DEPARTMENT OF GEOMATICS ENGINEERING
FACULTY OF ENGINEERING
UNIVERSITY OF BENIN, BENIN CITY, NIGERIA

INTRODUCTION

Advances in Computers, Big data Sciences, Artificial Intelligent (AI), Internet of Things (IoT), Digital and Space Technologies have revolutionized Geomatics Engineering and Mapping, their techniques and equipment, not only in data acquisition, but also, in data processing, presentation and management. With developments in modern digital equipment such as Electronic Total Station (ETS), Robotic Total Station (RTS), Digital Leveling Equipment, Electronic Field Books, the Global Navigation Satellite System (GNSS), continuous Operating Reference Station (CORS), Laser Alignment Devices, Terrestrial Laser Scanner (TLS), Unmanned Aerial Vehicle (UAV), Analytical Plotters and Digital Mapping equipment in combination with fast, large storage speed Computers, the Profession has changed both in scope, applications and methods of data processing and management.

The integration of measurement science and information science led to the term "**Geomatics Engineering "which is an information technology discipline that deals with the acquisition, modelling, analysis, storing, creating and management of spatial data for the benefits of mankind.** *Geomatics Engineering is a generic term depicting the nature and management of earth –bound information within a systemic context*. It is defined by International Standard Organization (ISO) as the modern scientific term referring to the integrated approach to measurement, analysis, management, and display of spatial data (data that can be linked to specific locations in geographic space). Our graduate focus on: Geospatial data sciences and software development, Unmanned and remote – sensing aerial systems, professional land Surveying, Sustainable agriculture, Sustainable community planning, Geodetic Engineering, Photogrammetry Engineering, Location – based services etc. It is a field of activity that integrates the acquisition, processing, analysis and management of spatial information. The term "Geomatics Engineering" has been accepted in most Colleges and Universities of the United States, Canada, Australia, United Kingdom, and Africa instead of the traditional use of the term Surveying or Land Surveying. Geomatics Engineer work in diverse teams in a discipline that is at the intersection of electrical, civil, Mechanical Engineering, Geophysics, mathematics, Physics and Law.

Geomatics Engineering, include, but not limited to, the traditional disciplines of Land and Engineering Surveying, Cartography, Geodesy, Mining Surveying, Hydrography, Land Information Management, Environmental monitoring and management, Digital Photogrammetry, Remote Sensing as well as Spatial Information System [Geographic Information System (GIS), Land Information System(LIS) and Computer Aided Design (CAD)].

The main aim of the Department of Geomatics Engineering, University of Benin is the training of Professionals with the required qualities and competencies to meet the ever-increasing needs of the Geospatial Industry in Nigeria, Africa and the entire World.

Geomatics Engineering services are required before, during and after the construction of most engineering infrastructure located on the earth's surface and plays immense role in the environmental development and management of the developing and developed nations of the World. Geomatics Engineer work in diverse teams in a discipline that is at the intersection of electrical, civil, Mechanical Engineering, Geophysics, mathematics, Physics and Law.

The Department is planning to "connect and collaborate" with the Geomatics Engineering Departments of some reputable Colleges and Universities worldwide in order to expose our Graduates to global technological innovations and developments.

PHILOSOPHY AND OBJECTIVES OF THE UNDERGRADUATE PROGRAMME

The main aim of the undergraduate programmme the Department is to train high level manpower for both public and private sectors thatare skilled in carrying out Geomatics Engineering services in various sectors of the economy.

The objectives of the Undergraduate Degree Programs include, but not limited tothe following:

i. Train students in the theoretical and practical aspect of acquisition, processing, analysis, storage, presentation, distribution, management, and application of spatial data.

ii. Produce skilled Professionals who are not only well equipped to provide spatial and other environmental information necessary for the planning, design, and construction of various infrastructure required for the development of any nation but also excel in spatial data modeling, analysis, and management.

In conformity with the NUC minimum standards the undergraduate curriculum is a five- year degree programme. The 100 level and 200 level Students share common courses with Engineering Students with introduction to Geomatics Engineering and Computer Graphics and Design in 200 level to the Geomatics Engineering Students. The long vacations of the second and third year as well as the second semester of the fourth year are to be spent on industrial attachment schemes. As part of the degree requirement, each student is expected to undertake an independent research project to be supervised by an academic staff.

JUSTIFICATION FOR THE COURSES

The courses are designed to reflect adequately all areas of Geomatics Engineering and further harness appropriate knowledge of Mathematics, Physics, Electronics, Civil Engineering, Law, Architecture, Geophysics, information sciences, Artificial intelligent, Big data science, and Environmental Studies which are needed in the field of Geomatics Engineering.

The courses are carefully structured at producing world class professionals who will not only beregistrable by Council for the Registration of Engineering in Nigeria (COREN) and Surveyors Council of Nigeria (SURCON) but also other professional bodies.

The courses are also structured to produce graduates with a broad and balanced knowledge both in theory and practice, in the field of Geomatics Engineering.

Admission Requirements for Bachelor of Engineering Degree in Geomatics Engineering.

A) Admission Requirements for the Five-Year Full-Time Degree Programme (University Matriculation Examination[UME])

Candidates seeking admission into this programme should possess any of the following qualifications:

At least five ordinary credit passes in WASC, WAEC, SSCE/GCE, NECO or NABTEB, NTC or any of their recognized equivalents at not more than two sittings. The subjects should include physics, Chemistry, Mathematics and English language.

Duration of Course

The duration of the course is a minimum of 10 semesters for UME candidates.

NOTE:

The Unified Tertiary Matriculation Examination (UTME) subjects are.

(a) Use of English (b) Mathematics (c) Physics (d) Chemistry

(B) Admission Requirements for the Four-Year Full-Time Degree Programme (Direct Entry)

In addition to (a) above, candidates who possess any of the following qualifications may be considered for admission:

i. At least two Advanced Level passes in the General Certificate Examination (GCE) or the Higher School Certificate (HSC) or any of their recognized equivalents at not more than two sittings. The subjects should include Physics, Chemistry and Mathematics.
ii. National Diploma (ND) or its equivalent in surveying, with pass at Upper Credit level, from an NBTE accredited institution or recognized higher institution.
iii. Bachelor's Degree in the physical Sciences and Engineering Disciplines.

Duration of course

The duration of the course is a minimum of 8 semesters for Direct Entry candidates.

Candidates admitted by direct entry may be required, where applicable, to take specified courses to make up for deficiencies found in their academic background.

Graduation

Graduation Requirement

A student must have passed all the required compulsory and electives courses in his/her department to qualify for graduation. Such a student must have met the Industrial training requirement and passed all General Studies courses as required by the University.

Degree in view

The Degree in view is B. Eng (Hons) Geomatics Engineering

Duration of Programme

To graduate, a student must have met the minimum number of years required for graduation. The minimum and maximum number of years for graduation depends on the year or level of entry as shown in Table1.

TABLE 1: Minimum and Maximum Years for Graduation(Full-Time)

Level of Entry	Minimum Number of Years To Graduate	Maximum Number of Years To Graduate
100	5	8
200	4	7
300	3	6

Grading

The pass mark in any examination is normally 45%. Marks scored by Students by examinations are classified by means of letter grades with the appropriate grade points as follows:

Table 2: Classification of Examination Results

Course Mark (CM)	Letter Grade	Grade Point
70-100%	**A**	**5**

60-69%	**B**	**4**
50-59%	**C**	**3**
45-49%	**D**	**2**
0-44%	**F**	**0**

Classification of Degrees

A Grade Point Average (GPA) is calculated for each level of courses with appropriate weighting according to the number of credits attached to each course. The final grade is calculated from the sum of the GPA with appropriate weighting for each level of course. The class of degree is determined by the final weighted grade point average or final weighted grade (FWG) as follows:

Table 3: Classification of Degrees

Class of Degree	**FWG**
First Class Honours	4.50-5.00
Second Class, Upper Division	3.50-4.49
Second Class, Lower Division	2.40-3.49
Third Class Honours	1.50-2.39
Fail	Below 1.5

STAFF LIST FOR GEOMATICS DEPARTMENT

ACADEMIC STAFF

S/N	NAME	ACADEMIC QUALIFICATIONS	STATUS	AREA OF SPECIALIZATION
1	Engr. Prof. Ehigiator-Irughe Raphael	B. Sc (GeoInformatics and Surveying) UNN, PGD (Petroleum Engineering) (Uniben), M. Eng Water Resources and	Professor	Geodesy & Geomatics Engineering, Geodynamics, GNSS, Water Resources and Environmental

		Environmental Engineering (Uniben), Ph. D Geodesy and Geomatics Engineering (SSUGAT Russia), MNSE, MNIS, MNAG, Regd. Engineer (COREN), Regd. Surveyor (SURCON)		Engineering, oil, and gas Geomatics Engineering support
2	Engr. Surv. Prof. Jacob O. Ehiorobo	M.Sc. (Surveying Engineering) (Moscow), Ph. D(Uniben), FNIS, FNICE, MNSE, MNES, MNAG, MNIMRegd.). Engineer (COREN), Regd. Surveyor (SURCON	Professor **(Pro bono)**	Geodesy & Geomatics Engineering, Water Resourse& Environmental System Engineering
3	Engr. Prof. Izinyon C.	B.Eng. M. Eng, PhD Civil Engineering; MNSE, COREN	Professor	Water Resources and Environmental Engineering
4	Engr. Surv. Prof. Henry A. P. Audu	M.Sc. Surveying Engineering (Sofia), Ph. D (Uniben), MNIS, MNSE, MNIM, Regd. Engineer (COREN), Regd. Surveyor (SURCON), MNIS, MNSE, MNAHS.	Professor	Geomatics Engineering, Water Resources and Environmental Engineering.
5	Engr. Prof. S.O Osuji	B. Eng, M. Eng, PhD Civil Engineering. MNSE, COREN	Professor	Structural Engineering and Finite Elements Analysis
6	Engr. Prof. Okovido, J.O.	B. Eng, M. Eng, PhD Civil Engineering. MNSE, MNIStrucE, MINCE, FNIStrucE, FIPMD, COREN, QMS – Lead Auditor	Professor	Structural Engineering and Mathematical Methods

