Geometrical Optics	2	E	30	
3	CSC 105	Intro to Bioinformatics & Comp. Biology I	2	E	30	45
4	CSC 107	Introduction to Software Requirements I	2	E	30	45

SECOND SEMESTER

S/N	Course Code	Course Title	Units	Status	LH	PH
1	CSC 102	Introduction to Problem Solving	2	C	30	45
2	CSC 110	Human-Computer Interaction I	2	R	30	45
3	MTH 102	General Mathematics II	3	R	45	-
4	MTH 172	Statistics for Physical Sciences	2	R	30	-
5	PHY 102	General Physics II	2	R	30	-
6	PHY 108	Experimental Physics II	1	R	-	45
7	GES 112	Communication in English II	2	C	30	-
8	GES 122	Logic, Philosophy and Human Existence	2	R	30	-
9	GES 124	Communication in French	2	R	30	-
10	GES 142	Community Service	1	R	-	30
11	THG 172	Introduction to Church History	2	R	30	-
12	*** ***	Elective	2	E		
	Total		23			

ELECTIVES

S/N	Course Code	Course Title	Units	Status	LH	PH
1	MTH 104	General Mathematics III	2	E	30	-
2	CSC 104	Introduction to Information Systems II	2	E	30	45
3	CSC 106	Intro to Bioinformatics & Comp. Biology II	2	E	30	45
4	CSC 108	Introduction to Software Requirements II	2	E	30	45

200 LEVEL

FIRST SEMESTER

S/N	Course Code	Course Title	Units	Status	LH	PH
1	CSC 201	Computer Programming I	2	C	30	45
2	CSC 203	Operating Systems I	2	C	30	45
3	CSC 209	Computer Architecture and Organization I	2	R	30	-
4	CSC 215	Software Engineering I	2	R	30	45
5	CSC 219	Artificial Intelligence	2	E	30	45
6	MTH 201	Mathematical Methods I	2	R	30	45
7	PHY 201	Electric Circuits and Introductory Electronics	3	R	30	45
8	GES 222	Peace and Conflict Resolution	2	R	30	-
9	GES 223	Entrepreneurship and Innovation	2	R	30	45
10	THG 211	Basic Spiritual Theology	1	R	30	-
11	*** ***	Elective	2	E		
	Total		22			

ELECTIVES

S/N	Course Code	Course Title	Units	Status	LH	PH
1	STA 214	Stochastic Processes	2	E	30	-
1	MTH	Linear Algebra	2	E	30	-
2	PHY 201	General Physics III	2	E	30	-
3	CSC 205	Human-Computer Interaction II	2	E	30	45
4	CSC 207	Natural Language Processing I	2	E	30	45
5	CSC 211	Image Processing and Computer Vision	2	E	30	45
6	CSC 213	Introduction to Machine Learning I	2	E	30	45
7	CSC 217	Data Science and Big Data I	2	E	30	45
8	CSC 221	Data Mining I	2	E	30	45
9	CSC 241	Info Technology: Design, Policy & Applications	2	E	30	

SECOND SEMESTER

S/N	Course Code	Course Title	Units	Status	LH	PH
1	CSC 202	Computer Programming II	2	C	30	45
2	CSC 204	Operating Systems II	2	C	30	-
3	CSC 206	Fundamentals of Data Structures	2	R	30	45
4	CSC 208	Introduction to Database Systems I	2	C	30	45
5	CSC 210	Foundation of Sequential Program	2	R	30	45
6	CSC 212	Computer Hardware	2	R	30	45

7	CSC 214	Computer Architecture and Organization II	2	R	30	-
8	MTH	Mathematical Methods II	2	R	30	-
9	GES 212	Business Creation and Growth	2	R	30	-
10	THG 272	Social Teachings of the Church	2	R	30	-
11	CSC ***	Elective	2	E		
	Total		22			

ELRCTIVES

S/N	Course Code	Course Title	Units	Status	LH	PH
1	CSC 208	Natural Language Processing II	2	E	30	45
2	CSC 214	Introduction to Machine Learning II	2	E	30	45
3	CSC 216	Software Engineering II	2	E	30	45
4	CSC 218	Data Science and Big Data II	2	E	30	45
5	CSC 222	Data Mining II	2	E	30	45

300 LEVEL

FIRST SEMESTER

S/N	Course Code	Course Title	Units	Status	LH	PH
1	CSC 301	Structured Programming	2	C	30	45
2	CSC 303	Object-Oriented Programming	2	C	30	45
3	CSC 307	Discrete Structures	2	R	30	-
4	CSC 311	Algorithms and Complexity Analysis	2	R	30	-
5	CSC 315	Compiler Construction I	2	R	30	-
6	CSC 321	Systems Analysis and Design	2	R	30	45
7	CSC 333	Computational Science and Numerical Methods	2	R	30	-
8	CSC 335	Survey of Programming Languages	2	C	30	45
10	CSC 3**	Elective	2	E		
	Total		18			

ELECTIVES

S/N	Course Code	Course Title	Units	Status	LH	PH
1	CSC 313	Enterprise Application Development	2	E	30	45
2	CSC 317	Mobile Application Development	2	E	30	45
3	CSC 319	Games Application Development	2	E	30	45
4	CSC 323	Virtual and Augmented Reality	2	E	30	45
5	CSC 325	Introduction to Embedded Systems	2	E	30	45
6	CSC 327	Introduction to Assistive Technologies	2	E	30	45

SECOND SEMESTER

S/N	Course Code	Course Title	Units	Status	LH	PH
1	CSC 390	Students' Industrial Work Experience Scheme	6	C		
2	Total		6			

400 LEVEL

FIRST SEMESTER

S/N	Course Code	Course Title	Units	Status	LH	PH
1	CSC 403	Introduction to Database Systems II	2	C	30	45
2	CSC 411	Research Methods	2	R	30	-
3	CSC 415	Compiler Construction II	2	C	30	-
4	CSC 421	Net-Centric Computing	2	R	30	-
5	CSC 423	Computer Networks and Communication I	2	C	30	45
6	CSC 431	Distributed Computing Systems	2	R	30	45
7	CSC 481	Research Seminar	1	R		
8	CSC 4**	Elective	2	E		
	Total		15			

ELECTIVES

S/N	Course Code	Course Title	Units	Status	LH	PH
1	CSC 409	Modelling and Simulation	2	E	30	45
2	CSC 435	Optimization Techniques	2	E	30	45
3	CSC 439	Introduction to Robotics	2	E	30	45
4	CSC 443	Open Source Software Development	2	E	30	45
5	CSC 451	Formal Models of Computation	2	E	30	45
6	CSC 491	Special Topics in Computer Science	2	E	30	45
7	CSC 495	Web Engineering	2	E	30	45

SECOND SEMESTER

S/N	Course Code	Course Title	Units	Status	LH	PH
1	CSC 402	Organization of Programming Languages	2	R	30	-
2	CSC 422	Software Project Management	2	R	30	45
3	CSC 432	Computer Graphics and Visualization	2	R	30	45
4	CSC 442	Human Computer Interface	2	R	30	45
5	CSC 490	Project	6	C		
6	CSC 4**	Elective	2	E		
	Total		16			

ELECTIVES

S/N	Course Code	Course Title	Units	Status	LH	PH
1	CSC 408	Queuing Systems Performance Evaluation	2	E	30	-
2	CSC 410	Computer System Performance Evaluation	2	E	30	-
3	CSC 416	Intelligent Systems	2	E	30	45
4	CSC 424	Computer Networks and Communication II	2	E	30	45
5	CSC 462	Information Technology Law	2	E	30	-

Note: E = Elective; C = Compulsory; R = Required; LH = Lecture Hours; PH = Practical Hours

5.0 COURSE SYNOPSES:

100 LEVEL

100 LEVEL: FIRST SEMESTER

CSC 101: Introduction to Computer Science (Units: 3, LH 30, PH 45)
Survey of computer and information processing and their roles in society;this course introduces a historical perspective of computing: hardware, software, information systems, and human resources and explores their integration and application in business and other segments of society. Students will be required to complete lab assignments using the PC's operating system, and several commonly used applications, such as word processors, spread sheets, presentations, graphics and other applications. Internet and online resources, browsers, and search engines.

