CALEB UNIVERSITY, LAGOS

COLLEGE OF COMPUTING AND INFORMATION SCIENCES (COCIS)

DEPARTMENT OF

SOFTWARE ENGINEERING

PROGRAMME:

SOFTWARE ENGINEERING.

STUDENT HANDBOOK

FEBRUARY,2026

PREFACE

Welcome to the Department of Software Engineering, Caleb University, Lagos.

At the heart of Caleb University's College of Computing and Information Sciences (COCIS), the Department of Software Engineering stands as a dynamic center for innovation and excellence. We are dedicated to training the next generation of software architects, developers, and tech leaders who will engineer the intelligent solutions of tomorrow.

Our rigorous, industry-aligned curriculum bridges foundational theory with cutting-edge practice. Our students are trained to master the full software development lifecycle, starting from requirements analysis and system design to coding, testing, deployment, and maintenance within a framework of ethical and professional standards.

Guided by experienced faculty members, and through hands-on projects, state-of-the-art labs, and strategic industry partnerships, our graduates are equipped to excel in a rapidly evolving digital world. We also foster not just technical proficiency, but also critical thinking, teamwork, and entrepreneurial spirit.

Join us to build, innovate, and lead. Craft your future in code, right here at Caleb University, Lagos.

Engineering Tomorrow's Solutions, Today.

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Ag, H.O.D Software Engineering Department

1.0 Introduction

1.1 Brief History

Caleb University, Lagos established in 2007, has rapidly emerged as a prominent private university in Nigeria, consistently recognized among the top institutions for its commitment to academic excellence and innovation. The university has Prof. Olalekan Asikhia as the current Vice-Chancellor and is dedicated to nurturing individuals with curiosity, drive, passion, and empathy, equipping them to make a positive impact locally and globally. Caleb University prides itself on producing exceptional and innovative students who embody godly character and demonstrate verifiable academic and industry performance both within Nigeria and internationally.

The university currently offers 27 undergraduate and 9 postgraduate degree programs, structured across six colleges: the College of Environmental Sciences and Management (COLENSMA), College of Pure and Applied Sciences (COPAS), College of Arts, Social and Management Sciences (CASMAS), College of Education (COLED), College of Law (COLAW), and College of Postgraduate Studies (COPOS). All mature programs have successfully undergone accreditation by the National Universities Commission (NUC) and relevant professional bodies, affirming the quality and relevance of Caleb University's educational offerings.

1.2 Mission:

The mission of Caleb University, Lagos is to nurture individuals with a passion for learning, integrity, and social responsibility. Through rigorous academic programs, innovative research, and experiential learning opportunities, the university prepares students to become ethical leaders and productive members of society. Grounded in Christian values, Caleb University fosters a culture of excellence, inclusivity, and community engagement, striving to produce graduates who are not only intellectually capable but also morally upright and socially conscious.

1.3 Vision

The vision of Caleb university, Lagos is underpinned by her core values that guide its operations and aspirations, which are:

1. **Excellence**: To uphold the highest standards of academic rigor, professionalism, and ethical conduct in all teaching, research, and administrative endeavors.
2. **Integrity**: To demonstrate unwavering honesty, transparency, and accountability in all actions and interactions, fostering trust within the university community and beyond.
3. **Service**: To embrace a spirit of selflessness and actively contribute to the betterment of society through community engagement, outreach, and impactful research.
4. **Innovation**: To encourage creativity, critical thinking, and adaptability, driving positive change and addressing complex challenges through pioneering solutions.
5. **Inclusivity**: To celebrate diversity and create a welcoming and supportive environment where every individual is valued, respected, and empowered to reach their full potential.
6. **Leadership**: To inspire and empower students to lead with integrity, compassion, and vision, preparing them for influential roles in their personal and professional lives.
7. **Community**: To foster a strong sense of belonging, mutual support, and collaboration among students, faculty, staff, and all stakeholders, building a cohesive and supportive university family.

SOFTWARE ENGINEERING GLOBAL COURSE STRUCTURE

(EXCERPT FROM CCMAS)

100 Level

Course Code	Course Title	Unit(s)	Status	LH	PH
GST111	Communication in English	2	C	15	45
GST112	Nigerian Peoples & Culture	2	C	30	0
MTH101	Elementary Mathematics I	2	C	30	0
MTH102	Elementary Mathematics II	2	C	30	0
PHY101	General Physics I	2	C	30	0
PHY102	General Physics II	2	C	30	0
PHY107	General Practical Physics I	1	C	0	45
PHY108	General Practical Physics II	1	C	0	45
STA 111	Descriptive Statistics	3	C	45	0
COS101	Introduction to Computing Sciences	3	C	30	45
COS102	Introduction to Problem Solving	3	C	30	45
TOTAL		**23**			

200 Level

Course Code	Course Title	Unit(s)	Status	LH	PH
GST 212	Philosophy, Logic And Human Existence	2	C	30	0
ENT212	Entrepreneurship and Innovation	2	C	30	0
MTH 201	Mathematical Methods I	2	C	30	0
MTH 202	Mathematical Methods II	2	C	30	0
COS201	Computer Programming I	3	C	30	45
COS202	Computer Programming II	3	C	30	45
SEN201	Introduction to Software Engineering	2	C	30	0
SEN299	SIWES I	3	C	0	135
CSC203	Discrete Structures	2	C	30	0
INS204	System Analysis and Design	3	C	30	45
IFT 211	Digital Logic Design	2	C	15	45
IFT 212	Computer Architecture and Organisation	2	C	15	45

TOTAL		**28**			

NOTE: ***SIWES will take place during long vacations of 200 Level and 300 Level.

300 Level

Course Code	Course Title	Unit(s)	Status	LH	PH
GST 312	Peace and Conflict Resolution	2	C	30	0
ENT312	Venture Creation	2	C	15	45
SEN301	Object-Oriented Analysis and Design	2	C	15	45
SEN304	Software Testing and Quality Assurance	2	C	15	45
SEN306	Software Construction	2	C	15	45
SEN322	Software Engineering Innovation and New Technology	2	C	15	45
SEN399	SIWES II	3	C	0	135
CSC301	Data Structures	3	C	15	45
CSC308	Operating Systems	3	C	30	45
TOTAL		**21**			

400 Level

Course Code	Course Title	Unit(s)	Status	LH	PH
COS409	Research Methodology and Technical Report Writing	3	C	30	0
SEN401	Software Configuration Management and Maintenance	2	C	15	45
SEN410	Software Architecture and Design	2	C	15	45
SEN497	Final Year Student's Project I	3	C	0	135
SEN498	Final Year Student's Project II	3	C	0	135
INS 401	Project Management	2	C	30	0
	TOTAL	**15**			

SOFTWARE ENGINEERING DETAILED COURSE STRUCTURE

100 LEVEL FIRST SEMESTER

S/N	COURSE CODE	COURSE TITLE	STATUS	NUMBER OF UNITS
1.	CSC 101	Introduction to computer science	C	3
2.	CUL-CYB 171	Cyber hygiene	C	2
3.	STA 111	Introduction to statistics	C	3
4.	PHY 101	General physics	C	2
5.	PHY 107	Practical physics i	C	1
6.	MTH 101	General mathematics	C	2
7.	GST 111	Introduction to English language	C	2
8.	GST 121	Character in leadership	C	1
9.	CTC 101	Tech plus i	C	0
		TOTAL		**16**

100 LEVEL SECOND SEMESTER

S/N	COURSE CODE	COURSE TITLE	STATUS	NUMBER OF UNITS
1.	MTH 102	Elementary mathematics ii	C	2
2.	GST112	Nigerian peoples and culture	C	2
3.	PHY 102	General physics ii	C	2
4.	PHY 108	General physics practical ii	C	1
5.	COS 102	Problem solving	C	3
6.	GST 104/ CTC 102	Tech plus i	C	0
7.	CUL-CSC 178	Basic electronics	C	2
8.	CUL-CSC 176	Introduction to web design	C	2
9.	CUL-CSC 172	Data mining and warehousing	C	3
		TOTAL		**17**