7	Engr.Dr. Okonofua Ehiz. Solomon	Phd Water Resourse and Environmental Engineering (FUTA). M.Eng. (Uniben), B.Eng. Civil Engineering (AAU) Registered Engineer, COREN, MNSE, MNICE, MNIM.	Senior Lecturer	Civil Engineering, Water Resources and Environmental Engineering
8	Engr. Dr. Olaye	B. Eng, M.Eng, Ph.D. Computer Engineering	Senior Lecturer	Software Engineering
9	Engr. Dr. (Mrs) Ihimekpen	B. Eng, M. Eng, Ph. D Civil Engineering.	Associate Professor	Water Resources and Environmental Engineering.
10	Surv. (Ms.) Ekun Mercy Oluwabukola	Master of Science in Surveying and GeoInformatics (Unilag) Bachelor of Technology in Surveying &GeoInformatics (FUTMINNA)	Lecturer I	Remote Sensing and Hydrography
11	Surv. Chika Okorocha	B.Sc. (Hons) Surveying and GeoInformatics FUT Minna, Master of Science in Surveying and GeoInformatics (Unilag). Ph. D Geomatics Engineering (UNIBEN) **in view**	Adjunct Lecturer Geomatics Engineering	GNSS, Digital information Modeling and CORS Engineer.
12	Surv. Dr. Nwodo Geoffrey Ogbonna	B.Sc. (Hons)in GeoInformatics and Surveying (UNN) M.Sc.(GIS and Remote Sensing) (UNN) Ph.D. Geodesy	Lecturer I	Surveying, Remote Sensing and GIS Geodesy and Geodynamics

		and Geodynamics (UNN)		
13	Surv. Oladosu Olushola Stephen	Master of Science in Surveying and GeoInformatics (Unilag) Bachelor of Technology in Surveying &GeoInformatics (FUTMINNA). Phd HydroSpatial Engineering UNILAG (**In view).**	Lecturer I	HydroSpatial and Navigation Engineering
14	Surv.Ojo Emwantaide Peter	Ph.D Hydrography (Akwa) **(In View)** M.Sc. Hydrographic Surveying (UNN) B. Tech Surveying and GeoInformatics (FUTY) ND Land Surveying	Lecturer I	HydroInformatics, Surveying and GeoInformatics
15	Engr. Prudence Ehizuenlen	B. Eng Uniben, M. Eng Uniben, Ph.D Uniben	Adjunct Lecturer	Software Engineer.
16	Engr Mrs. Mabel E. Alenkhe.	B. Eng Uniben, M. Eng Uniben	Adjunct Lecturer	Water Resources

TECHNOLOGIST/ TECHNICAL STAFF

1.	Dr. Chistopher Ibhadode	HND Land Surveying, PG, Surveying and GeoInformatics, Oyo, Auchi, PGD Technical Education, MBA, Uniben, M.Sc. Environmental Quality	Chief Technologist	Land Surveying

		Management, Uniben. Ph. D Environmental Management and Technology AAU, Ekpoma		
1	Mr Yusuf Tijjani Muhammad	HND Surveying & GeoInformatics, PGD, Surveying and GeoInformatics (FUTA).	Technologist II	Land Surveying
2	Mr. Ndinwa Emmanuel Chuks	Professional Masters in Geoinformation and Environmental Management (RECTAS) 2014 B.Sc. Science Laboratory Technology (Geology option) (Uniben) 2008	Technologist II	GIS & Environmental Management

ADMINISTRATIVE STAFF

1.	Mrs. Iyare	• M.Sc. Educational Studies and Management 2014 • B.Sc. Political Science and Public Admin. Education-(Uniben) 2007	Administrative Assistant	Administrative Staff
2.	Mr. Benjamin Iyawe	• B.Sc. EDU. Biology Education (UNIBEN)	Principal Executive Officer II	Administrative Staff

3.	Mrs. Omosede Ekpu	• M.ED. Sociology of Education • PGD. Public Administration. • B.ED English Education, (UNIBEN)	Administrative Officer.	Administrative Staff

UNDERGRADUATE PROGRAMMES
IN GEOMATICS ENGINEERING

B.Eng. GEOMATICS ENGINEERING

GUIDELINES AND PROSPECT

BACHELOR'S DEGREE PROGRAMMES

(Common to all Department/ Programmes)

COURSE STRUCTURE

NOTE:L=Lecture Hours

T=Tutorial Hours

P=Practical Hours

100 LEVEL COURSES						
COURSE CODE	**COURSE TITLE**	**L**	**T**	**P**	**COURSE CREDIT**	**PRE-REQUISITE**
	First Semester					
CHM 111	General Chemistry I	2	1	-	3	
CHM 113	Organic Chemistry I	2	1	-	3	
MTH 111	Algebra and Trigonometry	2	1	-	3	
MTH 112	Calculus and Real Analysis	2	1	-	3	
PHY 111	Mechanics, Thermal Physics & Properties of Matter	2	1		3	
PHY 113	Vibrations, Waves and Optics	2	1	-	3	
GST 111	Use of English I	2	1	-	2	
GST 112	Philosophy and logic	1	1	-	2	
	Total	**15**	**8**		**22**	
	Second Semester					
CHM 122	General Chemistry II	2	1	-	3	
CHM 124	Organic Chemistry II	2	1	-	3	
MTH 123	Vectors, Geometry and Statistics	2	1	-	3	
MTH 125	Differential Equations and Dynamics	2	1	-	3	
PHY 109	Practical Physics	-	-	2	2	
PHY 124	Electromagnetism & Modern physics	3	1	-	4	
GST 121	Peace Studies and Conflict Resolution	1	1	-	2	
GST 122	Nigerian Peoples and Culture	1	1	-	2	
GST 123	History and Philosophy of Science	1	1	-	2	
	Total	**14**	**8**	**2**	**24**	

200 LEVEL COURSES				
COURSE CODE	COURSE TITLE	HOURS PER WEEK	COURSE CREDIT	PRE-REQUISITE
	First Semester			
GEE 221	Computing and Software Engineering	2	2	
EMA 281	Engineering Mathematics I	2	2	
GEE 231	Computer Programming I	2	2	
MEE 211	Applied Mechanics I	3	3	
MEE 221	Engineering Drawing I	3	3	
EEE 211	Electrical Engineering I	3	3	
GEE 211	Introduction to Geomatics Engineering I	2	2	
CVE 211	Strength of Materials	3	3	
ELA 201	Laboratory/ Field Work I	6	2	
	Total	**26**	**22**	
	Second Semester			
EMA 282	Engineering Mathematics II	4	4	
GEE 212	Introduction to Geomatics Engineering II	2	2	
GEE 232	Computer Programming II	2	2	
GEE 252	Geospatial Data Science and Software	2	2	
MEE 222	Engineering Drawing II	2	2	
MEE 212	Engineering Mechanics II	2	2	
GEE 222	Mathematical Cartography	2	2	
GEE 214	Architecture Graphics	2	2	
EEE 212	Electrical Engineering II	3	2	
ELA 202	Laboratory/Field Work II	6	2	
	Total Credits	**26**	**22**	

300 LEVEL COURSES				
COURSE CODE	COURSE TITLE	HOURS PEI WEEK	COURSI CREDIT	PRE-REQUISITE
	First Semester			
EMA 381	Engineering Mathematics III	3	4	EMA 281/282
MEE 351	Thermodynamics	2	2	MEE 212
CVE 341	Engineering Geology I	3	3	CVE 341
GEE 331	Geomatics Engineering Networks	2	2	GEM 211/212
GEE311	Cadastral and Land Information Managemer	2	2	GEM 212
GEE 341	Engineering Statistics	2	2	GEM 281/282
GEE 361	Geospatial Information Technology I	2	2	GEM 211/212
GEE 351	Photogrammetry & Remote Sensing I	2	2	GEM 211/212
MEE 361	Fluid Mechanics I	2	2	MEE 212
CED 300	Entrepreneurship	6	2	
	Total	**26**	**23**	
	Second Semester			
EMA 382	Engineering Mathematics IV	3	3	EMA 281/282
GEE 314	Engineering Geophysics	2	2	EMA 281/282
GEE 312	Operations Research in Geomatics Engineering	2	2	GEM 221/282
GEE 322	Introduction to Artificial Intelligence, Machine learning and Convergent Technology.	2	2	CVE 341
GEE 392	HydroSpatial Engineering I	2	2	GEM 222
GEE 332	Mining and Special Geomatics Engineering	2	2	GEM 221
GEE 362	Photogrammetry and Remote Sensing II	2	2	GEM 222
GEE352	Geometric Geodesy	2	2	GEM 221
GEE 372	Adjustment in Geomatics Engineering	2	2	GEM 211/212
ELA 302	Swimming/Field camping	6	2	GEM 232/281 LAB 201/202
	OPTIONAL COURSES (Choose one course only			
GEE 342	Geodetic Astronomical Methods	2	2	
GEE 346	Big Data Computing	2	2	
MEE 362	Fluid mechanics II	2	2	
	Total	**29**	**23**	

400 LEVEL COURSES (FIRST SEMESTER)				
COURSE CODE	**COURSE TITLE**	**HOURS PER WEEK**	**COURSE CREDIT**	**PRE-REQUISITE**
	First Semester			
GEE 481	Applied Engineering Mathematics for Geomatics	3	3	EMA 381/382
GEE 443	Introduction to Software Engineering	2	2	CVE 341
GEE 421	Engineering Surveying	2	2	GEM 311/352
GEE 411	HydroSpatial Engineering II	2	2	GEM 392
GEE 431	Geodetic Engineering	2	2	GEM 311/352
GEE461	Geospatial Information Technology II	2	2	GEM351/361
GEE 451	Advanced Remote Sensing and GIS	2	2	GEM342/362
CVE423	Environmental Engineering	2	2	CVE 341
GEE471	Potential Theory for Earth Sciences			EMA 382
GEE 403	Spatial data Structures	2	2	
LAB 401	Laboratory/field work			
		2	2	
		6	2	
	OPTIONAL COURSES (Choose one course only)			
CVE 421	Hydraulic and Hydrology	2	2	GEM322
GEE445	Introduction to Cybersecurity and Strategy	2	3	
CVE 431	Introduction to Transportation Engineering			
	TOTAL	29	25	

400 LEVEL (SECOND SEMESTER)				
COURSE CODE	**COURSE TITLE**	**HOURS PER WEEK**	**COURSE CREDIT**	**PRE-REQUISITE**
GEE 422	Students Industrial work Experience Scheme (SIWES)	6 Months	15	