CSC 103: Introduction to Information Systems I (Units: 3, LH 30, PH 45)
Information systems concepts: information and data, capture of data, storage processing and display, information systems in organizations, the use of information by organizations to conduct business and solve problems. Information systems principles and how they form an integral part of modern organizations; systems concepts; organizational processes; technological aspects of information systems; the Internet; information technology security and ethical issues; database management; and systems development lifecycle; the digital economy, introduction to systems ideas and their application to information handling activities, the sociotechnical character of information systems; Information systems within organizations: the role and functions of information systems within organizations including providing management information, supporting e-commerce, supporting knowledge work and undertaking transaction processing, use of information by various types of people and as applied to various tasks, new models of organizing, information systems management roles and structures.Types of information systems

CHM 101: General Chemistry I (Units: 2, LH 30)
Atoms, molecules and chemical reactions.Modern electronic theory of atoms. Electronic configuration, periodicity and building up of the periodic table. Hybridisation and shapes of simple molecules.Valence Forces; Structure of solids.Chemical equations and stoichiometry; Chemical bonding and intermolecular forces, kinetic theory of matter.Elementary thermochemistry; rates of reaction, equilibrium and thermodynamics.Acids, bases, and salts.Properties of gases.Redox reactions and introduction to electrochemistry.Radioactivity.

MTH 101: General Mathematics I (Units: 3, LH 45)
(Algebra and Trigonometry)
Elementary set theory, subset, union, intersection, compliments, Venn diagrams. Real numbers, integers, rational and irrational numbers. Mathematics induction, real sequences, and series, theory of Quadratic equations, Binomial theorem, complex numbers, algebra of complex numbers, the Argand diagram. De-Moire's theorem, nth roots of unity. Circular measure, trigonometric functions of angles of any magnitude, addition and factor formulae.

PHY 101: General Physics I (Units: 2, LH: 30)
(Mechanics, Thermal Physics and Waves)
Space and Time, Units and Dimension, Kinematics; Fundamental Laws of Mechanics, statics and dynamics; work and energy; Conservation laws. Moments and energy of rotation; simple harmonic motion; motion of simple systems; Elasticity; Hook's law, Young's shear and bulk moduli, Hydrostatics; Pressure; buoyance, Archimedes' Principles; Surface tension; adhesion, cohesion, capillarity, drops and bubbles; Temperature; heat; gas laws; laws of thermodynamics; kinetic theory of gases; Sound. Types and properties of waves as applied to sound and light energies. Superposition of waves. Propagation of sound in gases, solids and liquids and their properties. The unified spectra analysis of waves. Applications.

PHY 107: Experimental Physics I (Unit: 1, PH 45)
This introductory course emphasizes quantitative measurements, the treatment of measurement errors, and graphical analysis. A variety of experimental techniques will be employed. The experiments include studies of meters, the oscilloscope, mechanical systems, electrical and mechanical resonant systems, light, heat, viscosity, etc., covered in PHY 101 and PHY 102. However, emphasis should be placed on the basic physical techniques for observation, measurements, data collection, analysis and deduction.

GES 111: Communication in English I (Units: 2, LH 30)
Study skills and methods including use of language and use of the library. Listening, comprehension skills; Reading skills; Using grammar in reading and writing; Writing skills; Examination techniques.

GES 113: Nigerian Peoples and Culture (Units: 2, LH 30)
The concepts of culture; Pre-colonial cultures and languages of Nigeria; Principles of kinship, descent and marriage in Nigerian cultures; Nigerian economic institutions; Nigerian political institutions; Education and development in Nigeria; Religion in Nigerian culture; Culture, environment and health practices in Nigeria.

GES 115: History and Philosophy of Science (Units: 2, LH 30)
Scientific evolution of man: the history of science; classification; scientific methods. Science and the environment: terrestrial and cosmic life; ecology and types of habitat; climate and vegetation; Energy resources: fossil fuels, nuclear energy and renewable energy resources; the Nigerian energy reserves. Characteristics of living things; cell and tissue biology, biochemistry and cellular metabolism, taxonomy of living things; heredity and evolution: Technology and technological evolution; Engineering technology and socio-economic development of Nigeria; the effect of adequate and stable electric power supply and satellite communication technology on the technological development of Nigeria; political and other constraints. The interaction between science and technology: Social implications of advances in science and technology: automated industrial plants; satellite technology; space technology; genetic engineering technology; weapons of mass destruction (WMD), and environmental pollution.

GES 121: Use of Library, Study Skills and Info & Comm. Technology (Units: 2, LH 30)
Brief history of libraries; library and education, university libraries and other types of libraries; types of library materials, using library resources including e-learning, e-materials, etc. understanding library catalogues (card, OPAC, etc.) and classification; copyrights and its implications, database

resources, bibliographic citations and referencing; Study skills. Development of modern ICT, hardware technology, software technology, input devices, storage devices, output devices, communication and internet services, word processing skills (typing, etc.); Hands on practice using Microsoft Word Excel and Power Point.

ELECTIVES

BIO 101: General Biology I (Units: 2, LH 30)
Origin of life and influence of living things on the chemistry of the Earth. Essentials of life, including sources and use of energy, responsiveness to natural selection and cellularity. Cell structure and organization, functions of cellular organelles, diversity, characteristics and classification of living things, general reproduction, interrelationship of organisms; heredity and evolution, elements of ecology and types of habitat.

PHY 181: Heat and Geometrical Optics (Units: 2, LH 30)
Heat and Energy: Temperature and thermal equilibrium; specific heat of solids, liquids, and gases; latent heat, gas laws, ideal and real gases; Isothermal and adiabatic processes; Heat transfer, energy spectrum; Geometrical Optics: Law of reflections and refraction, location of images, plane and curved mirrors; Converging and diverging thin lenses and combinations; Optical Instruments: the human eyes and aberrations; Dispersion, interference and polarization of light; Photometry, sound waves, Doppler effects and other properties of sound waves.

CSC 105: Introduction to Bioinformatics& Computational Biology I(Units: 2, LH 30, PH 45)
Introduction to the principles of bioinformatics and computational biology, introduction to information networks and bioinformatics tools on the internet, bioinformatics database designs, mining bioinformatics data, Basic molecular biology, techniques in bioinformatics, algorithms for structure prediction and similarity..

CSC 107: Introduction to Software Requirements I (Units: 2, LH 30, PH 45)
Introduction to Requirements Engineering: Process Improvement; Requirements documents; Requirements Engineering Processes; Description of software requirements engineering and its processes; Requirements elicitation; requirements prioritization; Requirements Development: Establishing the product vision and project scope, Finding and hearing the voice of the customer, Understanding user requirements, Documenting requirements.

100 LEVEL: SECOND SEMESTER

CSC 102: Introduction to Problem Solving (Units: 2, LH 30, PH 45)
Role of algorithms in problem solving process, concepts and properties of Algorithms. Implementation strategies, Development of Flow Charts, Pseudo Codes, Program objects. Implementation of Algorithms in a programming language – Visual Basic/Java/C/C++.

CSC 210: Human-Computer Interaction I (Units: 2, LH 30, PH 45)
Human-computer interaction, applied ergonomics; usability: models, methods and metrics; usability dimensions, concept of experience, user experience, aspects of user experience, instrumental & non-

instrumental UX qualities, interaction design, user-centred design, design heuristics, principles and guidelines; pragmatic, aesthetic, affective, and hedonic designs; software technology adoption.

MTH 102: General Mathematics II (Units: 3, LH 45) This is an introductory course on calculus. The topics include Functions of real variables, graphs, limits and continuity; the derivative as a limit of rate of change; Techniques of differentiation. The straight line, parallel and perpendicular lines, angle between two straight lines, the distance between points from a line, parametric equations, tangents and normal. Curve sketching; Rules of differentiation, maxima and minima, integration as an inverse of differentiation, Integration as a limit of a sum, areas under a curve, volumes.