200 LEVEL FIRST SEMESTER

S/N	COURSE CODE	COURSE TITLE	STATUS	NUMBER OF UNITS
1.	SEN 201	Introduction to software engineering	C	2
2.	MTH 201	Mathematical methods	C	2
3.	CSC 203	Discrete statistics	C	2
4.	IFT 211	Digital logic design	C	2
5.	ENT 211	Entrepreneurship and innovation	C	2
6.	GST 203	Tech plus ii	C	0
7.	GST 221	Character in leadership ii	C	2
8.	COS 201	Computer programming i	C	3
9.	CUL-CSC 279	Computer techniques against cultism	C	2
10.	CUL-CSC 283	Management information systems	C	3
		TOTAL		**20**

200 LEVEL SECOND SEMESTER

S/N	COURSE CODE	COURSE TITLE	STATUS	NUMBER OF UNITS
1.	GST 212	Philosophy, Logic and Human Existence	C	2
2.	GST 204	Introduction to French	C	2
3.	CTC 208	Tech Plus III	C	0
4.	MTH 202	Mathematical methods II	C	2
5.	COS 202	Computer Programming II	C	3
6.	INS 204	System Analysis and Design	C	3
7.	SEN 202	Python Programming	C	2
8.	SEN 203	Java Programming	C	2
9.	IFT 212	Computer Architecture and Organization	C	2

10.	SEN 299	SIWES I	C	3
		T**OTAL**		**21**

300 LEVEL FIRST SEMESTER

S/N	COURSE CODE	COURSE TITLE	STATUS	NUMBER OF UNITS
1.	GST 321	Character in Leadership III	C	1
2.	CTC 311	Tech Pro Elevate I	C	0
3.	SEN 301	Object-Oriented analysis and design	C	2
4.	SEN 302	UX-UI Design	C	2
5.	SEN 304	Software testing and quality assurance	C	2
6.	SEN 305	Database Management I	E	2
7..	SEN 306	Software Construction	C	2
8.	SEN 307	React Development	E	2
9.	CSC 301	Data Structure and Algorithms	C	3
10.	SEN 308	Game Design and Development	C	2
		TOTAL		**16**

300 LEVEL SECOND SEMESTER

S/N	COURSE CODE	COURSE TITLE	STATUS	NUMBER OF UNITS
1.	ENT 312	Ventures Creation	C	2
2.	GST 312	Peace and Conflict Resolution	C	2
3.	CTC 304 IT	Tech Pro Elevate II	C	0
4.	SEN 320	Database Management II	E	2
5.	SEN 321	Computer Networking and Design	E	2
6.	SEN 322	Software Engineering innovation and new technology	C	2
7.	CSC 308	Operating Systems	C	3
8.	SEN 324	Web Application Development	C	3
9.	SEN 399	SIWES II	C	3

		TOTAL		**17**

400 LEVEL FIRST SEMESTER

S/N	COURSE CODE	COURSE TITLE	STATUS	NUMBER OF UNITS
1.	GST 411	Character in Leadership IV	C	2
2.	CTC 407	Works Pro Experience I	C	0
3.	SEN 401	Software configuration management and maintenance	C	2
4.	SEN 402	DevOps Mastery and Engineering Mobile Application Development	E	2
5.	SEN 403	Cloud computing and Cyber Security	E	2
6.	COS 409	Research methodology and technical report writing	C	3
7.	SEN 404	API Development	C	3
8.	SEN 497	Final year project I	C	3
		TOTAL		**15**

400 LEVEL SECOND SEMESTER

S/N	COURSE CODE	COURSE TITLE	STATUS	NUMBER OF UNITS
1.	CTC 408	Work Pro Experience II	C	0
2.	SEN 410	Software Architecture and Design	C	2
3.	SEN 411	Data Science and Data Engineering	E	2
4.	SEN 412	Big Data Analytics and Simulations	E	2
5.	SEN 413	Artificial Intelligence and Expert Systems	E	2
6	SEN 414	Embedded Systems	E	2
7.	INS 401	Project Management	C	2
8.	SEN 498	Final year project II	C	3
		TOTAL		**13**

Course Contents and Learning Outcomes

100 Level

GST 111: Communication in English (2 Units C: LH 15; PH 45)

Learning Outcomes

At the end of this course, students should be able to:

1. identify possible sound patterns in English language;
2. list notable Language skills;
3. classify word formation processes;
4. construct simple and fairly complex sentences in English;
5. apply logical and critical reasoning skills for meaningful presentations;
6. demonstrate an appreciable level of the art of public speaking and listening; and 7. write simple and technical reports.

Course Contents

Sound patterns in English Language (vowels and consonants, phonetics and phonology). English word classes (lexical and grammatical words, definitions, forms, functions, usages, collocations). Sentence in English (types: structural and functional, simple and complex). Grammar and Usage (tense, mood, modality and concord, aspects of language use in everyday life). Logical and Critical Thinking and Reasoning Methods (Logic and Syllogism, Inductive and Deductive Argument and Reasoning Methods, Analogy, Generalisation and Explanations). Ethical considerations, Copyright Rules and Infringements. Writing Activities: (Pre-writing, Writing, Post writing, Editing and Proofreading; Brainstorming, outlining, Paragraphing, Types of writing, Summary, Essays, Letter, Curriculum Vitae, Report writing, Note making etc. Mechanics of writing). Comprehension Strategies: (Reading and types of Reading, Comprehension Skills, 3RsQ). Information and Communication Technology in modern Language Learning. Language skills for effective communication. Major word formation processes. Writing and reading comprehension strategies. Logical and critical reasoning for meaningful presentations. Art of public speaking and listening. Report writing.

GST 112: Nigerian Peoples and Culture (2 Units C: LH 30)

Learning Outcomes

At the end of the course, students should be able to:

1. analyse the historical foundation of the Nigerian culture and arts in pre-colonial times;
2. list and identify the major linguistic groups in Nigeria;
3. explain the gradual evolution of Nigeria as a political unit;
4. analyse the concepts of Trade, Economic and Self-reliance status of the Nigerian peoples towards national development;
5. enumerate the challenges of the Nigerian State towards Nation building;
6. analyse the role of the Judiciary in upholding people's fundamental rights;
7. identify acceptable norms and values of the major ethnic groups in Nigeria; and
8. list and suggest possible solutions to identifiable Nigerian environmental, moral and value problems.

Course Contents

Nigerian history, culture and art up to 1800 (Yoruba, Hausa and Igbo peoples and culture; peoples and culture of the ethnic minority groups). Nigeria under colonial rule (advent of colonial rule in Nigeria; Colonial administration of Nigeria). Evolution of Nigeria as a political unit (amalgamation of Nigeria in 1914; formation of political parties in Nigeria; Nationalist movement and struggle for independence). Nigeria and challenges of nation building (military intervention in Nigerian politics; Nigerian Civil War). Concept of trade and economics of selfreliance (indigenous trade and market system; indigenous apprenticeship system among Nigeria people; trade, skill acquisition and self-reliance). Social justices and national development (law definition and classification. Judiciary and fundamental rights. Individual, norms and values (basic Nigeria norms and values, patterns of citizenship acquisition; citizenship and civic responsibilities; indigenous languages, usage and development; negative attitudes and conducts. Cultism, kidnapping and other related social vices). Re-orientation, moral and national values: The 3Rs – Reconstruction, Rehabilitation and Re-orientation; Reorientation Strategies: Operation Feed the Nation (OFN), Green Revolution, Austerity Measures, War Against Indiscipline (WAI), War Against Indiscipline and Corruption(WAIC), Mass Mobilisation for Self-Reliance, Social Justice and Economic Recovery (MAMSER), National Orientation Agency (NOA). Current socio-political and cultural developments in Nigeria.

MTH 101: Elementary Mathematics I(Algebra and Trigonometry) (2 Units C: LH 30)

Learning Outcomes

At the end of the course, students should be able to:

1. understand the basic definition of Set, Subset, Union, Intersection, Complements and use of Venn diagrams;
2. solve quadratic equations;

3. solve trigonometric functions;
4. understand various types of numbers; and 5. solve some problems using binomial theorem.

Course Contents

Elementary set theory, subsets, union, intersection, complements, Venn diagrams. Real numbers; integers, rational and irrational numbers, mathematical induction, real sequences and series, theory of quadratic equations, binomial theorem. Complex numbers; algebra of complex numbers; the Argand diagram. De-Moivre's theorem, nth roots of unity. Circular measure, trigonometric functions of angles of any magnitude, addition and factor formulae.