500 LEVEL COURSES				
COURSE CODE	**COURSE TITLE**	**HOURS PER WEEK**	**COURSE CREDIT**	**PRE-REQUISITE**
PRE 571	Engineering Management, Economics and Administration	2	3	CVE 432
GEE 531	Engineering Geodesy	2	2	GEM 421
GEE 521	Space and Satellite Geodesy	2	2	GEM 421
GEE 561	Physical Geodesy and Geodynamics	2	2	GEM 471
GEE 541	Mapping Concepts and Geographic Data Management	2	2	GEM 441
GEE 501	Final year Project	6	3	GEM 441
GEE 557	Software Engineering	2	2	GEM 471
CVE 531	Highway Design	2	2	GEM 423
	OPTIONALCOURSES (Choose two Courses only)			
GEE 511	Geo-Environmental Engineering	2	2	
GEE 551	Applied Building Information Modelling	2	2	
				CVE 431
CVE 521	Civil Engineering Hydraulics	2	2	
CVE 523	Engineering Hydrology I	2	2	
GEE 553	Non-Topographic Photogrammetry	2	2	
GEE 555	Positioning, Navigation, and wireless location	2	2	
CVE 541	Geotechnical Engineering	2	2	
				GEM 421
	Total	**30**	**20**	
	2ND SEMESTER			
GEE 528	Water Resources and Environmental Engineering	2	2	CVE 471

GEE 516	Mapping Laws and Code of Professional Practice for Geomatics and Civil Engineering	2	2	GEM 431
GEE 514	Marine Geodesy	2	2	GEM 411
GEE 522	Digital Image Processing	2	2	GEM 461
GEE 532	Machine Learning and Artificial Intelligence	2	2	GEM 451
GEE 524	Adjustment & Mathematical analysis	2	2	GEM 372
GEE 592	Sensor Web and Internet of Things	2	2	
GEE 502	Final Year Project	6	3	
	OPTIONAL COURSES (Choose two Courses only)			
CVE 542	Geotechnical Engineering II	2	2	CVE 541
GEE 552	Health, Safety and Environmental Management system.	2	2	GEM 441
		2	2	
GEE 562	Environmental Remote Sensing and GIS			
GEE 572	Software Architecture and Design	2	2	GEM441
GEE 556	Environmental, Monitoring and Management	2	2	
GEE 558	Big Data Analysis			CVE 523
		2	2	
	Total	**24**	**21**	

B.Eng. GEOMATICS ENGINEERING COURSE STRUCTURE

100 LEVEL FIRST SEMESTER COURSES

CHM 101: General Chemistry I (2 Units C: LH 30)

Learning Outcomes

At the end of this course, the students should be able to:
1. define atom, molecules and chemical reactions;
2. discuss the Modern electronic theory of atoms;
3. write electronic configurations of elements on the periodic table;
4. justify the trends of atomic radii, ionization energies, electronegativity of the elements based on their position in the periodic table;
5. identify and balance oxidation – reduction equation and solve redox titration problems;
6. illustrate shapes of simple molecules and hybridized orbitals;

7. identify the characteristics of acids, bases and salts, and solve problems based on their quantitative relationship;
8. apply the principles of equilibrium to aqueous systems using LeChatelier's principle to predict the effect of concentration, pressure and temperature changes on equilibrium mixtures;
9. analyse and perform calculations with the thermodynamic functions, enthalpy, entropy and free energy; and
10. determine rates of reactions and its dependence on concentration, time and temperature.

Course Contents

Atoms, molecules, elements and compounds, 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.

CHM 113: ORGANIC CHEMISTRY I (3 CREDITS)

Learning Outcomes

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

1. Understand organic chemistry principles, compound classification, and functional groups.
2. Learn isolation methods and structure determination for organic compounds.
3. Grasp isomerism and the electronic theory of organic compounds.
4. Explore properties and reactions of alkanes

Course Contents

A. General Principles of Organic Chemistry

i. Introduction: Definition of Organic Chemistry, Classification of Organic compounds, Homologous series, Functional groups.

ii. General procedure for insolation and purification of organic compounds.

iii. Determination of structure of organic compounds, Elemental analysis of percentage composition, empirical and molecular formula, Structural formula.

iv. Isomerism, Structural isomerism and stereo isomerism.

v. Electronic theory in organic chemistry, atomic models, quantum numbers, atomic orbitals, Hybridization leading to formation of carbon, carbon single, double and triple bonds, Hydrogen bonding, Electro-negativity dipole moments, polarization, bond energy, Inductive and resonance effects.

B. Non-polar Functional Group Chemistry

i. Alkanes: Structure and Physical properties, Substitution actions including mechanism.

ii. Alkenes: Structure and Physical properties. Reaction addition of H_2, X_2, HX, H_2O, O_3, etc. Oxidation polymerization, Stereo isomerism – definition, geometrical and optical isomers, conditions for optical isomerism.

iii. Alkynes: Structure and Physical properties. Acidity of acetylene hydrogen. Reactions: Addition of H_2, X_2, HX, H_2O etc. Test for Alkynes.

iv. Benzene: Structure and aromaticity of benzene. Introduction to electrophilic substation reactions.

C.

i. Nomenclature: Common or trivial names. IUPAC names of classes of compounds.

ii. Petroleum chemistry: Introduction to Petro-chemistry, origin of petroleum, importance, fractional distillation of crude oil, components, properties and uses.Octane number, cracking.

iii. Coal tar chemistry: Origin, production fractions, important components and uses.

iv. Practical Organic chemistry

Experiment in basic techniques in organic chemistry. Determination of melting point and boiling points, distillation, fractional distillation, recrystallization, tests for functional groups; organic preparations.

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. define and explain set, subset, union, intersection, complements, and demonstrate the

use of Venn diagrams;
2. solve quadratic equations;
3. solve trigonometric functions;
4. identify 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-Moiré'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. identify the types of rules in differentiation and integration;
2. recognise and understand the meaning of function of a real variable, graphs, limits and continuity;
3. solve some applications of definite integrals in areas and volumes;
4. solve function of a real variable, plot relevant graphs, identify limits and idea of continuity;
5. identify the derivative as limit of rate of change;
6. identify techniques of differentiation and perform extreme curve sketching;
7. identify integration as an inverse of differentiation;
8. identify methods of integration and definite integrals; and
9. perform integration application to areas, volumes.

Course Contents

Functions of a real variable, graphs, limits and idea of continuity. The derivative, as limit of rate of change. Techniques of differentiation, maxima and minima. Extreme curve sketching, integration, definite integrals, reduction formulae, application to areas, volumes (including approximate integration: Trapezium and Simpson's rule).

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

Learning Outcomes

On completion, the 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's 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 104: General Physics IV (Vibration Waves and Optics) (2 Units C: LH 30)

Learning Outcomes

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

1. describe and quantitatively analyse the behaviour of vibrating systems and wave energy;
2. explain the propagation and properties of waves in sound and light;
3. identify and apply the wave equations; and
4. explain geometrical optics and principles of optical instruments.

Course Contents

Simple harmonic motion (SHM). Energy in a vibrating system. Damped SHM. Resonance and transients. Coupled SHM. Q values and power response curves. Normal modes. Waves (types and properties of waves as applied to sound). Transverse and longitudinal waves (superposition, interference, diffraction, dispersion, polarization). Waves at interfaces (energy and power of waves). The wave equation. 2-D and 3-D wave equations. Wave energy and power. Phase and group velocities. Echo and beats. The Doppler-effect. Propagation of sound in gases, solids and liquids and their properties. Optics: Nature and propagation of light. Reflection and refraction. Internal reflection. Scattering of light. Reflection and refraction at plane and spherical surfaces. Thin lenses and optical instruments. Wave nature of light. Dispersion. Huygens's principle (interference and diffraction).

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

Sounds and sound patterns in English Language (vowels and consonants, phonetics and phonology); English word classes (lexical and grammatical words, definitions, forms, functions, usages, collocations); major word formation processes; the sentence in English (types: structural and functional); grammar and usage (tense, concord and modality). Reading and types of reading, comprehension skills, 3RsQ. Logical and critical thinking; reasoning methods (logic and syllogism, inductive and deductive argument, analogy, generalisation and explanations). Ethical considerations, copyright rules and infringements. Writing activities (pre-writing[brainstorming and outlining], writing [paragraphing, punctuation and expression]. post- writing [editing and proofreading]. Types of writing (summary, essays, letter, curriculum vitae, report writing, note-making) etc. Mechanics of writing. Information and Communication Technology in modern language learning. Language skills for effective communication. The art of public speaking.

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

Learning Outcomes

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

1. analyse the historical foundation of Nigerian cultures and arts in pre-colonial times;
2. identify and listthe major linguistic groups in Nigeria;
3. explain the gradual evolution of Nigeria as a political entity;
4. analyse the concepts of trade andeconomic self-reliance of Nigerian peoples in relation to national development;
5. enumerate the challenges of the Nigerian state regarding nation building;
6. analyse the role of the udiciary in upholding fundamental human rights
7. identify the acceptable norms and values of the major ethnic groups in Nigeria; and
8. list 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 cultures; peoples and cultures of the minority ethnic 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). Concepts of trade and economics of self-reliance (indigenous trade and market system; indigenous apprenticeship system among Nigerian peoples; trade, skill acquisition and self-reliance). Social justice and national development (definition and classification of law); Judiciary and fundamental rights. Individuals, norms and values (basic Nigerian 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; re-orientation strategies: Operation Feed the Nation (OFN), Green Revolution, Austerity Measures, War Against Indiscipline and Corruption (WAIC), Mass Mobilization for Self-Reliance, Social Justice and Economic Recovery (MAMSER), National Orientation Agency (NOA). Current socio-political and cultural developments in Nigeria.

GET 101: Engineer in Society (1 Unit C: LH 15)

Learning Outcomes

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

1. differentiate between science, engineering and technology, and relate them to innovation;
2. distinguish between the different cadres of engineering – engineers, technologists, technicians and craftsmen and their respective roles and competencies;
3. identify and distinguish between the relevant professional bodies in engineering;
4. categorise the goals of global development or sustainable development goals (SDGs); and
5. identify and evaluate safety and risk in engineering practice.