MTH 172: Statistics for Physical Sciences (Units: 2, LH 30)
Nature and scope of statistics; populations and samples; Tabulation of data: frequency table, discrete and grouped data frequency polygon. Curve and ogive, measures of location: Mean median, mode, deviation, standard deviation, quartiles, deciles scatter diagrams, fitting of straight lines, linear regression, correlation coefficient, rank correlation coefficient, measures of skewness, simple concept of probability. Introduction to random variable (discrete and continuous)

PHY 102: General Physics II (Units: 2, LH 30)
(Electricity, Magnetism and Modern Physics)
Electrostatics; conductors and currents; dielectrics; magnetic fields and induction; Maxwell's equations; electromagnetic oscillations and waves; Applications

PHY 108: Experimental Physics II (Unit: 1, PH 45)
The experiments covered in this course will mainly be drawn from topics covered in General Physics II. They include verification of laws of current electricity, measurement of electrical properties of conductors, d. c. and a. c. circuit properties, series and parallel connections, resonant circuits, transformer characteristics and other electrical circuit problems

GES 112: Communication in English II (Units:2, LH 30)
This is a continuation of GES1011 (English and Communication Skills 1) which introduced students to the rudiments of English for academic purposes with emphasis on study skills and reading comprehension. The focus of this course is academic writing and use of library skills. Broadly, the course covers the use of English for academic discourse, use of library skills as well as library resources to support academic research writing. The use of English component seeks to equip students with the linguistic conventions and skills suitable for academic writing. The use of library segment seeks to expose students to various sources of information; equip students with information location, retrieval and utilization skills appropriate for constructive, creative and critical academic tasks in order to train independent learners who should take responsibility for their own learning.

GES 122: Logic, Philosophy and Human Existence (Units: 2, LH 30)
The nature, definition and branches of Philosophy; Philosophy and other disciplines; Nature of philosophical problems; Periods in the history of Philosophy: Philosophy and national development; national ideology and patriotism. Types of argument and reasoning: Symbolic logic. Inferences and bi-conditional: Qualification theory.

GES 124: Communication in French (Units: 2, LH 30)
Introduction to French, Alphabets and Numeracy for effective communication (written oral). Conjugation and simple sentence construction based on communication approach, sentence construction, comprehension and reading of simple texts.

GES 142: Community Service (Units: 2, LH 30)
Civil works beneficial to the University community and its environs including but not limited to farming, road building and maintenance, landscaping, planting of flowers and hedges, grass-cutting and general cleaning of campus and its environs, concreting and laying of seating and footpath slabs, etc.

THG 172: Introduction to Church History (Units: 2, LH 30)
Ancient Church history comprises the patristic period often taken to be the period from the closing of the NT writings circa; 100 to the council of Chalcedon, in 451. The course is design to highlight the importance of this period to theological scholarship, doctrinal development and ecumenical studies. Medieval Church History covers the Middle age period which gave birth to scholasticism and humanism. These two are important to any attempt to understand the development of history of theology in this period and the religious and intellectual factors that led to the Reformation. This is a period between the Dark Ages and the 16th Century however the Reformation and Counter Reformation period is purposely included in order to bring the period of its logical conclusion to the contemporary era and the Second Vatican Council.

ELECTIVES

MTH 104: Elementary Mathematics III (Units: 2, LH 30)
(Vectors, Geometry and Dynamics)
Geometric representation of vectors in 1-3 dimensions, components, direction cosines; addition; scalar, multiplication of vectors, linear independence, scalar and vector products of two vectors; differentiation and integration of vectors with respect to a scalar variable; two-dimensional co-ordinate geometry; straight lines, circles, parabola, ellipse, hyperbola, tangents, normal, impact of two smooth sphere, and of a sphere on a smooth sphere.

CSC 104: Introduction to Information Systems II (Units: 2, LH 30, PH 45)
Information and communication technologies: introduction to computer hardware and software, communications technologies and networks, the internet, data storage systems, files and databases, cloud computing, operating systems, applications packages and user written programmes, open source software, social networking; Systems development: information systems development approaches: life cycle, prototyping, incremental models, systems analysis tasks, methodologies, modeling and agile methods, data modeling, system implementation, professional roles in systems development, criteria for successful applications development, systems implementation and the management of change; Managing information systems; Practical: design and implementation of simple information systems. Introduction to a programming language

CSC 106: Introduction to Bioinformatics & Computational Biology II (Units 2, LH 30, PH 45)
Pairwise and multiple sequence alignments using packages such as BLAST, Clustal W, Perl Language for bioinformatics programming, Sequence similarity and alignment, Phylogenetics, Phylogenic trees,

comparative genomics and proteomics, expression analysis, database searching, artificial life, Protein structure, RNA secondary structure and prediction, Gene prediction, Microarrays, Mass spectrometry, Hidden Markov models, L systems, Information theory in natural computing, biological computation.

CSC 108: Introduction to Software Requirements II (Units: 2, LH 30, PH 45)
Verifying and Validating the requirements, Special requirements development challenges; Requirements Management: Requirements Management principles and practices; Change happens, Links in the requirements chain, Tools for requirements management; Tools and Techniques for Requirement Engineering: Structured Systems Analysis and Design Method, IEEE Software Engineering Standards, Object-oriented methodology, Unified Modelling Language, Agile Methods; Ambiguity in Stating Requirement, ambiguity and specificity; Sources of Ambiguity; Pitfalls and best practices for requirements engineering.

200 LEVEL

200 LEVEL: FIRST SEMESTER

CSC 201: Computer Programming I (Units: 3, LH 30, PH 45)
Introduction to problem solving methods and algorithm development, designing, coding, debugging and documenting programmes using techniques of a good programming language style, programming language and programming algorithm development. A widely used programming language should be used in teaching the above.

CSC 203: Operating Systems I (Units: 2, LH 30, PH 45)
Overview of O/S: Role & Purpose, Functionality Mechanisms to Support Client-server models, hand-held devices, Design Issues, Influences of Security, networking, multimedia, Windows, O/S Principles: Structuring methods, Abstraction, processes of resources, Concept of APIs, Device organization, Interrupts.

CSC 209: Computer Architecture and Organization I (Units: 2, LH 30)
Fundamental building blocks, logic expression, immunization,sum of product forms. Register transfer notation, Physical considerations. Data representation, and number bases, Fixed and Floating point systems, representation memory systems organization and architecture.

CSC 215: Software Engineering I (Units 2, LH 30, PH 45)
Agile Software Development:Introduction: Introduction and overview of various agile methods, such as eXtreme Programming (XP), Scrum, Feature-Driven Development, and Agile; Agile Development using XP: XP practices and tools. Test driven development (TDD); Tools and frameworks for testing and mocking, Pair Programming. Agile Development using Scrum: Scrum practices and tools, Continuous integration, Using ad extending frameworks, such as Spring, Refactoring, Comparisons of iterative development and architecture-centric/design-driven development methods, Maximizing reusability, extendibility, maintainability. Agile development using a dynamic language: Strengths and weakness of using dynamic languages in agile software development, Importance of TDD in software development using dynamic languages, Test coverage monitoring, Improving performance and quality. Introduction to Software Design: Elements of Software architecture, Fundamentals of Design Patterns, Object Oriented analysis & Design, Design for re-use. Using APIS: API programming Class

browsers and related tools, Introduction to Component-based computing; Software tools and Environment: Requirements analysis and design modeling Tools, Testing tools, Tool integration mech.

CSC 219: Artificial Intelligence I (Units: 2, LH 30,PH 45)
Introduction to artificial intelligence, understanding natural languages, knowledge representation, expert systems, pattern recognition, the language LISP, Prolog.

MTH 201: Mathematical Methods I (Units: 2, LH 30, PH 45)
Real-value functions of a real variable. Review of differentiation, integration, and their applications; Mean-value theorem; Taylor series; Real-valued functions of two and three variables, implicit functions; Partial derivatives, Chain rule, extrema, Lagrange multipliers, increments, differentials and linear approximations. Coordinate transformations; Evaluation of line and multiple integrals.