MTH 102: Elementary Mathematics II (Calculus) (2 Units C: LH 30)

Learning Outcomes

At the end of the course, students should be able to:

1. understand types of rules in Differentiation and Integration;
2. understand the meaning of Function of a real variable, graphs, limits and continuity; and 3. solve some applications of definite integrals in areas and volumes.

Course Contents

Function of a real variable, graphs, limits and idea of continuity. The derivative, as limit of rate of change. Techniques of differentiation. Extreme curve sketching; Integration as an inverse of differentiation. Methods of integration, Definite integrals. Application to areas, volumes.

PHY 101: General Physics I (Mechanics) (2 Units C: LH 30)

Learning Outcomes

At the end of the course students should be able to:

1. identify and deduce the physical quantities and their units;
2. differentiate between vectors and scalars;
3. describe and evaluate motion of systems on the basis of the fundamental laws of mechanics;
4. apply Newton's laws to describe and solve simple problems of motion;
5. evaluate work, energy, velocity, momentum, acceleration, and torque of moving or rotating objects;
6. explain and apply the principles of conservation of energy, linear and angular momentum; 7. describe the laws governing motion under gravity; and

8. explain motion under gravity and quantitatively determine behaviour of objects moving under gravity.

Course Contents

Space and time; units and dimension, Vectors and Scalars, Differentiation of vectors: displacement, velocity and acceleration; kinematics; Newton laws of motion (Inertial frames, Impulse, force and action at a distance, momentum conservation); Relative motion; Application of Newtonian mechanics; Equations of motion; Conservation principles in physics, Conservative forces, conservation of linear momentum, Kinetic energy and work, Potential energy, System of particles, Centre of mass; Rotational motion; Torque, vector product, moment, rotation of coordinate axes and angular momentum. Polar coordinates; conservation of angular momentum; Circular motion; Moments of inertia, gyroscopes and precession; Gravitation: Newton's Law of Gravitation, Kepler's Laws of Planetary Motion, Gravitational Potential Energy, Escape velocity, Satellites motion and orbits.

PHY 102: General physics II (Electricity & magnetism) (2 Units C: LH 30)

Learning Outcomes

At the end of the course, students should be able to:

1. describe the electric field and potential, and related concepts, for stationary charges;
2. calculate electrostatic properties of simple charge distributions using Coulomb's law, Gauss's law, and electric potential;
3. describe and determine the magnetic field for steady and moving charges;
4. determine the magnetic properties of simple current distributions using Biot-Savart and Ampere's law;
5. describe electromagnetic induction and related concepts and make calculations using Faraday and Lenz's laws;
6. explain the basic physical of Maxwell's equations in integral form;
7. evaluate DC circuits to determine the electrical parameters;
8. determine the characteristics of ac voltages and currents in resistors, capacitors, and Inductors.

Course Contents

Forces in nature. Electrostatics (electric charge and its properties, methods of charging). Coulomb's law and superposition. Electric field and potential. Gauss's law. Capacitance. Electric dipoles. Energy in electric fields. Conductors and insulators. DC circuits (current, voltage and resistance. Ohm's law. Resistor combinations. Analysis of DC circuits. Magnetic fields. Lorentz force. Biot-Savart and Ampère's laws. Magnetic dipoles. Dielectrics. Energy in magnetic fields. Electromotive force. Electromagnetic induction. Self and mutual inductances. Faraday and Lenz's laws. Step up and step down

transformers. Maxwell's equations. Electromagnetic oscillations and waves. AC voltages and currents applied to inductors, capacitors, and resistance.

PHY 107: General Practical Physics I (1 Unit C: PH 45)

Learning Outcomes

At the end of the course, students should be able to:

1. conduct measurements of some physical quantities;
2. make observations of events, collect and tabulate data;
3. identify and evaluate some common experimental errors;
4. plot and analyse graphs; and
5. draw conclusions from numerical and graphical analysis of data.

Course Contents

This introductory course emphasizes quantitative measurements, the treatment of measurement errors and graphical analysis. A variety of experimental techniques should 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.

PHY 108 - General Practical Physics II (1 Unit C: PH 45)

Learning Outcomes

At the end of the course, students should be able to:

1. conduct measurements of some physical quantities;
2. make observations of events, collect and tabulate data;
3. identify and evaluate some common experimental errors;
4. plot and analyse graphs;
5. draw conclusions from numerical and graphical analysis of data; and
6. prepare and present practical reports.

Course Contents

This practical course is a continuation of PHY 107 and is intended to be taught during the second semester of the 100 level to cover the practical aspect of the theoretical courses that have been covered with emphasis on quantitative measurements, the treatment of measurement errors, and graphical analysis. However, emphasis should be placed on the basic physical techniques for observation, measurements, data collection, analysis and deduction.

STA 111: Descriptive statistics: (3 Units C: LH 45)

Learning Outcomes

At the end of the course, students should be able to:

1. explain the basic concepts of descriptive statistics.
2. present data in graphs and charts.
3. differentiate between measures of location, dispersion and partition.
4. describe the basic concepts of Skewness and Kurtosis as well as their utility function in a given data set.
5. differentiate rates from ratio and how they are use.
6. compute the different types of index number from a given data set and interpret the output.

Course content

Statistical data. Types, sources and methods of collection. Presentation of data. Tables chart and graph. Errors and approximations. Frequency and cumulative distributions. Measures of location, partition, dispersion, skewness and Kurtosis. Rates, ratios and index numbers.

COS 101: Introduction to Computing Sciences (3 Units C: LH 30; PH 45) Learning Outcomes

At the end of the course, students should be able to:

1. explain basic components of computers and other computing devices;
2. describe the various applications of computers;
3. explain information processing and its roles in the society;
4. describe the Internet, its various applications and its impact;
5. explain the different areas of the computing discipline and its specializations; and
6. demonstrate practical skills on using computers and the internet.

Course Contents

Brief history of computing. Description of the basic components of a computer/computing device. Input/Output devices and peripherals. Hardware, software and human ware. Diverse and growing computer/digital applications. Information processing and its roles in society. The Internet, its applications and its impact on the world today. The different areas/programs of the computing discipline. The job specializations for computing professionals. The future of computing.

Lab Work: Practical demonstration of the basic parts of a computer. Illustration of different operating systems of different computing devices including desktops, laptops,

tablets, smart boards and smart phones. Demonstration of commonly used applications such as word processors, spreadsheets, presentation software and graphics. Illustration of input and output devices including printers, scanners, projectors and smartboards. Practical demonstration of the Internet and its various applications. Illustration of browsers and search engines. How to access online resources.

COS 102: Problem Solving (3 Units C: LH 30; PH 45)

Learning Outcomes

At the end of this course, students should be able to:

1. explain problem solving processes;
2. demonstrate problem solving skills;
3. describe the concept of algorithms development and properties of algorithms;
4. discuss the solution techniques of solving problem;
5. solve computer problems using algorithms, flowcharts, pseudocode, etc.; and
6. solve problems using programming language using C, PYTHON etc.

Course Contents

Core concepts of computing. Identification of problems. Types of problems (routine problems and non-routine problems). Problem-solving. Methods of solving computing problems. Algorithms and heuristics. Solvable and unsolvable problems. Solution techniques of solving problems; abstraction; analogy; brainstorming; trial and error; hypothesis testing; reduction; literal thinking; means-end analysis. Method of the focal object; morphological analysis; research; root cause analysis; proof; divide and conquer. General Problem-solving process. Solution formulation and design; flowchart; pseudocode; decision table; decision tree. Programming in any language.

Lab Work: Use of simple tools for algorithms and flowcharts; writing pseudocode; writing assignment statements, input-output statements and condition statements; demonstrating simple programs using any programming language (Visual Basic, Python, C)

200 Level

GST 212: Philosophy, Logic and Human Existence (2 Units C: LH 30)

Learning Outcomes

At the end of this course, students should be able to

1. know the basic features of philosophy as an academic discipline;

2. identify the main branches of philosophy & the centrality of logic in philosophical discourse;
3. know the elementary rules of reasoning;
4. distinguish between valid and invalid arguments;
5. think critically and assess arguments in texts, conversations and day-to-day discussions;
6. critically asses the rationality or otherwise of human conduct under different existential conditions;
7. develop the capacity to extrapolate and deploy expertise in logic to other areas of knowledge, and
8. guide his or her actions, using the knowledge and expertise acquired in philosophy and logic.