Course Contents

History, evolution and philosophy of science. engineering and technology. The engineering profession – engineering family (engineers, technologists, technicians and craftsmen), professional bodies and societies. Engineers' code of conduct and ethics, and engineering literacy. Sustainable development goals (SDGs), innovation, infrastructures and nation building - economy, politics, business. Safety and risk analysis in engineering practice. Engineering competency skills – curriculum overview, technical, soft and digital skills. Guest seminars and invited lectures from different engineering professional associations.

<u>100 LEVEL SECOND SEMESTER COURSES</u>

CHM 102: General Chemistry II (2 Units C: LH 30)

Learning Outcomes

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

1. state the importance and development of organic chemistry;
2. define fullerenes and their applications;
3. discuss electronic theory;
4. determine the qualitative and quantitative of structures in organic chemistry;
5. describe rules guiding nomenclature and functional group classes of organic chemistry;
6. determine rate of reaction to predict mechanisms of reactions;
7. identify classes of organic functional group with brief description of their chemistry;
8. discuss comparative chemistry of group 1A, IIA and IVA elements; and

9. describe basic properties of Transition metals.

Course Contents

Historical survey of the development and importance of Organic Chemistry. Fullerenes as fourth allotrope of carbon, uses as nanotubules, nanostructures, nanochemistry. Electronic theory in organic chemistry. Isolation and purification of organic compounds. Determination of structures of organic compounds including qualitative and quantitative analysis in organic chemistry. Nomenclature and functional group classes of organic compounds. Introductory reaction mechanism and kinetics. Stereochemistry. The chemistry of alkanes, alkenes, alkynes, alcohols, ethers, amines, alkyl halides, nitriles, aldehydes, ketones, carboxylic acids and derivatives. The Chemistry of selected metals and non-metals. Comparative chemistry of group IA, IIA and IVA elements. Introduction to transition metal chemistry.

CHM 124 ORGANIC CHEMISTRY II (3 CREDITS)

Learning Outcomes

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

1. Describe monocarboxylic acids, their structure, and properties.
2. Explain their acidity, preparation methods, and reactions.
3. Recognize the importance of tests for carboxylic acids.
4. Understand anhydrides, acid halides, esters, and amides.
5. Explain changes in reactivity when substituting the -OH group of the acid.
6. Describe amines, their structure, and properties.
7. Explain methods of preparation, reactions, and the importance of tests.

Course Contents

A. **Polar functional Group Chemistry**

i. Hydroxyl group- Alcohol and phenols. Classification. Acidity-Comparison. Important methods of preparation. Reactions: with metals, bases, alkyl halides. Oxidation, dehydration. Tests for alcohols and phenols, importance.

ii. Carbonyl group- Aldehydes and ketones structures: Physical properties. Important methods of preparation. Reactions: Tollen's reagent, Fehling's solution, Benedict's solution, Iodoform reactions, with HCN $NaHSO_3$; alcohol's, including mechanisms with ammonia hydrazine's and their derivatives, including mechanisms, aldol condensation. Tests for aldehydes and Ketones. Importance.

iii. Carboxylic group – Monocarboxylic acids. Structure, physical properties. Acidity and resonance. Important methods of preparation, from alcohols, aromatic hydrocarbons, through Grignard's reagent. Reaction with bases. Conversion to esters, amides, halides, and anhydrides. Test for Carboxylic acid. Importance.

iv. Carboxylic acid derivatives: Anhydrides, acid halides, esters and amides. Change of reactivity when OH of acid is replaced by -OCOR -X-OR, - NR. Reaction with water, alcohols, ammonia and amines, LiACH4, NaBH4. Test for esters,

v. Amino groups – Amines. Structure. Physical properties. Important methods of preparation. Reaction with acids, Basicity and salt formation. Alkylation, acylation; with nitrous acids, Heisenberg method of separation. Tests for amines. Importance.

B. Miscellaneous Topics.

i. Fats and oils. Definition, Importance. Saponification. Soaps and detergents. Mode of cleaning action; Reaction of soap with hard water, mineral acids. Drying oil, mode of action, use in paints and varnishes.

ii. Amino acids, proteins: Definition, classification, essential amino acids, special properties and reactions, isoelectric point, tests. Importance.

iii. Carbohydrates: Definition, classification, Importance, Nomenclature, structure and reactions of glucose, maturation tests.

iv. Natural products, main classes (other than liquids, carbohydrates and proteins); Steroids, terpenoids, Alkaloids, prostaglandin's definition. Importance, examples

MTH 103: Elementary Mathematics III (Vectors, Geometry and Dynamics) (2 Units C: LH 30)

Learning Outcomes

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

1. solve some vectors in addition and multiplication;
2. calculate force and momentum; and
3. solve differentiation and integration of vectors.

Course Contents

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 coordinate geometry. Straight lines, circles, parabola, ellipse, hyperbola. Tangents, normals. Kinematics of a particle. Components of velocity and acceleration of a particle moving in a plane. Force, momentum, laws of motion under gravity, projectiles and resisted vertical motion. Elastic string and simple pendulum. Impulse, impact of two smooth spheres and a sphere on a smooth surface.

STA 112: Probability I (3 Units C: LH 45)

Learning Outcomes

At the end of the course students should be able to

1. explain the differences between permutation and combination;
2. explain the concept of random variables and relate it to probability and distribution functions;
3. describe the basic distribution functions; and
4. explain the concept of exploratory data analysis.

Course Contents

Permutation and combination. Concepts and principles of probability. Random variables. Probability and distribution functions. Basic distributions: Binomial, geometric, Poisson, normal and sampling distributions; exploratory data analysis.

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

Quantitative measurements. Treatment of measurement, errors and graphical analysis. Experimental techniques for studies of meters, oscilloscope, mechanical systems, electrical and mechanical resonant systems, light, heat, viscosity and others covered in PHY 101. Emphasis should be placed on the basic physical techniques for observation, measurements, data collection, analysis and deduction.

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

Learning Outcomes

At the end of this 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 the roles of international organisations, media and traditional institutions in peace building.

The concepts of peace, conflict and security in a multi-ethnic nation. Types and theories of conflicts: ethnic, religious, economic, geo-political 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, ZangoKartaf, chieftaincy and land disputes, etc. Peace building, management of conflicts and security: Peace & Human Development. Approaches to Peace & Conflict Management (religious, government, community leaders.). 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 and Security Council (international, national and local levels). Agents of conflict resolution – Conventions, Treaties Community Policing: Evolution and Imperatives. Alternative Dispute Resolution (ADR) (dialogue,. arbitration, negotiation, collaboration, etc). The roles of international organizations 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). The media and traditional institutions in peace
building. Managing post-conflict situations/crises: Refugees. Internally Displaced Persons (IDPs);the role of NGOs in post-conflict situations/crises.

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 generation and financial independence;
4. engage in entrepreneurial thinking;
5. identify key elements in innovation;
6. describe the 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

The 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 (The 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 alliance formation, and joint ventures). Contemporary entrepreneurship issues (knowledge, skills and technology, intellectual property, virtual office and 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

200 LEVEL FIRST SEMESTER COURSES

GEE 221: COMPUTING AND SOFTWARE ENGINEERING (2CREDITS)

Learning Outcomes

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

1. Develop a fundamental understanding of computer systems, including computer organization, data processing, memory, registers, and addressing schemes.
2. Master the principles of Boolean algebra and apply them to logical operations used in computing.
3. Learn how to represent numerical and non-numeric information in computing, including floating-point arithmetic.
4. Acquire problem-solving skills and the ability to develop algorithms to solve computational problems.
5. Gain proficiency in solution design using flowcharts and pseudo codes for coding and programming.
6. Understand data models and data structures used in computer programming and their applications in various scenarios.
7. Explore computer software, operating systems, and programming paradigms, including an introduction to object-oriented, structured, and visual programming. Utilize MATLAB for engineering applications.

8. Develop a foundational knowledge of Information and Communication Technology (ICT) and the Internet of Things (IoT) and their relevance in modern computing.
9. Learn the fundamental principles and concepts of software engineering to efficiently design, develop, and maintain computer programs and systems.

Course Contents

Introduction to computers and computing; computer organisation – data processing, memory, registers and addressing schemes; Boolean algebra; floating-point arithmetic; representation of non-numeric information; problem-solving and algorithm development; coding (solution design using flowcharts and pseudo codes). Data models and data structures; computer software and operating system; computer operators and operators precedence; components of computer programs; introduction to object oriented, structured, and visual programming; use of MATLAB in engineering applications. ICT fundamentals, Internet of Things (IoT). Elements of software engineering.

EMA 281: ENGINEERING MATHEMATICS I (2 CREDITS)

Learning Outcomes

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

1. Understand and compute roots of complex numbers and the exponential function of a complex variable.
2. Be able to use addition formulae for any number of angles to express trigonometric functions (e.g., Sin Φ) in series of sines or cosines of multiple angles.
3. Learn about circular and hyperbolic functions in the context of complex variables.
4. Understand and apply logarithmic functions to complex variables.
5. Master vector operations related to force, moment, angular velocity, and vector differentiation and integration.
6. Gain a deep understanding of linear spaces and the algebra of determinants and matrices.

7. Learn advanced calculus concepts, including differentiation and its applications, the mean value theorem and its extensions, Taylor and Maclaurin formulae, Leibnitz's theorem, and the application of these concepts to solve differential equations with variable coefficients, as well as De L'Hôpital's rule for partial derivatives of functions of two or more variables.

Course Contents

(i) Complex Analysis: Roots of a complex number, Addition formulae for any number of angles to express Sin Φ in series of sins or cosines of multiple angles, Exponential function of a complex variable, Circular functions of complex variable, Hyperbolic functions, Real and imaginary parts of a circular and hyperbolic functions, Logarithmic functions of a complex variable. Real numbers; Sequence and series, their convergence and divergence.

(ii) Vectors: Force moment and angular velocity, Vector differentiation and integration.

(iii) Linear algebra: Linear spaces, Algebra of determinants and matrices

(iv) Calculus: Differentiations and applications, The mean values theorem and its applications, Extension of mean value theorem, Taylor and Maclaurin formulae, Leibnitz's theorem. (Application to the solution of differential equations with variable coefficients). De L'Hospital's partial derivatives of functions of two and more variables.

GEE 231: COMPUTER PROGRAMMINGI (2 CREDITS)

Learning Outcomes

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

1. Gain a solid understanding of different programming paradigms, including functional programming, declarative programming, logic programming, and scripting languages.
2. Explore OOP as a technique for modeling computation and understand its principles and advantages.
3. Grasp fundamental object-oriented concepts such as abstraction, objects, classes, methods, parameter passing, and encapsulation.