PHY 201: Electric Circuits and Introductory Electronics (Units: 3, LH 30, PH 45)
D.C. Circuits; Kirchoff's Laws, sources of end and current, network analysis and circuit theorems. A.C. Circuits. Inductance, capacitance, the transformer, sinusoidal wave-forms run and peak values, power, impedance and admittance series, RLC circuit, Q factor, resonance, Network analysis and circuit theorems, filters. Electronics; semiconductors, the pn-junction, field effect transistors, bipolar transistors, Characteristics and equivalent circuits, amplifiers, feedback, oscillators.

GES 222: Peace and Conflict Resolution (Units: 2, LH 30)
Basic concepts in peace studies and conflict resolution. Peace as vehicle of unity and development, conflict issues, types of conflicts e.g. ethnic/religious/political/economic conflicts. Root causes of conflict and violence in Africa, elements of peace studies and conflict resolution, developing a culture of peace, peace meditation and peace keeping, alternative dispute Resolution, dialogue/Arbitration in conflict resolution, role of international organizations in conflict resolution, example ECOWAS, African Union, United Nations.

GES 223: Entrepreneurship and Innovation (Units: 2, LH 30, PH 45)
The focus of the two-semester course on entrepreneurship—Entrepreneurship Studies I and II—is on examining entrepreneurship theories and fostering the practice of entrepreneurship among student participants leading to self-employment and job creation after graduation. In this first segment of the course, the students learn conceptually about being an entrepreneur in Nigeria. The first half of the semester will be devoted to studying the following topics: basic concepts of entrepreneurship, business risks and profits, historical role of entrepreneurship in industrial and socioeconomic development of the society, entrepreneurship theories, and types of entrepreneurs. Others are the personal and interpersonal characteristics and behavioural traits of entrepreneurs, personal traits required for successful performance as an entrepreneur, entrepreneurship role demands, and the problem of succession in entrepreneurial enterprises. The second half of the semester will focus on learning how to conduct a market survey and consumer research for identifying and evaluating new business opportunities, setting up a business organization, and keeping of basic business/accounting records, developing a business plan, and identifying sources of financing. The problems of financing and managing growth in entrepreneurial firms will be discussed.

THG 211: Basic Spiritual Theology **(Unit: 1, LH 30)**

The course aims to lead the students into the nature of the spiritual life in a way that gives meaning and purpose to the spiritual exercises they perform. It studies the nature of theology as a systematic reflection on the meaning and content of Christian revelation and faith; various theological disciplines and their interconnectedness; meaning of spirituality; different aspect of spirituality- Biblical, Liturgical, Pastoral and African; rise and development of monasticism and modern Spirituality; Since theology does not restrict itself to spiritual matters alone but concerns itself with the entire human well being, the course therefore with reference to the social teaching of the Church as also pastor of the material well being of the human persons, with special emphasis on human dignity and rights. Overview of the history of Christian spirituality; Christian virtues and universal application of charity, chastity, poverty and obedience, spiritual retreats.

ELECTIVES

STA 214: Stochastic Processes **(Units: 2, LH 30)**

Introductory probability; General functions: tail probabilities and convolutions; Recurrent events; Random walk (unrestricted and restricted); Gamblers ruin problem; Markov processes in discrete and continuous time; Poisson, branching, birth and death processes; Queuing processes: M/M/I, M/M/s, M/a/I queues and their waiting time distributions

MTH: Linear Algebra **(Units: 2, LH 30)**

Vector spaces: Linear equations and matrices, Systems of equations, linear mappings, determinants, Eigen-values and eigenvectors, minimum and characteristic polynomials of a linear transformation; Eigen-systems, unitary and similarity transformations, Cayley-Hamilton theorem, bilinear and quadratic forms and variational principles, orthogonal diagonalisation, Canonical forms; linear programming.

PHY 201:General Physics III **(Units: 2, LH 30)**
(Elementary Modern Physics)

Special Relativity; Defect in Newtonian Mechanics; the Speed od Light; the Lorentz transformation; transformation of Velocities; Experimental basis of Quantum Theory: Black body radiation; electron and quanta; Bohr's theory of atomic structure; De Broglie hypothesis the uncertainty principle; Schrodinger's equation and simple applications; Compton effect; thermionic emission; radioactivity; measurement and detection of charged particles (including the treatment of detectors); x-rays: nature and spectra.

CSC 205: Human-Computer Interaction II **(Units 2, LH 30, PH 45)**

Information Architecture: History and definition of Information Architecture (IA); Types of Information Architecture; User-Centred Design; Information Architecture Models and case studies; Information Architecture Problem Solving; Information Design; Information Architecture Development Process; Professional Practice (working as an information architect). Visual Design: Introduction to Visual Design. Design Theory;Information Design, Colour, Visual Perception Theory. Colour symbolism, meaning, and cultural variation; Colour Theory; Typography and Typographical Elements; the Design Process; Symbolism; Collage: Collage; Photomontage; Assemblage; Digital collage/e-Collage; Influence of movements. Visual Identity and Branding: Visual branding; Visual identity; Logo design. UI, UX, and Design for the Web. Information Visualization: Introduction to

information visualization; History of information visualization; Visual perception, colour, and narrative; Cognition and visual perception, the aesthetics of visual media; Theoretical, practical, and aesthetic perspectives on information visualization; Visual representations; Techniques for processing and manipulating information for the purpose of visualization; Temporal & statistical visualization: studies of spatial, relational, multivariate, time-series, interactive, and other visual approaches; Design and narrative for visualization; Mapping, counter mapping, and geospatial visualization; Network visualization; Evaluation of information visualization.

CSC 207: Natural Language Processing I (Units: 2, LH 30, PH 45)
Introduction: NLP tasks in syntax, semantics, and pragmatics. Applications such as information extraction, question answering, and machine translation. The problem of ambiguity. The role of machine learning. Brief history of the field. Part Of Speech Tagging and Sequence Labelling: Lexical syntax. Hidden Markov Models (Forward and Viterbi algorithms and EM training);Basic Neural Networks: Any basic introduction to perceptron and back propagation.

CSC 211: Image Processing and Computer Vision (Units: 2, LH 30, PH 45)
Introduction: Overview of Applications of Vision and Image Processing. Image Formats: Digital Image Formats and Colour Models. Matlab Basics --To be learnt outside class time: Data Types, Operators, Manipulating Matrices, File I/O, The Image Processing Toolbox. Grayscale Transforms and Filtering: Thresholding, Histogram Equalization, Linear Filtering (convolution), Noise Reduction and Nonlinear Filtering. Edge Detection: Gradients, Edge Magnitude and Direction, Finite Difference Filters, Laplacian of Gaussian Filter and Canny Edge Detector. Colour Image Processing: Colour Transformations, Colour Histogram Equalization, Colour Median Filtering, Colour Gradient and Edge Detection. Thresholding and Region Processing: Thresholding as a form of Segmentation, Basic Global Thresholding, Optimal Global Thresholding, Techniques to improve global thresholding, Region Labelling, Boundary Tracing. Segmentation: Edge Based Segmentation, Region-based Segmentation, Hybrid Methods. Classification: Supervised and Unsupervised Clustering, Nearest Neighbour Classifiers, Bayesian Classification, Training and Testing Methodologies

CSC 213: Introduction to Machine Learning I (Unit: 2, LH 30, PH 45)
Introduction: Definition of learning systems. Goals and applications of machine learning. Aspects of developing a learning system: training data, concept representation, function approximation. Inductive Classification: The concept learning task. Concept learning as search through a hypothesis space. General-to-specific ordering of hypotheses. Finding maximally specific hypotheses. Version spaces and the candidate elimination algorithm. Learning conjunctive concepts. The importance of inductive bias. Decision Tree Learning: Representing concepts as decision trees. Recursive induction of decision trees. Picking the best splitting attribute: entropy and information gain. Searching for simple trees and computational complexity. Occam's razor. Over fitting, noisy data, and pruning.