Course Contents

Scope of philosophy; notions, meanings, branches and problems of philosophy. Logic as an indispensable tool of philosophy. Elements of syllogism, symbolic logic— the first nine rules of inference. Informal fallacies, laws of thought, nature of arguments. Valid and invalid arguments, logic of form and logic of content — deduction, induction and inferences. Creative and critical thinking. Impact of philosophy on human existence. Philosophy and politics, philosophy and human conduct, philosophy and religion, philosophy and human values, philosophy and character molding, etc.

ENT 211: Entrepreneurship and Innovation (2 Units C: LH 30)

Learning Outcomes

At the end of this course, students should be able to:

1. explain the concepts and theories of entrepreneurship, intrapreneurship, opportunity seeking, new value creation, and risk taking;
2. state the characteristics of an entrepreneur;
3. analyse the importance of micro and small businesses in wealth creation, employment, and financial independence;
4. engage in entrepreneurial thinking;
5. identify key elements in innovation;
6. describe stages in enterprise formation, partnership and networking including business planning;
7. describe contemporary entrepreneurial issues in Nigeria, Africa and the rest of the world; and
8. state the basic principles of e-commerce.

Course Contents

Concept of Entrepreneurship (Entrepreneurship, Intrapreneurship/Corporate Entrepreneurship,). Theories, Rationale and relevance of Entrepreneurship

(Schumpeterian and other perspectives, Risk-Taking, Necessity and opportunity-based entrepreneurship and Creative destruction). Characteristics of Entrepreneurs (Opportunity seeker, Risk taker, Natural and Nurtured, Problem solver and change agent, Innovator and creative thinker). Entrepreneurial thinking (Critical thinking, Reflective thinking, and Creative thinking). Innovation (Concept of innovation, Dimensions of innovation, Change and innovation, Knowledge and innovation). Enterprise formation, partnership and networking (Basics of business plan, forms of business ownership, business registration and forming alliances and joint ventures). Contemporary Entrepreneurship Issues (Knowledge, Skills and Technology, Intellectual property, Virtual office, Networking). Entrepreneurship in Nigeria (Biography of inspirational Entrepreneurs, Youth and women entrepreneurship, Entrepreneurship support institutions, Youth enterprise networks and Environmental and cultural barriers to entrepreneurship). Basic principles of e-commerce.

MTH 201: Mathematical Methods 1 **(2 Units C: LH 30)**

Learning Outcomes

At the end of the course, students should be able to:

1. understand Real-valued functions of a real variable;
2. solve some problems using Mean value Theorem and Taylor Series expansion; and
3. evaluate Line Integral, Surface Integral and Volume Integrals.

Course Contents

Real-valued functions of a real variable. Review of differentiation and integration and their applications. Mean value theorem. Taylor series. Real-valued functions of two and three variables. Partial derivatives chain rule, extrema, lagrangian multipliers. Increments, differentials, and linear approximations. Evaluation of line, integrals. Multiple integrals.

MTH 202: Mathematical Methods II **(2 Units C: LH 30)**

Learning Outcomes

At the end of the course, students should be able to:

1. define the following: order and degree of a differential equation;
2. describe some techniques for solving first and second order linear and non-linear equations; and
3. solve some problems related to geometry and physics.

Course Contents

Derivation of differential equations from primitive, geometry, physics etc. order and degree of differential equation. Techniques for solving first and second order linear and non-linear equations. Solutions of systems of first order linear equations. Finite linear difference equations. Application to geometry and physics.

COS 201: Computer Programming I **(3 Units C: LH 30; PH 45)**

Learning Outcomes

At the end of this course, students should be able to:

1. explain the principles of good programming and structured programming concepts;
2. explain the programming constructs, syntax and semantics of a higher-level language;
3. describe the chosen programming language variables, types, expressions, statements and assignment; simple input and output;
4. describe the programme control structures, functions and parameter passing, and structured decomposition; and
5. develop simple programs in the taught programming language as well as debug and test them.

Course Contents

Essentials of computer programming. Types of programming: Functional programming, Declarative programming, Logic programming, object-oriented programming. Scripting languages, structured programming principles. Basic data types, variables, expressions, assignment statements, and operators. Basic object-oriented concepts: abstraction, objects, classes, methods; parameter passing; encapsulation. Class hierarchies and programme organisation using packages/namespaces. Use of API – use of iterators/enumerators, List, Stack, Queue from API. Searching; sorting; Recursive algorithms. Event-driven programming: event-handling methods; event propagation; exception handling. Introduction to Strings and string processing. Simple I/O; control structures; Arrays. Simple recursive algorithms, inheritance, polymorphism.

Lab work: Programming assignments; design and implementation of simple algorithms e.g. average, standard deviation, searching and sorting. Developing and tracing simple recursive algorithms. Inheritance and polymorphism.

COS 202: Computer Programming II **(3 Units C: LH 30; PH 45)**

Learning Outcomes

At the end of this course, students should be able to:

1. demonstrate the principles of good programming and structured programming concepts;
2. demonstrate string processing, internal searching, sorting, and recursion;

3. demonstrate the basic use of OOP concepts: classes, objects, inheritance, polymorphism, data abstraction;
4. apply the tools for developing, compiling, interpreting and debugging programs; and
5. demonstrate the use of syntax and data objects, operators. Central flow constructs, objects and classes programming, Arrays, methods, Exceptions, Applets and the Abstract, OLE, Persistence, Window Toolkit.

Course Contents

Review and coverage of advanced object-oriented programming - polymorphism, abstract classes and interfaces; Class hierarchies and program organisation using packages/namespaces; Use of API – use of iterators/enumerators, List, Stack, Queue from API; Searching; sorting; Recursive algorithms; Event-driven programming: event-handling methods; event propagation; exception handling. Applications in Graphical User Interface (GUI) programming.

Lab work: Programming assignments leading to extensive practice in problem solving and program development with emphasis on object-orientation. Solving basic problems using static and dynamic data structures. Solving various searching and sorting algorithms using iterative and recursive approaches. GUI programming.

SEN201: Introduction to Software Engineering (2 units C: LH 30)

Learning Outcomes

At the end of this course, students should be able to:

1. describe the concept of the software life cycle;
2. explain the phases of requirements analysis, design, development, testing and maintenance in a typical software life cycle;
3. differentiate amongst the various software development models;
4. utilise UML for object oriented analysis and design;
5. describe different design architectures;
6. explain the various tasks involved in software project management; and
7. describe the basic legal issues related to Software Engineering.

Course Contents

Software Engineering concepts and principles. Design, development and testing of software systems. Software processes: software lifecycle and process models. Process assessment models. Software process metrics. Life cycle of software system. Software requirements and specifications. Software design. Software architecture. Software metrics. Software quality and testing. Software architecture. Software validation. Software evolution: software maintenance; characteristics of maintainable software; re-engineering; legacy systems; software reuse. Software Engineering and its place as a

computing discipline. Software project management: team management; project scheduling; software measurement and estimation techniques; risk analysis; software quality assurance; software configuration management. Software Engineering and law.

CSC 203: Discrete Structures (3 Units C: LH 45)

Learning Outcomes

At the end of this course, students should be able to:

1. convert logical statements from informal language to propositional and predicate logic expressions;
2. describe the strengths and limitations of propositional and predicate logic;
3. outline the basic structure of each proof technique (direct proof, proof by contradiction, and induction) described in this unit;
4. apply each of the proof techniques (direct proof, proof by contradiction, and induction) correctly in the construction of a sound argument;
5. apply the pigeonhole principle in the context of a formal proof.;
6. compute permutations and combinations of a set, and interpret the meaning in the context of the particular application;
7. map real-world applications to appropriate counting formalisms, such as determining the number of ways to arrange people around a table, subject to constraints on the seating arrangement, or the number of ways to determine certain hands in cards (e.g., a full house); and
8. solve a variety of basic recurrence relations.

Course Contents

Propositional Logic, Predicate Logic, Sets, Functions, Sequences and Summation, Proof Techniques, Mathematical induction, Inclusion-exclusion and Pigeonhole principles, Permutations and Combinations (with and without repetitions), The Binomial Theorem, Discrete Probability, Recurrence Relations.