4. Learn how to design class hierarchies and organize programs using packages or namespaces.
5. Understand how to utilize APIs, including the use of iterators/enumerators, List, Stack, Queue, for various programming tasks.
6. Learn about event-handling methods, event propagation, and exception handling, which are crucial for developing event-driven applications.
7. Master the basics of programming, including data types, variables, expressions, assignment statements, operators, control structures, arrays, simple I/O, and string processing. Additionally, develop skills in implementing simple algorithms, working with inheritance, and applying polymorphism in object-oriented programming.

Course Contents

Introduction to computer programming. Functional programming; Declarative programming; Logic programming; Scripting languages. Introduction to object-orientation as a technique for modelling computation. structured, and even some level of functional programming principles; Introduction of a typical object-oriented language, such as Java; 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.

MEE 211: APPLIED MECHANICS I (3 CREDITS)

Learning Outcomes

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

1. describe and explain the fundamental quantities of mechanics, such as mass, length, and time, and understand their significance in solving mechanical problems.
2. apply different coordinate systems and understand the concept of dimensions in a space when solving mechanics problems.
3. manipulate vectors, including addition, subtraction, and scalar multiplication, and apply them to represent physical quantities in mechanics.
4. analyze and predict the equilibrium of rigid bodies by understanding the concepts of forces, moments, and couples.
5. analyze and calculate the effects of distributed forces on structures and machines, including beams and trusses.
6. calculating work done by forces, understanding the concept of virtual work, and applying these principles to analyze mechanical systems in terms of energy conservation.

Course Contents

Mechanics: Fundamental quantities of mechanics, Division of mechanics, coordinates dimension in a space, problem solving, vectors, system of forces and couples. Rigid bodies and equilibrium, distributed forces, structures and machines. Friction, moment and product of inertia, work and virtual work.

MEE 221: ENGINEERING DRAWING I (3 CREDITS)

Learning Outcomes

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

1. Gain proficiency in drafting tools, enabling the use of drawing instruments for engineering drawings.
2. Demonstrate the ability to differentiate and use various types of lines common in engineering drawings.
3. Apply dimensioning techniques accurately to convey the size and placement of objects and features in engineering drawings.

4. Construct complex geometric shapes, including corner radii, tangents, polygons, conics, cycloids, and involutes.
5. Employ graphical methods for engineering analysis, including graphical integration and differentiation, to solve problems and analyze engineering systems.
6. Create orthographic projections for simple objects, understand the concept of first angle projection, and interpret the projections of lines, plane figures, compound figures, and simple solids.

Course Contents

Principles of Draftsmanship: Use of drawing instruments lettering, Different types of lines used in engineering Drawing, Dimensioning. Engineering graphics: Construction of corner radii, tangents and polygons, Construction of conics, Cycloids and involutes, Mechanism loci, Graphical integration and differentiation, Cam profiles, Velocity diagrams. Principles of projections: projections of lines, plane figures, Compound figures and simples solids, Orthographic projections, First angle and their projections, Orthographic projection of simple objects.

EEE 211: ELECTRICAL ENGINEERING I (3 CREDITS)

Learning Outcomes

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

1. Understand and apply the appropriate units of measurement in electrical circuits.
2. Describe the behavior of basic circuit elements in DC circuits.
3. Apply fundamental circuit laws and theorems for DC circuit analysis.
4. Introduce the key concepts of AC circuits and alternating voltage and current.
5. Explain the significance of resonance in electrical circuits.
6. Analyze power and power factor in electrical circuits, including calculations for apparent, active, and reactive power.

Course Contents

Units, Basic Circuit elements and their behavior in DC Circuits, Basic circuit Laws and theorems. Introduction to AC Circuits. Resonance, Power and factor, 3 phase circuits, Transformers, Basic distribution system, Introduction to DC and AC machines.

GEE 211: INTRODUCTION TO GEOMATICS ENGINEERING I (2 CREDITS)

Learning Outcomes

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

1. Demonstrate proficiency in various methods of distance measurement, including taping, optical methods, and Electronic Distance Meters (EDM). Understand the basic principles, features, and accuracy considerations for each method.
2. Explain the types and basic features of theodolites, and acquire the skills to test, adjust, and calibrate theodolites. Understand angular measurement procedures and accuracy standards.
3. Explore the principles and applications of gyrotheodolite measurements in various surveying contexts.
4. Gain an understanding of electronic total station instruments, including their basic features, calibration processes, and measurement procedures.
5. Identify different types of traverses and the instruments and methods used for conducting traverse surveys. Develop the ability to compute and adjust traverses, and learn methods for area computations.
6. Apply measurement procedures and accuracies to ensure precise and reliable survey data, integrating knowledge of distance measurement techniques, theodolite operation, and traverse survey principles.

Course Contents

Mechanical distance measurements: Measurement by taping. Optical methods and Electronic Distance meters EDM; Basic principles, features of the instrument, Testing adjustment and calibration of the instrument measurement procedures, Accuracies. The Theodolite: Types of Theodolites, Basic features of the theodolite, Testing, adjustment and calibration of theodolites, Angular measurement, procedures and accuracies, Gyrotheodolite measurements. Electronic Total Station instrument: basic features, instrument calibration and measurement procedures. Traverse surveys: Types of traverses, Instrument and method of traverses, Computation and adjustment of traverses and methods of area computations.

CVE 211: STRENGTH OF MATERIALS I (3 CREDITS)

Learning Outcomes

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

1. Understand the concept of free body diagrams and apply them to analyze the equilibrium of forces acting on a body.
2. Define and differentiate between stress and strain, and understand how they relate in the context of material behavior.
3. Familiarize yourself with the tensile test and its significance in determining material properties. Be able to calculate Young's modulus and other strength factors.
4. Analyze axially loaded bars and understand how various forces and stresses affect their behavior.
5. Explain the principles behind composite bars and their response to combined axial loads.
6. Analyze bending moments and shear forces in simple structures, and create axial diagrams to understand and predict the behavior of materials under various loads.

Course Contents

Force equilibrium: free body diagrams, concept of stress and strain, Tensile test, Young's moduli and other strength factors, axially load bars, Composite bars, Temperature stresses and simple indeterminate problems. Hoop stress: cylinders, rings, Bending moment, Shear force and axial diagrams for simple cases.

200 LEVEL SECOND SEMESTER COURSES

EMA 282: ENGINEERING MATHEMATICS II (4 CREDITS)

Learning Outcomes

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

1. Demonstrate proficiency in advanced integration techniques, including the use of reduction formulae.
2. Apply differential equation-solving skills to various fields, such as geometry, mechanics, chemistry, and heat transfer.
3. Analyze and understand mechanical and electrical oscillations, both damped and undamped, and identify resonances in electric circuits.
4. Master numerical methods, including solving non-linear equations, simultaneous linear equations, finite difference operators, and gain an introduction to linear programming.
5. Apply mathematical and scientific concepts to solve real-world problems in disciplines like physics and engineering.
6. Develop problem-solving and analytical skills, equipping learners to tackle complex mathematical and scientific challenges effectively.

Course Contents

(i) Further Integrations: Reduction formulae

(ii) Differential Equations:

(a) General Review, Exact differential equations, Simple application in Geometry, Mechanics, Chemical reactions and heat flow.

(b) Second order linear differential equations with constant coefficients, Further D-operator method, Solution of second order, differential equations by method of change of variables, Introduction of partial differential equations (separation of variables).

(iii) Mechanical and Electrical Oscillations: Oscillations of damped and un-damped mechanical systems, Electric circuit theory, Resonances.

(iv) Numerical methods: Introduction to numerical computation, Solution of non-linear equations, Solution of simultaneous linear equations-both direct and iterative schemes, Finite difference operators, Introduction to linear programming (Graphical Solution).

GEE 212: INTRODUCTION TO GEOMATICS ENGINEERING II (2 CREDITS)

Learning Outcomes

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

1. Understand the principles of leveling and use various types of level instruments. Learn to test and adjust these instruments for accuracy.
2. Gain proficiency in conducting differential and precise leveling surveys. Learn how to establish benchmarks and address challenges such as river crossings, curvature, and refraction.
3. Master the concepts of trigonometric heighting for precise elevation measurements.
4. Learn to create topographic maps, interpret contours, and apply direct and indirect methods of contouring. Understand contour interpolation and the multiple uses of contour maps and plans.
5. Explore advanced geodetic survey techniques, including triangulation, trilateration, traverse, satellite station baseline extension, and coordinate transformation.
6. Understand survey design, specifications, and advanced techniques like intersection (by angle, bearing) and resection. Learn the principles of 3D surveys using Total Station instruments.

Course Content

Leveling; Level instrument, Types of Levels, Tests and adjustment of level instruments, Differential leveling, Precise leveling, Establishment of Benchmarks, River crossing, Curvature and refraction, Trigonometric Heighting, Longitudinal and cross section, their uses. Topographic mapping, Contours and contouring, direct and indirect methods of contouring, contour interpolation, uses of contour maps and plan, Triangulation, Trilateration, Traverse and their combination, satellite station baseline extension, coordinates transformation, Introduction to the design of surveys and specifications, Intersection, by angle, bearing and derivations. Resection and their derivations. 3D Surveys with Total station instruments.

GEE 232: COMPUTER PROGRAMMING II (2CREDIT)

Learning Outcomes

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

1. Understand and apply polymorphism, abstract classes, and interfaces.

2. Organize code using packages/namespaces and create class hierarchies effectively.
3. Utilize iterators/enumerators, List, Stack, and Queue from APIs.
4. Implement searching, sorting, and recursive algorithms.
5. Develop event-driven applications, handle events, and manage exceptions.
6. Create Graphical User Interface (GUI) applications.
7. Solve problems using static and dynamic data structures, various search and sort algorithms, and GUI programming tasks.

Course Contents

Review and coverage of advanced object-oriented programming - polymorphism, abstract classes and interfaces; 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. Applications in Graphical User Interface (GUI) programming.

Lab work: Programming assignments leading to extensive practice in problem solving and programme 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.