CSC 217: Data Science and Big Data I (Units: 2, LH 30, LH 45)
Introduction: What is Data Science? - Big Data and Data Science hype – and getting past the hype - Why now? – Datafication; Current landscape of perspectives - Skill sets needed. Statistical Inference: Populations and samples; Statistical modeling, probability distributions, fitting a model; Intro to R. Exploratory Data Analysis and the Data Science Process: Basic tools (plots, graphs and summary statistics) of EDA; Philosophy of EDA; The Data Science Process; Case Study: Real Direct (online real estate firm). Three Basic Machine Learning Algorithms; Linear Regression - k-Nearest Neighbors

(k-NN) - k-means. One More Machine Learning Algorithm and Usage in Applications - Motivating application: Filtering Spam - Why Linear Regression and k-NN are poor choices for Filtering Spam - Naive Bayes and why it works for Filtering Spam - Data Wrangling: APIs and other tools for scrapping the Web. Feature Generation and Feature Selection (Extracting Meaning From Data) - Motivating application: user (customer) retention - Feature Generation (brainstorming, role of domain expertise, and place for imagination) - Feature Selection algorithms – Filters; Wrappers; Decision Trees; Random Forests.

CSC 221: Data Mining I **(Units: 2, LH 30, PH 45)**

Overview of Data Mining: some background on data objects and statistical concepts, the types of data to be mined and general classification of data-mining tasks. Data Pre-processing: Introduces techniques for preprocessing data before mining. Concepts such as the cleaning, integration, reduction, transformation, and discretization of data are discussed. Overview of Data Warehousing and OLAP: Introduction to data warehousing, OLAP, and data generalization. Mining Frequent Patterns, Associations, and Correlations:Methods for mining frequent patterns, associations, and correlations.

CSC 241: Information Technology: Design, Policy and Application **(Units: 2, LH 30)**

Design of information Technology (IT), IT policies: National IT policies and issues of implementation, Areas of application of Information Technology

200 LEVEL: SECOND SEMESTER

CSC 202: Computer Programming II **(Units: 3, LH 30, PH 45)**

Principles of good programming, structured programming concepts, Debugging and testing, string processing, internal searching and sorting, recursion. Use a programming language different from that in CSC 201, e.g. C-Language.

CSC 204: Operating Systems II **(Units: 2, LH 30)**

Concurrency: States & State diagrams Structures, Dispatching and Context Switching; interrupts; Concurrent execution; Mutual exclusion problem and some solutions. Deadlock; Models and mechanisms (Semaphores, monitors, etc.); Producer-Consumer Problems & Synchronization; Multiprocessor issues; Scheduling & Despatching; Memory Management: Overlays, Swapping and Partitions, Paging & Segmentations; Placement & Replacement policies, working sets and Trashing, Caching.

CSC 206: Fundamentals of Data Structures **(Units: 2, LH 30, PH 45)**

Primitive types, Arrays, Records, Strings and String processing, Data representation in memory, Stack and Heap allocation, Queues, Trees. Implementation Strategies for stack, queues, trees,. Run time storage management; Pointers and References, linked structures.

CSC 208: Introduction to Database Systems I **(Units: 2, LH 30, PH 45)**

Information storage & retrieval, Information management applications, Information capture and representation, analysis & indexing, search, retrieval, information privacy; integrity, security; scalability, efficiency and effectiveness; Introduction to database systems: Components of database systems. DBMS functions, Database architecture and data independence; use of database query language.Conceptual DB Design; Relational Data Model; Conversion of ER to Relational Data Model;

CSC 210: Foundation of Sequential Program (Units: 2, LH 30)
The relationships between H/L languages and the Computer Architecture that underlies their implementation: basic machine architecture, specification and translation of P/L Block, Structured Languages, parameter passing mechanisms.

CSC 212: Computer Hardware (Units: 2, LH 30, PH 45)
Computer circuits; diode arrays, PIAs etc; Integrated circuits fabrication process. Use of MSI, LSI, and VLSI ICs; Hardware Design. Primary and Secondary memories; core memories, etc.Magnetic devices; disks, tapes, video disks etc. Peripheral devices; printers, CRTs, keyboards, character recognition. Operational amplifiers; Analog-to-digital and Digital-to-analog converter.

CSC 214: Computer Architecture and Organization II (Units: 2, LH 30, PH 45)
Memory system, general; characteristics of memory operation. (Technology-magnetic recording, semi-conductor memory, coupled devices, magnetic bubbles).Memory addressing, memory hierarchy, virtual memory control systems. Hardware control, micro programmed control, Asynchronous control, I/C/ control. Introduction to the methodology of faulty tolerant computing.

MTH: Mathematical Methods II (Units: 2, LH 45)
Elementary vector calculus: The operators - grad, div and curl - in Cartesian coordinates; Ordinary first order differential equations (ODE): variables separable, homogeneous, exact, linear equations; use of integrating factor; orthogonal and oblique trajectories; complementary functions; general solution of an ODE, particular integral; Second order linear ODE with constant coefficients, General theory of 2nd order linear equations. Solution of initial value problems; Application of differential equations to life, physical and social science problems.

GES 212: Business Creation and Growth (Units: 2, LH 30)
The aim of this course is to develop students' competence and confidence in creating viable businesses with high potentials for new value addition and high income. The course is designed to enable students achieve economic independence after graduation. Its main goal is to help change students' mind-set away from paid jobs and over-dependence on families and government. By the end of the course, students will be able to start and manage businesses at micro or family level. They will also be able to grow ventures capable of generating employment and better utilize resources.

THG 272: Social Teachings of the Church (Units:2, LH 30)
Since theology does not restrict itself to spiritual matters alone but concerns itself with the entire human well being, the course therefore with reference to the social teachings of the Church, examines the efforts of the Church as also pastor of the material well being of human persons, with special emphasis on human dignity and rights.

ELECTIVES

CSC 208: Natural Language Processing II (Units: 2, LH 30, PH 45)

Syntactic parsing: Grammar formalisms and treebanks. Efficient parsing for context-free grammars (CFGs). Statistical parsing and probabilistic CFGs (PCFGs). Lexicalized PCFGs. Neural shift-reduce dependency. Semantic Analysis : Lexical semantics and word-sense disambiguation. Compositional semantics. Semantic Role Labelling and Semantic Parsing.Information Extraction (IE): Named entity recognition and relation extraction. IE using sequence labelling.Machine Translation (MT): Basic issues in MT. Statistical translation, word alignment, phrase-based translation, and synchronous grammars. Use of Python language; Text and Speech processing

CSC 214: Introduction to Machine Learning II (Units: 2, LH 30, PH 45)

Experimental Evaluation of Learning Algorithms: Measuring the accuracy of learned hypotheses. Comparing learning algorithms: cross-validation, learning curves, and statistical hypothesis testing. Computational Learning Theory: Models of learnability; Sample complexity; Computational complexity of training. Sample complexity for finite hypothesis spaces. Rule Learning: Propositional and First-Order: Translating decision trees into rules. Heuristic rule induction using separate and conquer and information gain. Artificial Neural Networks: Neurons and biological motivation. Linear threshold units. Perceptrons: representational limitation and gradient descent training. Multilayer networks and back propagation. Hidden layers and constructing intermediate, distributed representations. Over fitting, learning network structure, recurrent networks. Support Vector Machines: Maximum margin linear separators. Quadratic programming solution to finding maximum margin separators. Kernels for learning non-linear functions. Bayesian Learning:Probability theory and Bayes rule. Naive Bayes learning algorithm. Parameter smoothing. Generative vs. discriminative training. Logistic regression. Bayes nets and Markov nets for representing dependencies. Clustering and Unsupervised Learning: Learning from unclassified data. Clustering, Semi-supervised learning with EM using labelled and unlabelled data.