INS 204: Systems Analysis and Design (3 Units C: LH 30; PH 45) Learning Outcomes

At the end of this course, students should be able to:

1. describe system requirements gathering techniques;
2. explain data modelling technique (entity relationship modelling);
3. explain process modelling technique (data flow diagram);
4. describe system architectural design; 5. describe process and database design; and
6. explain user interface design.

Course Contents

Structured approach to analysis and design of information systems for businesses. Software development life cycle. Structured top-down and bottom-up design. Dataflow diagramming. Entity relationship modelling. Computer aided software engineering. Input and output, prototyping design and validation. File and database design. Design of user interfaces. Comparison of structured and object-oriented design

Lab Work: system requirements gathering techniques;data modelling techniques (entity relationship modelling);process modelling techniques (data flow diagram); use of UML diagrams; system architectural design; user interface design.

IFT 211: Digital Logic Design **(3 Units C: LH 15; PH 45)**

Learning Outcomes

At the end of this course, student should be able to:

1. explain why everything is data, including instructions, in computers;
2. describe how negative integers, fixed-length numbers and non-numeric data are represented;
3. convert numerical data from one format to another;
4. describe computations as a system characterised by a known set of configurations with transitions from one unique configuration (state) to another (state);
5. describe the distinction between systems whose output is only a function of their input (Combinational) and those with memory/history (Sequential);
6. describe a computer as a state machine that interprets machine instructions;
7. articulate that there are many equivalent representations of computer functionality, including logical expressions and gates, and be able to use mathematical expressions to describe the functions of simple combinational and sequential circuits; and
8. design the basic building blocks of a computer: arithmetic-logic unit (gate-level), registers (gate-level), central processing unit (register transfer-level), memory (register transferlevel).

Course Contents

Introduction to information representation and number systems. Boolean algebra and switching theory. Manipulation and minimisation of completely and incompletely specified Boolean functions. Physical properties of gates: fan-in, fan-out, propagation delay, timing diagrams and tri-state drivers. Combinational circuits design using multiplexers, decoders, comparators and adders. Sequential circuit analysis and design, basic flip-flops, clocking and timing diagrams. Registers, counters, RAMs, ROMs, PLAs, PLDs, and FPGAs.

Lab Work: Simple combinational gates (AND, OR, NOT, NAND, NOR); Combinational circuits design using multiplexers, decoders, comparators and adders.

Sequential circuit analysis and design using basic flip-flops (S-R, J-K, D, T flip-flops); Demonstration of registers, counters, RAMs, ROMs, PLAs, PLDs, and FPGAs.

IFT 212: Computer Architecture and Organisation (3 Units C: LH 30; PH 45)

Learning Outcomes:
At the end of this course, student should be able to:

1. explain different instruction formats, such as addresses per instruction and variable length vs. fixed length formats;
2. describe the organisation of the classical von Neumann machine and its major functional units;
3. explain how subroutine calls are handled at the assembly level;
4. describe the basic concepts of interrupts and I/O operations;
5. write simple assembly language program segments;
6. show how fundamental high-level programming constructs are implemented at the machine-language level;
7. compare alternative implementation of data paths;
8. discuss the concept of control points and the generation of control signals using hardwired or micro-programmed implementations;

Course Contents
Instruction format and types, memory and I/O instructions, dataflow, arithmetic, and flow control instructions, addressing modes, stack operations, and interrupts. Data path and control unit design. RTL, microprogramming, and hardwired control. Practice of assembly language programming. Memory hierarchy, cache memory, virtual memory. I/O fundamentals. Interrupt structures.

Lab work: Programming assignments to practice MS-DOS batch programming, Assembly Process, Debugging, Procedures, Keyboard input, Video Output, File and Disk I/O and Data Structure. Instruction and arithmetic pipelining, superscalar architecture. Reduced Instruction Set Computers. Parallel architectures and interconnection networks.

SEN 299: Students Industrial Work Experience Scheme I (3 Units C: PH 135)

Learning Outcomes
At the end of this training, students should be able to:

1. explain how a typical software engineering firm operates;
2. describe the various assignments carried out and the skills acquired during the SIWES period; and
3. submit a comprehensive report on the knowledge acquired and the experience gained during the exercise.

Course Contents

Students are attached to private and public organisations for a period of three months during the second year session long break with a view to making them acquire practical experience and to the extent possible, develop skills in all areas of Software Engineering. Students are supervised during the training period and shall be expected to keep records designed for the purpose of monitoring their performance. They are also expected to submit a report on the experience gained and defend their reports.

300 Level

GST 312: Peace and Conflict Resolution (2 Units C: LH 30)

Learning Outcomes

At the end of the course, students should be able to:

1. analyse the concepts of peace, conflict and security;
2. list major forms, types and root causes of conflict and violence;
3. differentiate between conflict and terrorism;
4. enumerate security and peace building strategies; and
5. describe roles of international organisations, media and traditional institutions in peace building.

Course Contents

Concepts of Peace, Conflict and Security in a multi-ethnic nation. Types and Theories of Conflicts: Ethnic, Religious, Economic, Geopolitical Conflicts; Structural Conflict Theory, Realist Theory of Conflict, Frustration-Aggression Conflict Theory. Root causes of Conflict and Violence in Africa: Indigene and settlers Phenomenon; Boundaries/boarder disputes; Political disputes; Ethnic disputes and rivalries; Economic Inequalities; Social disputes; Nationalist Movements and Agitations; Selected Conflict Case Studies – Tiv-Junkun; Zango Kartaf, Chieftaincy and Land disputes etc. Peace Building, Management of Conflicts and Security: Peace & Human Development. Approaches to Peace & Conflict Management --- (Religious, Government, Community Leaders etc.). Elements of Peace Studies and Conflict Resolution: Conflict dynamics assessment Scales: Constructive & Destructive. Justice and Legal framework: Concepts of Social Justice; The Nigeria Legal System. Insurgency and Terrorism. Peace Mediation and Peace Keeping. Peace & Security Council (International, National and Local levels) Agents of Conflict resolution – Conventions, Treaties Community Policing: Evolution and Imperatives. Alternative Dispute Resolution, ADR. Dialogue b). Arbitration, c). Negotiation d). Collaboration etc. Roles of International Organisations in Conflict Resolution. (a). The United Nations, UN and its Conflict Resolution Organs. (b). The African Union & Peace Security Council (c). ECOWAS in Peace Keeping. Media and

Traditional Institutions in Peace Building. Managing Post-Conflict Situations/Crisis: Refugees. Internally Displaced Persons, IDPs. The role of NGOs in Post-Conflict Situations/Crisis

ENT 312: Venture Creation **(2 Units C: LH 15; PH 45)**

Learning Outcomes

At the end of this course, students, through case study and practical approaches, should be able to:

1. describe the key steps in venture creation;
2. spot opportunities in problems and in high potential sectors regardless of geographical location;
3. state how original products, ideas, and concepts are developed;
4. develop business concept for further incubation or pitching for funding;
5. identify key sources of entrepreneurial finance;
6. implement the requirements for establishing and managing micro and small enterprises;
7. conduct entrepreneurial marketing and e-commerce;
8. apply a wide variety of emerging technological solutions to entrepreneurship; and 9. appreciate why ventures fail due to lack of planning and poor implementation.

Course Contents

Opportunity Identification (Sources of business opportunities in Nigeria, Environmental scanning, Demand and supply gap/unmet needs/market gaps/market research, Unutilised resources, Social and climate conditions, and technology adoption gap). New business development (business planning, market research). Entrepreneurial finance (venture capital, equity finance, microfinance, personal savings, small business investment organisations, and business plan competition). Entrepreneurial marketing and e-commerce (Principles of marketing, customer acquisition & retention, B2B, C2C and B2C models of e-commerce, first mover advantage, e-commerce business models and successful e-commerce companies,). Small business management/family business: Leadership & Management, basic bookkeeping, nature of family business and family business growth model. Negotiation and business communication (Strategy and tactics of negotiation/bargaining, traditional and modern business communication methods). Opportunity discovery demonstrations (business idea generation presentations, business idea contest, brainstorming sessions, idea pitching). Technological solutions (the concept of market/customer solution, customer solution, and emerging technologies, business applications of new technologies- Artificial Intelligence (AI), Virtual/Mixed Reality (VR), Internet of Things (IoT), Blockchain, Cloud Computing, renewable energy, etc. digital business and e-commerce strategies).