GEE 252: GEOSPATIAL DATA SCIENCE AND SOFTWARE DEVELOPMENT(2 CREDITS)

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

1. Proficiency in Python programming and computer vision techniques.
2. Effective image data handling and format selection.
3. Strong problem-solving and algorithm application skills.
4. Team collaboration on real-world projects.
5. Theoretical understanding applied to practical scenarios.
6. Adherence to ethical and data privacy considerations.

Course Contents

Introduction to software implementation, including image data formats, programming standards, Python programming and libraries, and writing, compiling and running software codes. Computer vision methods, algorithms, and applications, including edge detection, feature extraction, image matching, mathematical morphology, image segmentation, image classification, object detection, and 3D creation. 3D geospatial data processing, managing and modelling; problem-solving; and teamwork. Students will gain a more profound knowledge of 3D geospatial data and learn to design appropriate pipelines for 3D geospatial data processing, managing and modelling. Theoretical concepts along with examples.

MEE 222: ENGINEERING DRAWING II (3 CREDITS)

Learning Outcomes

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

1. Understand the principles of first and third angle orthographic projections and apply them to complex objects for accurate two-dimensional representations.
2. Learn about axonometric projections and their basic types in geometry, enabling the creation of 3D representations from complex objects.
3. Develop the ability to construct isometric views of objects, such as abodes, prisms, pyramids, circles, and long cylinders, to visualize objects in three dimensions.
4. Gain the skills to create isometric views from both three and two orthographic projections of an object, enhancing proficiency in translating between different representations.
5. Develop freehand drawing skills, with a focus on creating surfaces and curves of intersection in complex objects.
6. Understand and apply the basics of mechanical engineering drawing, including techniques for representing interpenetrating solids, as well as basic civil engineering drawings, including topographical, geological, structural, and architectural drawings

Course Contents

1. First and third angle orthographic projections of complex objects.

2.Axonometric projection and their basic types of geometry.

3.Construction of abode, prism, pyramid, circle, long cylinder in isometry.

4.Construction of isometric views for three and two orthographic projections of an object.

5.Freehand Drawing. Development of surfaces curves of intersection.

6.Interpenetration solids. Basic mechanical engineering drawing.

7.Basic civil engineering drawings including topographical, geological structural and architectural. 8.Basic wiring drawings, electronic components circuits.

MEE 212: ENGINEERING MECHANICS II (3 CREDITS)

Learning Outcomes

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

1. Understand the concept of position, reference frames, and types of coordinates for kinematic analysis.
2. Differentiate between scalar and vector functions and apply function differentiation to analyze motion in various reference frames.
3. Analyze the derivatives of vector quantities in the context of moving reference frames and determine velocities and accelerations in cases of relative motion.
4. Master the construction of velocity and acceleration diagrams in simple cases, identify instantaneous centers, and use graphical methods to analyze the behavior of cams.
5. Apply analytical techniques to study velocity and acceleration in simple mechanisms and understand the kinematics of rigid bodies, including translation and rotation about a fixed axis and general two-dimensional motion.
6. Explore vectorial and non-vectorial techniques in kinetics, employing impulse, momentum, energy methods, and understanding equivalent mass and moment of inertia. Analyze simple cases of equivalent dynamic systems.
7. Understand the kinematics of simple harmonic motion and its application in mechanical systems.
8. Gain proficiency in analyzing simple differential gear trains, belt and chain drives, and their role in mechanisms and machinery.

Course Contents

Position, reference frame and coordinates; Types of coordinates, Scalar and vector functions, Function differentiation, Derivatives of vector and moving references frames, Velocity and accelerations relative motion. Kinematics of Rigid Bodies: Velocity and acceleration diagrams in simple cases, Instantaneous centers, graphical treatment of cams, Analytical treatment of velocity and acceleration in simple mechanisms. Kinetics of rigid bodies: Translation and rotation about a fixed axis for rigid bodies, General two-dimensional motion of rigid bodies, Vectorial and non-vectorial techniques, Impulse, Momentum, Energy methods, Equivalent mass and moment of inertia, Simple cases of equivalent dynamic systems. Kinematics of simple harmonic motion: Simple harmonic motion. Mechanisms: Simple differential gear trains, belt and chain drives.

GEE 222: MATHEMATICAL CARTOGRAPHY(2CREDITS)

Learning Outcomes

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

1. Understand the fundamentals and history of cartography, including its nature and modern applications.
2. Comprehend data collection methods and data models, including their role in creating digital cartographic information.
3. Develop skills in map design, color theory, and map projection techniques.
4. Explore various types of map projections and their properties, including common projection types.
5. Master coordinate systems, including UTM, and learn to convert between geographical and grid coordinates.
6. Gain proficiency in geodetic and datum transformations, including the Bursa-Wolf and Molodensky-Badekas models.
7. Understand the mathematical and geometric considerations of the Earth's surface and the derivation of formulas for different surfaces and datums.

Course Contents

(a) Cartography today, nature of Cartography, History of Cartography, Cartographic visualization, Web Cartography, Maps and Graticles, Map direction, Data: Ground Surveying and GNSS Positioning, Remote Sensing Data Collection, Census and Sampling, Data Models, Models for Digital Cartographic information, Map digitizing, Cartographic design, Colour theory and models, Colour and pattern creation, Topography aid. Map Projections, scales. The concepts and properties of maps; classification of maps; Theory of distortions, conformality; Equivalency, Equidistancy; Tissot's indicatrix, Common types of projections eg, Azimuthal, Conical, Cylindrical, Conformal and Transverse Mercator projections. Transverse Mercator projection, the Nigeria Modified Transverse Mercator projection (NTM), Nigeria belt systems and the problem.

(b) Transverse Mercator projection, the Nigeria Modified Transverse Mercator projection (NTM), Nigeria belt systems and the problem. Coordinate systems, WGS84 and Minna datum, Geographical coordinates systems, Conversion of geographical coordinates to grid and to geographical, Universal Transverse Mercator Projection (UTM), UTM in Nigeria and zones, Conversion of geographical coordinates into UTM grid coordinates and verse – versa, Transformation of NTM to UTM and UTM to NTM coordinates systems. Coordinate reference frame: Coordinates transformation: Bursa – Wolf model, Molodensky – Badekas model, Molodensky Transformation, the Abridged Molodensky transformation. Test values for both Abridged and Molodensky Transformations. 2D conformal, Affine Transformations. Mathematical and Geometric consideration of the earth, Gaussian fundamental quantities, Derivation of Gaussian formula for Datum, projection, plane, sphere, and Ellipsoidal surfaces.

GEE 214: ARCHITECTURE GRAPHICS (2 CREDITS)

Learning Outcomes

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

1. Understand the fundamental principles of architectural presentation, encompassing 2D, 3D, and 4D projections and object resolution in plans, sections, and elevations.

2. Learn to use architectural symbols, scale, logos, and various presentation formats to effectively convey architectural designs.
3. Develop skills in basic architectural design, including space and function analysis, as well as the identification of relevant environmental factors. Create flow and bubble diagrams and coordinate dimensions vertically and horizontally.
4. Explore the intricate relationship between form and function in architectural design and understand the cost implications of design decisions.
5. Acquire knowledge of basic construction technology and the creation of sectional drawings, with a focus on working drawings for translating architectural designs into constructed structures.
6. Apply the principles learned to design a typical bungalow, including detailed building design and working drawings for a practical architectural project.
7. Develop freehand drawing skills, focusing on shapes, light, and shadow, and understand orthographic drawing techniques, including diametric and perspective projection and their practical applications. Explore common curves in architectural design.

Course Contents

The principles of architectural presentation: 2, 3 and 4 dimensional projections, Resolution of objects of plans, Sections and elevations. The use of Architectural symbols, scale, Logo and other presentation formats. Basic Architectural design; Space and function analysis and the identification of relevant environment, Flow/Bubble diagrams, Dimensional coordination (vertical and horizontal dimensions), Sectioning versus structural integrity, Form and function relationship, Cost implication of design decisions. Basic technology of construction and the sectional drawings, working drawings.

Student should design a bungalow – Typical building design and working drawings.

a. Introduction: Dimensional awareness, Graphic communication, Relations to environments.
b. Free hand drawing: Form in terms of shapes, Light and shadow.
c. Orthographic: Diametric, Perspective projection, Applications.

d. Common curves.

EEE 212: ELECTRICAL ENGINEERING II (3 CREDITS)

Learning Outcomes

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

1. Understand the fundamental principles of atomic structure and how materials are classified based on their properties, particularly in the context of electronic devices.
2. Comprehend the mechanisms of electron emission and the operation of gas discharge devices, which play a critical role in various electronic applications.
3. Explore the properties of semiconductor materials and the behavior of p-n junction diodes in electronic circuits.
4. Master the D.C. and A.C. analysis of transistor amplifier circuits, including the principles of amplification and signal processing in electronic devices.
5. Learn about the characteristics of transistor switching and its applications. Understand rectification and the role of D.C. power supplies in electronic devices.
6. Develop proficiency in using various electrical measurement instruments, including voltmeters, ammeters, ohmmeters, wattmeters, and energy meters. Gain knowledge of measuring three-phase power in electrical systems.

Course Contents

Physics of Devices: Atomic structure, Material classification, Electron emission, Gas discharge devices, Semiconductor materials, p-n junction diode and transistor. Transistor amplifier: D.C. and A.C. analysis of transistor amplifier circuits, Transistor switching characteristics, Rectification and D. C. power supplies. Electrical measurement: Voltmeters, Ammeters, Ohmmeters, Wattmeter's, Energy meters, Measurement of three phase power.

300 LEVEL FIRST SEMESTER COURSES

EMA 381: ENGINEERING MATHEMATICS III (3 CREDITS)

Learning Outcomes

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

1. Understand the properties and operations involving n-dimensional vectors, including vector addition and scalar multiplication. Explore matrices, including addition, scalar multiplication, and product operations.
2. Learn how to determine linear dependence and independence within a set of vectors. Understand the significance of linear combinations in vector spaces.
3. Master the properties of matrices, including determinants and their properties. Explore submatrices, matrix rank, and the concept of inverses. Understand the theory of systems of linear equations and linear transformations using matrices.
4. Understand bilinear and quadratic forms and their role in mathematical analysis, particularly in the context of vectors and matrices.
5. Explore plane polar coordinates, coordinate transformations, and solid geometry concepts, including spheres and quadratic surfaces. Learn to work with spherical, polar, and cylindrical polar coordinates.
6. Gain proficiency in dealing with functions of several variables, including understanding the mean value theorem, maxima and minima, differentiation under the sign of integration, and Jacobians. Explore numerical differentiation and quadrature formulae, as well as the analytical and numerical solutions of ordinary differential equations.