CSC 216: Software Engineering II (Units: 2, LH 30, PH 45)

Introduction to the fundamentals of software architecture; Software architecture and quality requirements of a software system; Fundamental principles and guidelines for software architecture design, architectural styles, patterns and frameworks; Methods, techniques and tools for describing software architecture; Software architecture design and evaluation processes; Approaches and tools for designing and evaluating software architectures;Software Process Improvement; Fundamentals of software quality management: process; Software pattern; Software process modelling; Software process improvement and assessment models; SPI and Cultural Change; Statistical process control. Software re-engineering configuration management; Formal specification; the Software Work Breakdown (WBS), Software Maintenance; development effort estimation; Performance Models, Optimal Performance, Sensitivity Analysis, Cost-Effectiveness Models; Software cost – estimation: COCOMO, Software patterns; Introduction to software quality; Software Quality Standards; Software Testing to Measure Software Quality; Software Testing of Web Applications; Software Quality Management; Software Quality Assurance; Software Quality Metrics; Measuring Software Quality; Software Quality System Implementation. Software testing fundamentals, testing types; Software testing techniques; levels of testing; Software testing for web applications; Defect analysis; test documentations, traceability matrices; testing estimation techniques.

CSC 218: Data Science and Big Data II (Units: 2, LH 30, PH 45)

Recommendation Systems: Building a User-Facing Data Product - Algorithmic ingredients of a Recommendation Engine - Dimensionality Reduction - Singular Value Decomposition - Principal Component Analysis - Exercise: build your own recommendation system. Mining Social-Network Graphs - Social networks as graphs - Clustering of graphs - Direct discovery of communities in graphs - Partitioning of graphs - Neighborhood properties in graphs. Data Visualization - Basic principles, ideas and tools for data visualization 3 - Examples of inspiring (industry) projects - Exercise: create your own visualization of a complex dataset. Data Science and Ethical Issues - Discussions on privacy, security, ethics - A look back at Data Science - Next-generation data scientists. Big data case studies and applications. Use of Java and Python.

CSC 222: Data Mining II (Units: 2, LH 30, PH 45)

Classification: Ways of classifying data: decision tree induction, Bayesian classification, rule-based classification, neural networks, support vector machines, associative classification, *k*-nearest-neighbour classifier, case-based reasoning, genetic algorithms, rough sets, and fuzzy set approaches. Cluster Analysis: Describes the partitioning, hierarchical, density-based, grid-based, and model-based methods data clustering. Outlier Detection: Major approaches to the detection of anomalies, such as the statistical, proximity-based, clustering-based, and classification-based methods.

300 LEVEL

300 LEVEL: FIRST SEMESTER

CSC 301: Structured Programming (Units: 2, LH 30 PH 45)

Structured Programming elements, structured design principles, abstraction modularity, stepwise refinement, structured design technique. Teaching of a structured programming language etc.

CSC 303: Object-Oriented Programming (Units: 2, LH 30, PH 45)

Basic OOP Concepts; Classes, Objects, inheritance, polymorphism, Data Abstraction, Tools for developing, Compiling, interpreting, and debugging, Java Programs, Java Syntax and data objects, operators. Central flow constructs, objects and classes programming, Arrays, methods. Exceptions, Applets and the Abstract, OLE, Persistence, Windows Toolkit, Laboratory exercises in an OOP language.

CSC 307: Discrete Structures (Units: 2, LH 30)

Basic Set Theory: Basic definitions, Relations, Equivalence Relations Partitions, Ordered Set. Boolean Algebra & Lattices, Logic, Graph theory: Directed and Undirected graphs, Graph Isomorphism, Basic Graph Theorems, Matrices; Integer and Real matrices, Boolean Matrices, Matrices med m, Path matrices,. Adjacency Vectors/Matrices: Path adjacency matrix, Numerical & Boolean Adjacency matrices. Applications to counting, Discrete Probability Generating Functions.

CSC 311: Algorithms and Complexity Analysis (Units: 2, LH 30)

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 & its representations.

CSC 315: Compiler Construction I (Units: 2, LH 30)
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. Internal form of course programme. Use of a standard compiler (FORTRAN/COBOL/PL) as a working vehicle; Error detection and recovery. Grammars and languages: the parsing problem. The scanner.

CSC 321: Systems Analysis and Design (Units: 2, LH 30, PH 45)
System Concept; System Development Life Cycle; Analysis: Fact gathering Techniques, data flow diagrams, Process description data modelling; System Design: Structure Charts, form designs, security, automated Tools for design; Object-Oriented Systems Analysis and Design.

CSC 333: Computational Science and Numerical Methods (Units: 2, LH 30)
Operations research, Numerical Computation, Graphical computation, Modelling and simulation, High performance computation

CSC 335: Survey of Programming Languages (Units: 2, LH 30, PH 45)
Overview of programming languages: History of programming languages, Brief survey of programming paradigms (Procedural languages, Object-oriented languages, Functional languages, Declarative – non-algorithmic languages, Scripting languages), the effects of scale on programming methodology; Language Description: Syntactic Structure (Expression notations, abstract Syntax Tree, Lexical Syntax, Grammars for Expressions, Variants of Grammars), Language Semantics (Informal semantics, Overview of formal semantics, Denotation semantics, Axiomatic semantics, Operational Semantics); Declarations and types: The concept of types, Declaration models (binding, visibility, scope, and lifetime), Overview of type-checking, Garbage collection; Abstraction mechanisms: Procedures, function, and iterations as abstraction mechanisms, Parameterization mechanisms (reference vs. value), Activation records and storage management, Type parameters and parameterized types, Modules in programming languages; Object oriented language paradigm; Functional and logic language paradigms.

ELECTIVES

CSC 313: Enterprise Application Development(Units: 2, LH 30, PH 45)
The Enterprise, Enterprise Systems, and ERP, Web Applications, Enterprise Systems Architectures, Data-driven Web Applications, Managing an ERP, Specialty Enterprise systems; Enterprise Application Development: Enterprise applications, Java EE technology, Simplifying Java EE, Design patterns; Spring Framework Fundamentals: Spring Architecture, Introducing IoC, Spring IoC, Applying IoC to Rainforest; The Spring JDBC Framework: Evaluating JDBC, JDBC Template, Applying Spring JDBC to Rainforest; Aspect-Oriented Programming (AOP): AOP with Spring, Schema-based AOP, AspectJ Pointcut Expression, Annotation-based AOP; Transaction Management: Java EE Transaction, Motivation and Architecture of Spring Transaction Support, Declarative Transaction Control; Spring MVC: Spring MVC overview, Spring MVC Component Architecture, Configuring Spring MVC, Spring MVC Development Process, REST-Style URLs, AJAX Controllers; Processing Forms and Validation: Form processing with Spring MVC; Introduction to Hibernate: Object-Relational Mapping, Hibernate Architecture, Working with Hibernate; Mapping Persistent

Classes: One-to-one relationships, Strategies for Handling Inheritance, One-to-Many Relationships; Working with Persistent Classes: Hibernate Architecture and Object Persistence, Hibernate Query Language, Executing Native SQL; Hibernate Performance and Spring Integration: The Hibernate Caching Architecture, Integrating Hibernate with Spring.

CSC 317: Mobile Application Development (Units:2, LH 30, PH 45)

Introduction to mobile application development: types of mobile devices, from computers to smartphones, comparing web-based applications to native applications, methods of transport, internet protocols for mobile applications; Infrastructure: basic networking capabilities, device connection to the internet, routing and proxies, mobile browser accessing of a network, and a server receiving of request and routingit to the appropriate logic in other to process the request; HTML/CSS/DOM and Scripting (JavaScript); JQuery and Structured Data: Extensible Markup Language (XML) or JSON; Scripting with Server Access: scripting from the client side and server side, asynchronous JavaScript and XML (AJAX), Dynamic HTML, XMLHTTPRequest object; Designing Mobile User Interface: usability, ascertaining users' needs through task and contextual analysis, approaches to building a good user interface, rapid prototyping and testing; Mobile Application Evaluation and Mobile Browsers; Mobile platforms: native and web-based mobile applications; HTML5 as a means of to fill the gap between native and web-based mobile apps, hybrid approaches such as PhoneGap, FlashLight, and JavaFX; Storage and Geolocation; Android Development (for phones and tablets): Java programming; Iphone/Ipad Development (for phones and tablets): iOS.