SEN 301: Object-Oriented Analysis and Design (2 Units C: LH 15; PH 45)

Learning Outcomes

At the end of this course, students should be able to:

1. explain the concept of the object-oriented approach to modelling;
2. describe the conceptual model of the UML-based software development life cycle; 3. demonstrate how to use the major UML diagrams for object-oriented analysis and design;

4. demonstrate the use of UML-based CASE tools.

Course Contents

Object-oriented approach to information system development, particularly in reference to the earlier stages of analysis and design. Importance of modelling, principles of modelling, objectoriented modelling, conceptual model of the Unified Modelling Language (UML), architecture, software development life cycle. The principles and basic concepts of object orientation and the different aspects of object-oriented modelling as represented by the UML technique. Case study of a typical UML-based CASE tool.

Lab Work: Practical exercises on different requirements specification and design activities; developing problem statements, SRS documents and Use Case Diagrams; designing UML Activity diagrams, UML Class diagrams and State Chart diagrams; drawing partial layered, logical architecture diagram with UML package diagram notation; Designing Component and Deployment diagrams.

SEN 304: Software Testing & Quality Assurance (2 Units C: LH 15; PH 45)

Learning Outcomes

At the end of this Course, students should be able to:

1. state the critical importance of software testing in ensuring software quality;
2. explain the difference between validation and verification and their different techniques;
3. describe the concept of quality assurance and differentiate between process assurance and product assurance;
4. describe the different statistical approaches to quality control.

Course Contents

The importance of Software Testing. Understanding Verification and Validation. How to assure it and verify it, and the need for a culture of quality. Avoidance of errors and other quality problems. Inspections and reviews. Testing, verification and validation

techniques. Process assurance vs. Product assurance. Quality process standards. Product and process assurance. Problem analysis and reporting. Statistical approaches to quality control

Lab WorK: Debugging tools; unit testing – black box and white testing techniques; integration and system testing tools; other testing tools – performance testing, load testing, stress testing, regression testing, security testing; manual testing vs automated testing.

SEN 306: Software Construction (2 Units C: LH 15; PH 45)

Learning Outcomes

At the end of this Course, students should be able to:

1. explain the importance of Software Construction and the key construction decisions;
2. describe the key issues in design including key design concepts, levels of design and Abstract Data Types (ADTs);
3. discuss best practices in dealing with routines, fundamental data types and different types of statements; and
4. describe how to ensure software quality through developer testing, debugging and software craftsmanship.

Course Contents

Definition of Software Construction; Its importance; Key construction decisions – choice of programming language, selection of major construction decisions. Design in construction – Key design concepts, levels of design, design heuristics. Abstract Data Types (ADTs). Working

Classes. High Quality Routines. The Pseudo Code Programming Process. Fundamental Data Types – Numbers, Characters and Strings, Boolean Variables, Arrays, Tables. Types of Statements – Straight Line Code, Loops, Control Structures; Developer Testing and Debugging. Software Craftsmanship – Layout and Style, Documentation, Personal Character. **Lab Work:** Practicals on the most common tools to ensure good software construction. The features include static code analysers to check that code follows coding conventions, special code searching and editing, collaboration support to allow multiple programmers working simultaneously, support for proper code documentation. Practice with IDEs (such as Visual Study Code, NetBeans and Eclipse) on debugging, compilation, running of code, auto completion and version control.

SEN 322: Software Engineering Innovation and New Technology (2 Units C: LH 15)

Learning Outcomes

At the end of this course, students should be able to:

1. explain business models;
2. identify some entrepreneurial opportunities available in Software Engineering;
3. describe business plan and business startup process;
4. explain business feasibility and strategy;
5. explain marketing strategies; and
6. discuss business ethics and legal issues.

Course Contents

Software entrepreneurial process. Principles of software business ownership. Identifying software market opportunities. Entrepreneurial software marketing. Software business communication and negotiation techniques. Feasibility analysis. Entrepreneurial financing. Legal issues. Software business plan development. Risk management.

SEN 399: Students Industrial Work Experience Scheme II (3 Units C: PH 135)

Learning Outcomes

At the end of this training, students should be able to:

1. explain how a typical software engineering firm operates;
2. describe the various assignments carried out and the skills acquired during the SIWES period; and
3. submit a comprehensive report on the knowledge acquired and the experience gained during the exercise.

Course Contents

Students are attached to private and public organisations for a period of three months during the third year session long break with a view to making them acquire additional practical experience in all areas of Software Engineering over and above what is gained in SEN 299. Students are supervised during the training period and shall be expected to keep records designed for the purpose of monitoring their performance. They are also expected to submit a report on the experience gained and defend their reports.

CSC 301: Data Structures (3 Units C: LH 30, PH 45)

Learning Outcomes

At the end of this Course, students should be able to:

1. discuss the appropriate use of built-in data structures;
2. apply object-oriented concepts (inheritance, polymorphism, design patterns, etc.) in software design;

3. implement various data structures and their algorithms, and apply them in implementing simple applications;
4. choose the appropriate data structure for modelling a given problem;
5. analyse simple algorithms and determine their efficiency using big-O notation; and
6. apply the knowledge of data structures to other application domains like data compression and memory management.

Course Contents

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.

Lab work: Writing C^{+}/C^{++} functions to perform practical exercises and implement using the algorithms on arrays, records, string processing, queues, trees, pointers and linked structures.

CSC 308: Operating Systems **(3 Units C: LH 30; PH 45)**

Learning Outcomes

At the end of this course, students should be able to:

1. recognise operating system types and structure;
2. describe OS support for processes and threads;
3. recognize CPU scheduling, synchronization, and deadlocks;
4. resolve OS issues related to synchronization and failure for distributed systems;
5. explain OS support for virtual memory, disk scheduling, I/O, and file systems;
6. identify security and protection issues in computer systems; and
7. use C and Unix commands, examine behaviour and performance of Linux, and develop various system programs under Linux to make use of OS concepts related to process synchronization, shared memory, mailboxes, file systems, etc.

Course Contents

Fundamentals of operating systems design and implementation, history and evolution of operating systems, Types of operating systems; Operating system structures; Process management: processes, threads, CPU scheduling, process synchronization; Memory management and virtual memory; File systems; I/O systems; Security and protection; Distributed systems; Case studies.

Lab work: Practical hands-on engagement to facilitate understanding of the material taught in the course. All the process, memory, file and directory management issues will be demonstrated under the LINUX operating system. Also UNIX commands will be briefly discussed. Alternatively, hands-on exposure may be through the use of operating

systems developed for teaching, like TempOS, Nachos, Xinu or MiniOS. Another possibility is through programming exercises that implement and simulate algorithms taught. Simulation of CPU scheduling algorithms, producer-consumer problem, memory allocation algorithms, file organisation techniques, deadlock algorithms and disk scheduling algorithms.

400 Level

COS 409: Research Methodology and Technical Report Writing (3 Units C: LH 45)

Learning Outcomes

At the end of this course, students should be able to:

1. describe research, types, approaches, significance of research, research methods, research process, criteria and strategy for good research;
2. discuss the principles of scientific research, scientific investigation, problem formulation, and technique of the research problem;
3. describe the various elicitation methods;
4. develop appropriate data collection instruments;
5. conduct the literature review process; and
6. prepare briefs as well as technical reports and know how to cite referenced works and prepare references and bibliography.

Course Contents

Foundations of Research. Types of Research. Research Approaches. Significance of Research. Research Methods versus Methodology. Research Process. Criteria and Strategy for Good Research. Principles of Scientific Research. Scientific investigation. Problem Formulation and Its Techniques. Developing Research Proposal and Research Plan. Formulation of Research Questions and Hypothesis Testing. Developing Research Proposal and Research Plan. Literature Review. Procedure for Reviewing Related Relevant Studies. Methods for Collection of Primary and Secondary Data. Elicitation Techniques - Questionnaires, Interviewing, Ethnography, etc. Guidelines for Constructing Data Instruments. Methods of AnalysingData in Computing and Related Disciplines.System Design: Architectural design, input design, process design, output design. Use case analysis, sequence diagram, activity diagram, deployment diagram, etc.Types of Reports. Technical Report Writing. Layout and Mechanics of Writing a Research Report. Standard Techniques for Research Documentation. Interpretation and Presentation of Results. How to Cite Referenced Works and Prepare References and Bibliography.