Course Contents

Linear Algebra; n-dimensional vectors, Addition and scalar multiplication, Linear dependence and independence of a set of vectors. Matrices; Operations of addition, Scalar multiplication and product, Determinants and their properties, sub matrices and rank, Inverse of a matrix, Theory of a system of linear equations, Linear transformation and matrices, Eigen values and eigen vectors of a matrix, eigenvalues of Hermitian, Skew Hermitian and unitary matrices, Bilinear quadratic forms.

Analytical Geometry; Plane polar coordinate, Coordinate transformation, Solid Geometry and spheres and quadratic surfaces, Spherical, Polar, Cylindrical polar coordinates.

Functions of several Variables, Mean value theorem for function of several variables, Maxima and minima, Differentiation under the sign of integration, Jacobians.
Numerical Analysis; Numerical differentiation and quadrature formulae, Analytical and numerical solution of ordinary differential equation.

MEE 351: THERMODYNAMICS (2CREDITS)

Learning Outcomes

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

1. Understand the fundamental concepts in thermodynamics, including systems, stages, properties, interactions, equilibrium, and the differentiation between point and path functions.
2. Master the properties of pure substances, such as perfect gases, specific and latent heats, and equations of state. Explore the phases of pure substances, including solids, liquids, and gases, as well as phase equilibria and changes near the critical point.
3. Learn the First Law of Thermodynamics and its application to energy conservation. Understand the general energy equation and Bernoulli's equation in the context of heat and work transfer. Study engine cycles, air-standard cycles, and various thermodynamic processes.
4. Explore the Second Law of Thermodynamics, including the concept of entropy and irreversibility in energy systems.
5. Understand the properties and state of thermodynamic systems, including temperature, equilibrium, and the application of the Zeroth Law.
6. Gain proficiency in the First Law of Thermodynamics, specific heat, enthalpy, and the behavior of ideal gases. Study flow systems and their thermodynamic properties.
7. Learn about thermodynamic cycles, including the Carnot Cycle and practical applications like heat pumps. Explore the calculation of entropy changes and perform energy analyses in thermodynamic systems.

Course Contents

Systems, Stages, Property, Interactions, Equilibrium, Cycle, Point and Path Functions Temperature, etc. Thermodynamics Properties of Pure Substances: Perfect Gas, Specific and Latent Heats, Equations of State. Phases of Pure Substances – Solids, Liquids and Gases. Phases Equilibria and Charges in Critical Point, Properties of Vapours, and Use of Thermodynamics Tables. Heat and Work Transfer: First Law of Thermodynamics, General Energy Equation and Bernoulli's Equation. Engine Cycles, Air-Standard Cycle, Otto Cycle, Simple Gas Turbine Cycle, Carnot Cycle, Heat Pump, etc. Second Law of Thermodynamics, Entropy Irreversibility. Energy, Thermodynamic Systems, Properties and State, Temperature and the Zeroth Law, Equilibrium, Properties of the Pure Substance, Equation of State; Work, Reversibility Heat, First Law, Specific Heat, Enthalpy, Ideal Gas, Flow Systems, Entropy and the Second Law, Carnot Cycle, Thermodynamic Temperature Scale, Process Efficiencies Cycles, Calculation of Entropy Change Energy Analysis.

CVE 341: ENGINEERING GEOLOGY(3 CREDITS)

Learning Outcomes

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

1. Understand the definition, scope, and subdivisions of geology, and its relevance to civil engineering. Gain insights into the origin and evolution of celestial bodies, including Earth's relationship with the sun and other planets.
2. Explore exogenic processes like weathering and erosion, which shape the Earth's surface and impact its topography and geological features.
3. Understand structural geology concepts such as folding, faulting, jointing, and rifting. Learn about isostasy, changes in sea levels, and their causes and effects on Earth's geological processes.
4. Explore the concepts of transgression and regression in geological contexts and their relation to tectonics and sedimentation.
5. Recognize the practical implications of geological knowledge for civil engineering. Understand how geological factors can impact construction, infrastructure stability, and environmental considerations in civil engineering projects.

Course Contents

(i) Introduction: Definition, Scope and subdivision of geology, Aspects of geology and their

relevance to Civil Engineering, Brief discussion on the origin and the evolution of the planets, the earth and its relations to the sun and other plants.

(ii) Structure and composition of the Earth: The core, the mantle and the crust composition of the

various layers, Radioactivity and magnetism of some rocks and minerals.

(iii) Geological processing: Exogenic processes (weathering and erosion), Endogenic processes. (Magma, its origin, Crystallization, Differential and solidification into rock-earthquakes, volcanoes, rifting and continental drifts).

(iv) Geological Processes: Folding, Faulting, Jointing and rifting Isostasy, change in ecstatic's sea levels, Causes and effect: Transgression and regression, Tectonic and sedimentation.

GEE 331: GEOMATICS ENGINEERING NETWORKS(2 CREDITS)

Learning Outcomes

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

1. Understand the specifications and requirements for conducting control surveys in Nigeria, including the key factors that must be considered.
2. Learn about the accuracy standards and classification criteria for horizontal and vertical controls in surveying. Understand how different control points are categorized based on their precision and purpose.
3. Master the techniques and procedures for monumenting control points and accurately measuring horizontal controls using methods such as triangulation, trilateration, and transverse methods. Comprehend the importance of monumentation and its role in surveying accuracy.

4. Explore different surveying techniques, including intersection by angle and bearing, linear-angular intersection, and resection. Understand how these methods are used to determine the location of survey points.
5. Learn about geodetic leveling, including its classification, instrumentation, field procedures, and the adjustment process. Understand the importance of precise leveling in surveying and its applications.
6. Gain knowledge about GNSS systems, including updates, sources of errors, and the measurement of GNSS coordinate systems. Understand how GNSS technology is utilized in control surveys and point positioning.
7. Explore the principles and applications of differential GNSS and real-time kinematic (RTK) methods. Understand the software structure and processing considerations involved in GNSS-based surveying.

Course Contents

Specification for Control surveys in Nigeria, Accuracy standards and classification for horizontal and vertical controls, Monumentation, measurement and adjustment of horizontal controls by triangulation, trilateration, transverse and their combinations, Intersection, by angle, bearing and derivation, Linear – angular intersection. Resection and their derivations. Geodetic leveling.
Classification of geodetic leveling, Instrumentation, Field procedures and adjustment in geodetic leveling. Global Navigation Satellite Systems (GNSS); Systems update, Sources of errors in GNSS, Measurement of GNSS coordinates system, Observation control surveys by GNSS, Accuracies, Point positioning; Differential GNSS and RTK methods, Software structure and processing consideration.

GEE 311: CADASTRAL AND LAND INFORMATION MANAGEMENT (2 CREDITS)

Learning Outcomes

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

1. Understand the historical evolution and development of cadastral surveying and its significance in land administration.

2. Explore the land tenure system in Nigeria, including its historical context and the different forms of land ownership and management.
3. Learn about the various cadastral systems and their role in land administration, property rights, and land use planning.
4. Gain knowledge of the methods and legal processes for acquiring land rights in Nigeria, including ownership, leases, and land acquisition.
5. Master the techniques and methods used in cadastral survey computations, including the measurement and calculation of land parcels.
6. Understand the land registration system in Nigeria, survey rules and regulations, and the role of cadastral surveys in resolving land disputes. Explore the legal framework and processes for land registration.
7. Learn about the history, basic features, hardware and software systems, and data sources used in Land Information Systems (LIS). Understand how LIS is utilized in land administration and management.
8. Explore coastal zone management, maritime boundary delimitation, and relevant laws of the seas. Understand the significance of accurately defining maritime boundaries.
9. Gain an introduction to the Voluntary Guidelines on the Responsible Governance of Tenure of Land, Fisheries, and Forests in the Context of National Food Security (VGGT) and their relevance to land governance and security.

Course Contents

History of Cadastral surveying, Land tenure system in Nigeria, Cadastral systems, Methods of acquiring right in Land, Boundaries, Local and International boundaries, Cadastral survey computation, Land registration system in Nigeria, Land in dispute surveys, Survey rules and regulations. Subdivision of plots, Layout Survey, real property laws, parcel-based land information system, comparative analysis of land administration systems, Coastal zone management, Laws of the Seas, Delimitation of maritime boundaries. Land Information System (LIM); History of LIM, Basic features of LIM, Hardware and software system for LIM, Data source for LIM. Introduction to digital data collection. The basic concept of Voluntary Guideline on the

Responsible Governance of Tenure of Land, Fisheries and Forest in the Context of National Food Security (VGGT).

GEE 341: ENGINEERING STATISTICS (2 CREDIT)

Learning Outcomes

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

1. Gain an introductory understanding of statistics, including the fundamentals of probability theory, random variables, and expectations.
2. Learn about discrete and continuous probability distributions and how they are used in statistical analysis.
3. Explore key statistical concepts, including the probability of relative frequency, independent trials, and the Laplace-De Moivre's limit theorem.
4. Study specific probability laws, such as Poisson's law, and understand how they are applied in statistical analysis.
5. Understand the core concepts used in statistical analysis, including the calculation of expectations, variance, covariance, and correlations.
6. Learn about sampling theory and the estimation of population parameters. Explore the techniques used to reduce data and analyze it effectively.
7. Master regression analysis and analysis of variance techniques, as well as the application of statistical tests. Study both discrete and continuous distributions, including binomial, Poisson, multinomial, normal, chi-square, t, F, and gamma distributions.

Course Contents

(a) Introductory to statistics. Fundamentals of probability theory, random variables and expectations. Discrete and continuous distributions. Probability of relative frequency. Independent trials. The Laplace-De-Moivre's limit theorem. Poisson's law. Concepts used in statistics. Expectation of a sum, variance, covariance and correlations. Theory of errors. Estimation of variance and correlations. Linear regression. Random events. Frequency analysis. Data reduction techniques. Distributions and density functions. Expectation and other moments.

(b) Some aspects of probability theory. Random events. Frequency analysis, Data Reduction Techniques Random variables Distribution and density function, Expectation and other moment's discrete distribution Binomial, Poison, Multinomial Distribution. Continuous Distribution: Normal, Chi-Square, T, F and Gamma Distributions. Sampling theory, Estimation of population parameters and Statistical Test. Regression analysis and Analysis of Variance.