CSC 319: Games Design and Application Development (Units: 2, LH 30, PH 45)

A brief history of video games, games and society, games design, teams and processes, programming fundamentals, debugging games, games architectures, memory and I.O systems, mathematical concepts, collision detection and resolution, graphics, artificial intelligence, networks and multilayer mode. Use of C++ for games apps development; real-time graphics applications with modern API for design, development and critical evaluation of games and 3D graphics application; buffers, lighting and shading methods, texturing techniques, render to texture, tesselator and geometry shader; Mathematics for application development: elementary algebraic and geometric skills, transportation of formulae, coordinate geometry, vectors, matrix transformation, kinematics.

CSC 323: Virtual and Augmented Reality (Units: 2, LH 30, PH 45)

Virtual reality (VR): Introduction to Virtual Reality-fundamental concept and components of virtual reality, primary features and present development on virtual reality; Multiple modal interaction: multiple modals of input and output interface in Virtual Reality-Input—Tracker, sensor, digital clove, movement capture, video-based 3D Scanner etc, Output—Visual/auditory/haptic devices, visual-auditory-haptic, interaction immersion and imagination, Visual computation and environmental modelling: Visual computation in virtual reality—Fundamentals of computer graphics; real time rendering technology, principles of stereoscopic display, software and hardware technology on stereoscopic display; Environmental modelling in virtual reality: Geometric modelling (geometric behaviour), behaviour stimulation, and physically based simulation; management of large scale environment, augmented reality (AR), mixed reality (MR), digital entertainment, development and applications of VR. AR, and MR; Haptic and Force Interaction in Virtual Reality: Concept of haptic interaction, principles of touch feedback and force feedback, typical structure and principles of touch/force feedback facilities in application; Augmented reality: System structure of Augmented Reality, Key technology in AR, general solution for calculating geometric & illumination consistency

in the augmented environment; VR development tools: Frameworks of software development tools in VR, Modeling tools for VR, X3D Standard, Vega, MultiGen, Virtools, etc.; Applications of VR in Digital Entertainment: VR technology in Film & TV production, VR technology in physical exercises and games, Demonstration of digital entertainment by VR; Application of VR in other domains.

CSC 325: Developing Embedded Systems (Units: 2, LH 30, PH 45)

Introduction to embedded systems: terms definition, features, characteristics, applications, design route; Fundamentals of control and executive automation; Basics of measurement equipment: types of sensors, the principles of its operation, measurement accuracy; Design of Embedded systems; Embedded C: Embedded software development using C, Porting 8051 Assembly code to C, Cross compilation, downloading, testing, debugging; Design of embedded systems: problem definition, requirements and specification, software planning – hardware design and software design; Lab Sessions:--Development of a hardware/software counter; development of a simple alarm system; production characteristics of the electrical signal with an oscilloscope and multimeter. C, Embedded C, and Assembly language programming

CSC 327: Introduction to Assistive Technologies (Units: 2, LH 30, PH 45)

Introduction to disability; quality of life (disability simulations); task analysis; introduction to assistive technology; universal design & designing for accessibility, Client-centred design Assistive Technology (AT); Introduction to the domains: augmentative communication, orthotics, prosthetics and robotics, seating and mobility, computer access; Introduction to switches: Arduino exercise; Immersion in Current Assistive Technologies: augmentative communication, orthotics, prosthetics, and robotics, wheelchairs, architecture and the built environment; Disability Justice/history; Disability studies; Type of disabilities: academic disabilities, visual disabilities, hearing impairment, communication disorders, physical disabilities; Legal and policy foundations of assistive technology: legislative foundations of AT, Current legislation governing AT, Multidisciplinary teams and AT; Instruction and AT: Impact of computers on instruction, instructional delivery formats, multidisciplinary teams and AT, planning for individual needs in software and hardware; Assistive hardware and software: assistive solutions for visually impaired, assistive solutions for hearing impaired, assistive solutions for physically disabled, assistive solutions for academically disabled; Current assistive technology issues: financing assistive technology, assistive technology training, family issues dealing with assistive technology, inclusion and assistive technology, cultural issues and assistive technology; designing assistive technologies; design challenges in assistive technology; Human factors in the design of AT.

300 LEVEL: SECOND SEMESTER

CSC 390: Students' Industrial Work Experience Scheme (Units: 6)

Students Industrial Work Experience Scheme (SIWES): The students will spend a period of six (6) months working in relevant establishments that will enable them to gain on the job experience, putting into practice want they learnt. The experience will be documented and presented in a seminar.

400 LEVEL

LEVEL: FIRST SEMESTER

CSC 403: Introduction to Database Systems II (Units: 2, LH 30, PH 45)
Rational Databases: Mapping conceptual schema to relational Schema; Database Query Languages (SQL) Concept of Functional dependencies & Multi-Valued dependencies Transaction processing; Distributed databases;Relational Algebra; SQL; PL/SQL; Relational Calculus; Functional Dependencies & Normal Forms; Design Algorithms; Database System Access and Storage: Disk, Buffer, and File Management; Indexing Technique; Transaction Management.

CSC 411: Research Methods (Units: 2, LH 30, LP 45)
What is Science?: Philosophy of Science, Sociology of Science;Foundations of research; problem identification and formulation; research design; research protocol; qualitative and quantitative research; measurement; sampling; data analysis; interpretation of data and technical report writing; use of encyclopaedias, research guides, handbook etc., academic databases for computing discipline; use of tools/techniques for research: reference management software, software for detection of plagiarism; Metatheories. Research Design and Ethics: Evidence-based software engineering; What makes a good research paper? Research Design; Research Ethics. Basics of Doing Research: Finding good research questions; Theoretical Framework and Theory building; Evidence and Measurement; Peer-Review Process. Experiments: Controlled Experiments; Quasi-experiments; Sampling; Replication. Case Studies: Single and Multi-case; Longitudinal Case Studies; Approaches to Data Collection. Survey and Observation: Surveys; Focus Groups; Ethnographies. Interventions: Action Research; Pilot Studies; Benchmarking. Qualitative Analysis: Grounded Theory; Phenomenography; Mixed Methods Research (Triangulation). Qualitative Analysis: Basic Statistics; Parametric and non-parametric tests; Significant figures; Choosing a statistical model; Statistical Power Analysis; Meta-Analysis. Publishing and Reviewing: Where to publish; The peer review process. Replication and Beyond: How important is replication? Bias and Influences; Threats to Validity (and how to reduce them); When to use empirical methods; When not to use empirical methods;Simulation methods; Writing a research report.

CSC 415: Compiler Construction II (Units: 2, LH 30)
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 analysers. Construction of LR table. Organisation of symbol tablets. Allocation of storage to run-time variables. Code generation. Optimisation/Translator with systems.

CSC 421: Net-Centric Computing (Units: 2, LH 30)
Distributed Computing, Mobile & Wireless computing, Network Security; Client/Server Computing (using the web), Building Web Applications.

CSC 423: Computer Networks and Communication I (Units: 2, LH 30, PH 45)
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 vs asynchronous). Bus structures and loop systems, computer network Examples and design consideration, data switching principles broadcast techniques, network structure for packet switching, protocols, description of network e.g. ARPANET, etc.

CSC 431: Distributed Computing System (Units: 2, LH 30, PH 45)
Introduction: Definitions, Motivation; Communication Mechanisms: Communication Protocols, RPC, RMI, Stream Oriented Communication; Synchronization: Global State, Election, Distributed Mutual Exclusion, Distributed Transactions; Naming: Generic Schemes, DNS, Naming and Localization; Replication and Coherence: Consistency Models And Protocols; Fault Tolerance: Group Communication, Two - And Three-Phase Commit, Check pointing; Security: Access Control, Key Management, Cryptography; Distributed File Systems: NFS, Coda etc.

CSC 481: Research Seminar (Unit: 1)
Research based seminar topics chosen from a variety of computer areas including applications in various fields, computer installation, architecture, staffing and administration, computer maintenance, computing networks, artificial intelligence, databases, information security, human-computer interaction, informatics, software engineering, Data science and big data analytics, natural language processing, etc.