SEN401: Software Configuration Management & Maintenance (2 Units C: LH 15; PH 45)

Learning Outcomes

At the end of this course, students should be able to:

1. state the importance of software configuration management;
2. explain the typical processes in software configuration management; and 3. describe the key issues in software maintenance

Course Contents

Management of the software configuration management process – organisation context for software configuration management, constraints and guidance for software configuration management process. Planning for software configuration management, software configuration management plan, and surveillance of software configuration management. Software configuration identification and software library. Software configuration control – requesting, evaluating and approving software changes, implementing software changes, and deviations and waivers. Software configuration status accounting – software configuration status information and reporting. Software configuration auditing. Key issues in software maintenance – technical issues, management issues, maintenance cost estimation, and software maintenance measurement. Maintenance process – maintenance processes and activities. Techniques for maintenance – program comprehension, re-engineering, reverse engineering, migration, and retirement.

Lab Work: Practical demonstration of software configuration management processes. Working with software configuration management software. Illustration of software maintenance processes and activities. Working with software maintenance software. Illustration of software re-engineering and reverse engineering techniques.

SEN 410: Software Architecture and Design (2 Units C: LH 15; PH 45)

Learning Outcomes

At the end of this course, students should be able to:

1. describe design patterns, frameworks and architectures;
2. explain design of distributed systems and component based design; and
3. describe the techniques of designing for qualities such as reliability, performance, safety, security and reusability.

Course Contents

An in-depth look at software design. Continuation of the study of design patterns, frameworks, and architectures. Survey of current middleware architectures. Design of distributed systems using middleware. Component based design. Measurement theory and appropriate use of metrics in design. Designing for quality attributes such as reliability, performance, safety, security, reusability, etc. Measuring internal qualities and complexity of software. Evaluation and evolution of designs.

Lab Work: Practical demonstration of the use of design patterns, frameworks and architectures. Practical simulation of distributed systems. Illustration of component based design. Working with software design software. Use of software metrics measuring software.

SEN 497: Final Year Project I **(3 Units C: PH 135)**

Learning Outcomes:
At the end of this course, students should be able to:

1. identify researchable project topics in Software Engineering;
2. search and review literature pertinent to identified problem statements;
3. acknowledge and reference sources of information used in the research report;
4. conceptualise and design a research methodology to address an identified problem;
5. determine tools for analysing data collected based on research objectives;
6. write a coherent report on the research conducted;
7. take instruction to accomplish the set goals for the project with the guidance of the research supervisor; and
8. orally present the written project report.

Course Contents
An independent or group investigation to address a Software Engineering problem under the supervision of a lecturer. Before registering, the student must submit a written proposal to the supervisor for review. The proposal should give a brief outline of the project, estimated schedule of completion, and computer resources needed. A formal written report is essential and an oral presentation may also be required. At the end of the semester, the introduction, literature review and methodology employed should be submitted for grading.

SEN 498: Final Year Project II **(3 Units C: PH 135)**

Learning Outcomes
Upon completion of the project, students should be able to:

1. demonstrate technical skills in Software Engineering;

2. demonstrate generic transferable skills such as communication and team work;
3. produce a technical report in the chosen project;
4. defend the written project report; and
5. appreciate the art of carrying out a full-fledged research.

Course Contents

This is a continuation of SEN 497. This contains the implementation and the evaluation of the project. A formal written report (chapters 4-5) has to be approved by the supervisor. A final report comprising chapters 1-5 will be submitted to the department for final grading. An oral presentation is required.

INS 401 Project Management (2 Units C: LH 30)

Learning Outcomes

At the end of this course, students should be able to:

1. describe project management planning;
2. describe project scheduling;
3. explain management of project resources;
4. discuss project procurement, monitoring and execution; and
5. explain project communication and time management;

Course Contents

Introduction to Project Management. The Project Management Lifecycle. Project management and systems development or acquisition. The project management context, technology and techniques to support the project management lifecycle, and Project management processes. Managing Project Teams: Project team planning, Motivating team members, Leadership, power and conflict in project teams, and Managing global project teams. Managing Project Communication and enhancing team communication. Managing Project Scope: Project initiation, how organisations choose projects, activities, and developing the project charter. Managing Project Scheduling: Common problems in project scheduling, and Techniques for project scheduling. Managing Project Resources: Types of resources (human, capital, time), and techniques for managing resources. Project quality and tools to manage project quality.

Managing project risk and tools for managing project risk. Managing Project Procurement: Alternatives to systems development, External acquisition, Outsourcing-domestic and offshore, Steps in the procurement process, and Managing the procurement process. Project Execution, Control and Closure: Managing project execution, monitoring progress and managing change, Documentation and communication, and Common problems in project execution; Managing Project Control and Closure:

Obtaining information, Cost control, Change control, Administrative closure, Personnel closure, Contractual closure and Project auditing

The 30% Additions

CUL-CYB-171 Introduction to Cyber Hygiene (2 Units; Compulsory; LH = 30)

Senate-approved Relevance

A course in Cyber Hygiene is in tandem with Caleb University's vision of providing highly qualitative and relevant university education that will engender the production of future leaders imbued with the ability and integrity to positively impact their local environment while also being globally competitive. The world is at the centre spread of automation. Everyone in every place leverage on technology brought about by the internet. In all of these, much reliance is placed on systems to deliver as anticipated. Caleb University has integrity as one its core values without which everything is almost nothing. A proper way to maintain integrity in Cyberspace must begin with good cyber hygiene. Introduction to Cyber hygiene as a course offers students the culture of preserving user account and access control mechanisms.

Overview

Credential theft is a type of cybercrime that involves stealing a victim's proof of identity. Once credential theft has been successful, the attacker will have the same account privileges as the victim. Stealing credentials is the first stage in a credential-based attack. Credential theft allows criminals to reset passwords, lock victims out of their accounts, download private data, gain access to other computers in the network or wipe the victim's data and backups. Cybercriminals can also gain remote access to systems by using legitimate passwords to log into third-party services such as Dropbox, DocuSign and Microsoft 365.

This course makes students aware of the risk of accounts, credentials and identity theft, teach them how to safeguard their information, enable them to recognize the signs of accounts, credentials and identity theft, and provide them with the knowledge and tools to recover if they were to become victims.

Learning Objectives

By the end of the lesson, students will understand:

1. Explain techniques used to steal one's accounts, credentials and identity
2. Describe the potential damage caused by accounts, credentials and identity theft
3. Explain accounts, credentials and identity theft
4. Protect their personal data and avoid becoming a victim
5. Recognize accounts, credentials and identity theft operation
6. Prevent credentials stealing

7. Evaluate steps to take if they are, or believe they may become, a victim of accounts, credentials and identity theft
8. Acquire resources available to help victim

Learning Outcomes

1. Learn how to defend against one of the worst kind of thieves – those who will rip off one's online accounts, credentials and identity and act on one's behalf in financial transactions, personal relations and more.
2. Determine the damage through accounts, credentials and identity theft
3. Recognise techniques used to steal one's accounts, credentials and identity.
4. Explain accounts, credentials and identity ploys.
5. Describe and evaluate methods to protect accounts, credentials and identity theft.
6. Know the action to be taken if one's accounts, credentials and identity is stolen.
7. Explain ways to operate more safely online and offline with digital devices.

Course Content

Introduction to accounts, credentials and identity. Types of accounts, credentials and identity theft. Effects of accounts, credentials and identities theft. Identity theft and the dark web.
The three d's (deter, detect and defend) of accounts, credentials and identities theft. Common ways accounts, credentials and identity theft happens. Recovery from accounts, credentials and identity theft. Prevention of accounts, credentials and identities theft. Internet – friend or foe.
Attacks – Dictionary attack, password attack (online and offline) and Brute Force. The dark web and accounts, credentials and identities theft. Passphrase. Password Security Manager. Personal Accounts Breach. Personal Accounts Recovery. Email Accounts.

Minimum Academic Standards

Computer Science laboratory with a NUC-MAS requirement facility.