ELECTIVES

CSC 409: Modelling and Simulation (Units: 2, LH 30, PH 45)
Basic Definitions and Uses, Simulation Process, Some basic statistic Distributions 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, Markov processes, Birth-Death Processes, Poisson Processes. Random Numbers; types of Random Number Exercises.

CSC 435: Optimization Techniques (Units: 2, LH 30, PH 45)
Linear Programming Problem Formulations: Blending, Diet, Multiperiod, Work Scheduling, Project Scheduling, and Financial Optimization Problems. Solving Linear Programs using Python. Simplex Algorithm: Basic and non-basic variables, Multiple Optimal Solutions, Unbounded Linear Programs, Degeneracy, Big-M Method, Two-Phase Simplex Method, Unrestricted Variables. Sensitivity Analysis. Duality Theory. Metaheuristic Algorithms.

CSC 439: Introduction to Robotics (Units: 2, LH 30, PH 45)
Introduction to robotics, the engineering design process, best practices in engineering design, introduction to electric circuits, Early robotic topics, Sensors, Actuators, and Manipulators: Micro controllers, Sensors and actuators, Manipulators, Gears and other mechanical systems; Introduction to Robot Mechanics: Power and torque, Acceleration and velocity, Design models for ground mobile robots, Design models for mechanical arms and lifting systems, Fundamentals of kinematics; Suitable programming language(s) for laboratory sessions.

CSC 443: Open Source Software Development (Units: 2, LH 30, PH 45)
Open Source support of process and product evaluation: the GQM method and the GQM tools. Licensing, compliance and governance of Open Source; Quality and trustworthiness assessment of Open Source products; Evaluation of Open Source Software development processes; Open Source marketing: how to make your product attractive for the community and end users; Testing Open

Source Software; ERP, SCM, and CRM Open Source; The business of Open Source Software; Grassroots Free Software: the case of volunteers of FOSS projects and their management.

CSC 451: Formal Models of Computation (Units: 2, LH 30, PH 45)
Automata theory: Roles of models in computation, Finite state Automata, Push-down Automata, Formal Grammars, Parsing, Relative powers of formal models; Basic computability: Turing machines, Universal Turing Machines, Church's thesis, solvability and Decidability.

CSC 491: Special Topics in Computer Science (Units: 2, LH 30, PH 45)
Special topics from any area of computer science considered relevant at given time. Topics are expected to change from year to year. Apart from seminars to be given by lecturers and guests, students are expected to do substantial readings on their own.

CSC 495: Web Engineering (Units: 2, LH 30, PH 45)
Web Applications: Introduction, categories, Characteristics; Requirements Engineering for Web Applications; Web Application Modeling: Requirements, content modeling, hypertext modeling, presentation modeling, methods and tools; Web Application architectures: Introduction, components, layered and data-aspect architectures; Technologies for web applications: Client side, server side, communication, and document specific technologies. Testing, operation and maintenance of web applications. Web Project management. Web Application Development Process. Advanced Topics: Usability, performance, security of web applications, semantic web, semantic web services

400 LEVEL: SECOND SEMESTER

CSC 402: Organization of Programming Languages (Units: 2, LH 30)
Language definition structure: Data types and structures, Review of basic data types, including lists and tress, control structure and data flow, Run-time consideration, interpretative languages, lexical analysis and parsing. Pre-requisite: CSC 201, 202, 301, 303.

CSC 422: Software Project Management (Units: 2, LH 30, PH 45)
Team Management, Project Scheduling, Software measurement and estimation techniques, Risk analysis, Software quality assurance, Software Configuration Management, Project Management tools.

CSC 432: Computer Graphics and Visualization (Units: 2, LH 30, PH 45)
Hardware aspect, plotters microfilm, plotters display, graphic tablets, light pens, other graphical input aids Facsimile and its problems Refresh display refresh huggers, changing images, light pen interaction. Two and three dimensional transformation, perspective Clipping algorithms. Hidden line removal bolded surface removal. Warmock'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 intersotive graphics.

CSC 442: Human Computer Interface (Units: 2, LH 30, PH 45)
Foundations of HCI, Principles of GUI, GUI toolkits; Human-centred software evaluation and development; GUI design and programming.

CSC 490: Project (Units: 6)

Students should embark on work that will lead to substantial software development or may embark on any research from any field of computing under the supervision of a staff advisor. The project should be innovative, unique and novel. The project's protocol should be research oriented with some effort to fill discovered gaps and solve practical problems.The project should be characterized by sound critical thinking and a strong literature base and should be reported in a research reporting format, e.g. abstract, keywords, introduction: background, problem statement, study motivation and rationale, research objectives, research questions, research hypotheses (if any), study significance: theoretical and practical significance, study scope, paper organization, literature review: conceptual framework, theoretical frameworks, and review of previous studies; materials and method, results, discussion of findings: major findings, findings corroboration with prior research: compare findings with previous research findings, contribution to knowledge and to the profession (i.e. contributions to theory and practice); conclusion and future work: summary of findings, recommendations, study limitations, future works, beneficiaries and conclusion. Report format: APA.

ELECTIVES

CSC 408: Queuing Systems Performance Evaluation (Units: 2, LH 30)

Introduction; Birth-death queuing systems; Markovian queues, the queue M/GI bounds, inequalities and approximations.

CSC 410: Computer System Performance Evaluation (Units: 2, LH 30)

Measurement techniques, simulation techniques; techniques, workload characterization, performance evaluation in selection problems, performance evaluation in design problems, evaluation of programme performance.

CSC 416: Intelligent Systems (Units: 2, LH 30, PH 45)

Introduction to Artificial Intelligence; Search; Representing Knowledge; Reasoning and Control; Machine learning;Algorithms for creating intelligent behaviour: Planning--HTM planning, MDP planning, Learning—Reinforcement learning, Coordination mechanisms—team planning, auction-based mechanisms; Robotic agents; Architecting intelligence (sense, think. Act in real-time): 3-tier architecture, cognitive architecture; Lab sessions with Matlab programming language; Key application areas (selected from): Expert systems; Decision support systems; Speech and Vision; Natural language processing, information retrieval, semantic web.

CSC 424: Computer Networks and Communication II (Units: 2, LH 30, PH 45)

Introduction to network security; Different areas of security; Characteristics of secured communication; Security fundamentals: Risk analysis, Network security components, Network security policies, Password use and misuse, Auditing; Threats; Common types of network attacks: Password attacks, Intrusion, Back door, DOS (Denial of Service), DDOS (Distributed Denial of Service), Buffer overflows, Network scanning, sweeping, Viruses/Worms/Trojans, Who is attacking the network? Hackers (hacker techniques), Crackers, Phrack; Remote Access; Email: Secure Email and Encryption, Email vulnerability; Network Defense tools and technique: Firewall (types of firewalls), Virtual Private Networks, Intrution detection; Computer Forensic and Security; Cryptography; Computer security; Telecommunications and Networking security.Introduction to Cloud Computing; Cloud computing platforms; Infrastructure as a Service (IaaS); Platform as a

Service (PaaS); Software as a Service (SaaS); Business Process as a Service (BPaaS), Parallel Programming in the Cloud; Distributed Storage Systems; Visualization; Cloud security, Multicore Operating Systems; Enterprise cloud-based high performance computing (HPC) applications.

CSC 462: Information Technology Law (Units: 2, LH 30)

Information Technology Act; Rules under Information Technology Act; The Rule of Cyberspace; Regulating Information Superhighway; Cyber Law – Policy Issues and Emerging Trends; Anonymous Blog – Regulation versus Free Speech; Jurisdiction and the Internet; Online Contract; Digital Signatures – Legal Implication; Cyber Crime; Data Protection; Liability of Intermediary; Copyright and Internet; Internet and Free Speech; Domain Name Dispute; Yahoo versus LICRA; Zippo Manufacturing Versus Zippo Com; ProCD versus Zeidenberg; US versus Morris; US versus Thomas; Viacom versus Google.

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