CUL-CSC 172 Data Mining and Warehousing (3 Units; Elective; LH = 30)

Senate-approved Relevance

A course in Data Mining and Warehousing is in tandem with Caleb University's vision of providing highly qualitative and relevant university education that will engender the production of future leaders imbued with the ability and integrity to positively impact their local environment while also being globally competitive. Data mining and warehousing as a course is aimed at raising students who would possess qualitative technological education that can match any university in the world having acquired relevance skills in data mining and warehousing. Data mining is intended to provide the organization with hidden insights that cannot otherwise be gleaned from large-scale data. Data mining is the process of sorting through large data sets to identify patterns and relationships that can help solve business problems through data analysis. Data mining techniques and tools enable enterprises to predict future trends and make more-informed business decisions. Data warehousing is intended to provide the organization with a reliable source of data for many types of business analysis Data warehousing improves the speed

and efficiency of accessing different data sets and makes it easier for corporate decision-makers to derive insights that will guide the business and marketing strategies that set them apart from their competitors. Therefore, it becomes imperative for our students to possess the basic knowledge of data mining and warehousing that would make it easier for them to mine relevant data from the warehouse which can be used for corporate decision making.

Overview

From the time immemorial humans have been manually extracting hidden predictive patterns from data, but the increasing volume of data in modern time requires an automatic approach. With the advent of data mining, it provides a new powerful technology with great potential to help private and public focus on the most important information in their data bases. Data mining is a result of a long process of research and product development, and the primary reason is to assist not only in uncovering hidden patterns from databases but also consists of collecting, managing, analysis and prediction of data. Data mining refers to extracting or mining knowledge from large amounts of data.

A data warehousing is process for collecting and managing data from varied sources to provide meaningful business insights. A data warehouse is typically used to connect and analyze business data from heterogeneous sources. The data warehouse is the core of the BI system which is built for data analysis and reporting. it is a blend of technologies and components which aids the strategic use of data. It is also a electronic storage of a large amount of information by a business which is designed for query and analysis instead of transaction processing. It is a process of transforming data into information and making it available to users in a timely manner to make a difference.

Objectives

The following are the objectives the course is set out to achieve:

1. Explain the basics of data mining and warehousing
2. Classify data mining and approaches to data mining problems
3. Provide the tools of data mining and its application.
4. Develop the capacity to build a simple data warehouse and secure it.

Learning Outcomes

At the end of the course students should be able to:

1. Define the term data mining
2. Know the motivation behind data mining? why it is so important?
3. Differentiate between data mining and knowledge discovery in databases (KDD)
4. Identify the different kinds of information collected in our databases
5. Explain the different kinds of data mining functionalities and the knowledge they discover.
6. Identify the various classifications of data mining systems
7. describe the various challenges facing data mining.
8. Identify the various applications of data mining in our societies.
9. Define the term data warehouse
10. State the goals and characteristics of data warehouse
11. Describe the users and application areas of data warehouse.

Course Contents

Concepts of Data Mining- Overview of Data Mining, Data Description for Data Mining, Classification of Data Mining, Data Mining Technologies. Data Processes and Trends- Data Mining Process, Data Preparation and Preprocesses, Data Mining Applications and Future Trends in Data Mining. Data Warehousing Concepts- Overview of Data Warehouse, Data Warehouse Architecture, Data Warehouse Design and Data Warehouse and OLAP Technology, and Securing the Data Warehouse.

Minimum Academic Standards
Computer Science laboratory with a NUC-MAS requirement facility.

CUL-CSC 176 **Introduction to Web Design** (2 Units; Elective; L =15, PH =45)

Senate-approved Relevance

A course in Web Design is in tandem with Caleb University's vision of providing highly qualitative and relevant university education that will engender the production of future leaders imbued with the ability and integrity to positively impact their local environment while also being globally competitive. Web design is the process of creating and designing websites. It involves a combination of visual aesthetics, user experience, and technical skills to develop a website that is both appealing and functional. The goal of web design is to create a website that not only looks good but also meets the needs of the website's target audience. A well-designed website can help a business or organization build credibility, increase traffic, and ultimately achieve its goals. The field of web design has evolved over the years, and today's designers use a variety of tools and techniques to create websites that are responsive, accessible, and optimized for search engines.

Overview

Web design incorporates various elements such as typography, color, layout, and visual imagery, to create an engaging user interface. It also involves the use of coding languages such as HTML, CSS, and JavaScript to build the website's structure, functionality, and interactivity. Today's web design practices have evolved to include responsive design, which ensures that websites are optimized for various screen sizes and devices, and accessibility, which ensures that the website is designed to be accessible to all users, including those with disabilities.

The importance of web design cannot be overstated, as it is often the first point of contact between a business or organization and its potential customers or clients. A well-designed website can help a business build credibility, attract more traffic, and ultimately achieve its goals. Web design is a dynamic field that continues to evolve and innovate. As technology advances and user expectations change, web designers must adapt to stay current and provide the best possible user experience.

Objectives

The following are the objectives the course is set out to achieve:

5. Describe different Text Editors
6. Implement Text formatting, text alignment, fonts and html elements
7. Demonstrate the Attribute Values, adding Links and lists to Webpages.
8. Add Images and Background Images
9. Create Forms and Frames on Webpages
10. Add styles and Image Gallery to Webpages
11. Insert Multimedia elements to Webpages.

Learning Outcomes

At the end of the course students should be able to:

12. Describe the process of Web Design.
13. Load a Text Editor and enter html tags.
14. Explain basic HTML tags
15. Demonstrate HTML elements and Attributes.
16. Describe HTML Hyperlinks, lists and Images.
17. Explain HTML Backgrounds, Colour, Frames, Tables and Form Elements.
18. Use CSS with HTML.
19. Describe how to integrate Multimedia on Webpages.

Course Contents

Definition of Internet. History of WWW. Benefits of internet application. The process of web design. Introduction to HTML. Basic HTML tags. HTML Attributes. HTML Text formatting. HTML Links. HTML Lists. HTML Images. HTML backgrounds. HTML Colours. HTML Forms elements. HTML frames and tables. Introduction to CSS. Introduction to Javascript. Introduction to Web Multimedia. Introduction to Flash. Introduction to XML.

Minimum Academic Standards

A Lecture room with white board, Computers, Overhead Projectors, and softwares like Text Editors, Browsers and Dreamweaver.

CUL-CSC-178 Basic Electronics (2 Units Compulsory LH = 30)

Senate-approved Relevance

A course in Basic Electronics is in tandem with Caleb University's vision of providing highly qualitative and relevant university education that will engender the production of future leaders imbued with the ability and integrity to positively impact their local environment while also being globally competitive. Basic Electronics is a course targeted at making students learn the basic principles of how the flow of little amount of current can be deployed to do certain things on their own. The University drives innovation and would thus this culture inculcated in all students. The

knowledge of basic Electronics would help the University to achieve this. In addition, nothing thrills students than doing things on their own and seeing the product working.

OVERVIEW

The course will expose our students to various technologies using electronics. It is a course that involves practical and motivates students to participate in group projects that add values to them individually and collectively. The computer field is expanding and can be diverse, lucrative and exciting. Businesses, both big and small require the use of computers to function.

Basic electronics will give a student the ability to provide businesses with valuable computer programming and maintenance skills. The course will offer the students knowledge necessary to work with a wide variety of business computer applications, software and business electronics.

OBJECTIVES

At the end of this course, students should be able to:

1. Acquire the basic knowledge of constituents of an atom
2. Identify the component involved in electronics
3. Trace how electron flows in semiconductors
4. Demonstrate the types of semiconductors
5. Describe the basic technologies in electronics
6. Distinguish between Diode Models
7. Describe the basic knowledge of Green Technology

LEARNING OUTCOMES

At the end of this course, students should be able to:

1. Explain what an atom is vis-à-vis its parts.
2. Relate how electricity flows from an atom.
3. Describe how electrons flow in semiconductors
4. Explain types and uses of semiconductors
5. List and explain some technologies emanating from electronics
6. Describe the Diode Models
7. Relate the acquired knowledge to Green Technology
8. Explain the principle of Green House Technology
9. Do mini projects in electronics.

COURSE CONTENT

The Atom. Materials for electronics. Flow of current in semicondutors. Types of semiconductors. Green Technology. Applications of green technology. The Diodes. Voltage and Current characteristics. Diode Models. Half Wave rectifiers. Full Wave rectifiers. Electrical circuit and

wiring. Emerging wireless technologies. DC and AC Electronics. Electronic devices. Micro-processor Architecture. Broadband essentials

Minimum Academic Standards

A Lecture room with white board and some security tools. An equipped electronics laboratory.