GEE 361: GEOSPATIAL INFORMATION TECHNOLOGY I (2 CREDITS)

Learning Outcomes

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

1. Understand the core concepts of Information and Communication Technology (ICT) and information systems, and their significance in various applications.
2. Explore the evolution of GIS, its components, functions, and architecture, and understand its role in spatial data management and analysis.
3. Gain knowledge of database concepts, including database design and management systems, and their importance in storing and organizing spatial data.
4. Learn about the basics of spatial data modeling, including concepts such as map projections, geodetic datums, and coordinate systems. Understand the process of georeferencing.
5. Explore various data modeling techniques, including entity-relationship modeling and extended entity-relationship modeling. Understand the differences between conventional database structures (relational, network, and hierarchic) and object-oriented data modeling.
6. Explore different spatial data models, including 2D, 3D, and 4D models. Understand tessellation data models, vector data models, and the importance of spatial relationships, including metric, topologic, and spatial order. Learn about data quality aspects, including positional accuracy, attribute accuracy, logical consistency, completeness, and lineage

Course Contents

Concept of ICT, and information system, GIS, the evolution of GIS, components of a GIS, GIS functions and architecture, characteristics of GIS, data base and data base design and management systems. Introduction to spatial data modeling and analysis, map projection, geodetic datum, coordinate systems, Georeferencing. Semantic data modelling: entity relationship and extended entity relationship modelling. Conventional database structures (relational, network and hierarchic). Object Oriented data modelling: object, classification, generalization/ specialization, aggregation, association, inheritance, propagation, encapsulation, persistence, polymorphism and overloading. Object-relational data structure. Applications: topographic, cadastral, utility and environmental database, Field-based and object-based concepts of real world. Spatial Data Models: 2D, 3D and 4D Model; tessellation data models; vector data models, tessellation versus vector spatial relationships: metric, topologic and spatial order. Data quality aspect: positional accuracy, attribute accuracy, logical consistency, completeness and lineage.

GEE 351: PHOTOGRAMMETRY AND REMOTE SENSING1 (2 CREDITS)

Learning Outcomes

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

1. Understand the characteristics of aerial and ground photographs, including vertical and near-vertical photographs. Learn about the principles of stereoscopy and how to view a pair of air photos stereoscopically.
2. Explore the scales of vertical photographs and how to measure photo coordinates. Learn how to determine ground coordinates from vertical aerial photographs and calculate heights from aerial photographs. Understand the process of producing contour maps and ground profiles from aerial photos.
3. Learn the fundamental elements of photo interpretation and its applications, including its use in bedrock studies and land-use analysis.

4. Understand the creation of photo mosaics and orthophotographs and their significance in generating accurate, distortion-free images from aerial photos.
5. Explore the concept of remote sensing, including the characteristics of remote sensing platforms and sensors. Understand the differences between photographic and digital imaging in remote sensing.

Course Contents

Aerial and ground photographs, Vertical and near vertical photograph and their appropriate geometrical relationship, Stereoscopy, Stereoscopic viewing of a pair of air photos, Scales of vertical photographs, Measurement of photo coordinates, Ground coordinates from vertical aerial photograph, Heighting from aerial photograph, Production of contour maps and ground profile from aerial photos.

Ground controls for aerial photography; basic and photo controls. Radial line method of increasing controls.

Photo interpretation; Principal element in photo interpretation, Applications to bedrock studies, Land use etc. Photo mosaics and Orthophotographs

Introduction to Remote Sensing; Concept of Remote Sensing, Remote Sensing platform and sensor characteristics, Photographic and digital imaging.

MEE 361: FLUID MECHANICS I (2 CREDITS)

Learning Outcomes

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

1. Understand the fundamental notions and definitions in fluid mechanics, including the continuum property, density, pressure, specific volume, surface tension, and viscous compressibility.
2. Learn about hydrostatic forces on submerged surfaces in incompressible fluids, pressure variation in static fluids, floatation principles, and considerations for the stability of floating bodies.

3. Explore the systems and control volume approach to the basic laws for continuous media, leading to the development of conservation equations of mass and momentum. Understand Euler's equation and Bernoulli's equation.
4. Gain insights into the flow of Newtonian fluids in pipes, including pressure drop, shear stress in pipe flows, velocity distribution, and the significance of the Reynolds number.
5. Study the philosophy of dimensional analysis in engineering, dimensional homogeneity, similitude, Buckingham's Pi-Theorem, and the importance of dimensionless groups in engineering.
6. Learn about flow meters and flow measurement techniques, including head flow meters in closed and open conduits, mechanical and electromagnetic flow meters, and the potential for scale errors in flow measurement.

Course Contents

Fundamental notions and Definitions: Continuum property, density, pressure, specific volume, surface tension, viscous compressibility, etc. Fluid Statics: Hydrostatic forces on submerged surfaces in incompressible fluid, pressure variation in static fluids, floatation, stability consideration of floating bodies. Dynamics of fluid flow: Systems and control volume approach to the basic and subsidiary laws for continuous media leading to the development of conservation equations of mass and momentum. Euler’s equation, Bernoulli’s equation. Introduction to incompressible viscous flow: Flow of Newtonian fluids in pipes – pressure drop and shear stress in pipe flows, velocity distribution, Reynolds number and its significance. Dimensional Analysis: Philosophy of dimensional analysis in engineering, dimensional homogeneity, similitude, Buchingams’s Pi-Theorem, important dimensionless groups in engineering. Flow Measurements: Flow meters and flow measurement, head flow meters in closed and open conduits mechanical and electromagnetic flow meters, scale errors in flow measurement.

CED 300: ENTREPRENEURSHIP (2 CREDITS)

Learning Outcomes

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

1. Understand entrepreneurship and new venture creation.
2. Identify and evaluate business opportunities.
3. Explore business forms and staffing.
4. Learn marketing strategies for new ventures.
5. Manage financial aspects and capital raising.
6. Conduct feasibility studies, address legal issues, and consider insurance and environmental factors.

Course Contents

Introduction to entrepreneurship and new venture creation; Entrepreneurship in theory and practice; The opportunity in theory and practice; the opportunity, Forms of business, Staffing, Marketing and the new venture; Determining capital requirements, Raising capital; Financial planning and management; Starting a new business, Feasibility studies; Innovation; Legal Issues; Insurance and environmental considerations, Possible business opportunities in Nigeria.

300 LEVEL SECOND SEMESTER COURSES

EMA 382: ENGINEERING MATHEMATICS IV (3 CREDITS)

Learning Outcomes

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

1. Understand Fourier series and its applications, including solving partial differential equations.

2. Focus on the practical applications of gamma and beta functions, particularly in probability theory.

3. Learn to solve differential equations, including series solutions. Explore special functions like Legendre and Bessel functions and their introductory applications.

4. Differentiate between scalar and vector fields, grasp directional derivatives, gradients, divergence, and curl. Perform integrals in vector field theory.

5. Explore key theorems like Gauss' divergence theorem, Stokes' theorem, and Green's theorem and understand their relevance in mathematics and physics.

6. Master line integrals independent of the path and comprehend irrotational vector fields.

Course Contents

Fourier series: periodic functions, Euler formula for coefficients in Fourier sine/cosine series of a function. Even odd functions and their Fourier series. Half range expansion. Theoretical basic of Fourier series. Application to the solution of partial differential equations.

Gamma, Beta and probability functions (emphasis rather on the applications).

Differential Equation: Equations of the form y"= f(x^1, y^1). Linear second order equations reducible to linear equation with constant coefficients. Series solution of differential equations. Legendre's differential equation and Legendre polynomials. Bessel's differential equation and Bessel functions of first kind, their properties and introduction to applications.

Vector field theory, Scalar field and vector fields; Directional derivative, gradient of a scalar field; divergent and Curl of a vector field, del operator, line, surface and volume integrals.

Divergence theorem of Gauss and stokes theorem, Green's theorem.

Line integral independent of path and irrational vector fields.

GEE 314: ENGINEERING GEOPHYSICS (2 CREDITS)

Learning Outcomes

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

1. Understand seismic exploration and its role in mineral exploration.
2. Master the principles of wave types, including direct, refracted, and reflected waves, and curved ray theory.
3. Learn to apply refraction theory for N-layer horizontal cases and use numerical solutions for profiling over dipping interfaces.
4. Explore modern seismic refraction techniques, data processing, and interpretation, including static correction charts and geophysical data evaluation.

5. Grasp the significance of electrical methods, IP resistivity, and magnetism in geophysics, particularly in oil exploration. Understand seismic wave propagation.
6. Analytically treat elementary seismic reflection problems, and gain expertise in seismic reflection data techniques, processing, and interpretation, including NMO charts.

Course Contents

Geophysics and mineral Exploration activity; Seismic exploration, Wave types; Direct, refracted and reflected wave paths, curved ray theory and application, Refraction for the N – later horizontal case. Numerical solution for a refracted profile over a single dipping interface; Field techniques, Processing and interpretation of modern seismic refraction sections, Static correction charts, evaluation of geophysical data as applicable in seismology and gravimetry, Electrical methods, IP resistivity and magnetism. The place of Geophysics in oil exploration, propagation of Seismic waves. Analytical treatment of elementary seismic reflection problems. Field techniques. Processing and interpretation of modern seismic reflection sections, NMO chats.

GEE 312: OPERATIONS RESEARCH IN GEOMATICS ENGINEERING(2CREDITS)

Learning Outcomes

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

1. Understand the fundamentals of operations research, including allocation, inventory, and maintenance problems, as well as dynamic programming.
2. Master Fourier series concepts, such as periodic functions, odd/even functions, and their differentiation and integration, along with the practical application of the Laplace transform.
3. Develop research skills, including selecting topics, defining objectives, formulating hypotheses, and designing experiments.
4. Grasp linear programming models, including primal and dual problems, simplex methods, and post-optimality analysis, and apply them to various optimization problems.

Course Contents

1. Introduction to operations research. Nature of operation research, allocation problems, inventory problems, replacement, maintenance and reliability problems. Dynamics programming, sequencing and coordination.
2. Fourier series. Period functions; Dirichlet conditions; odd and even functions; half-range. Fourier sine and cosine series. Parsevals; identify. Differentiation and integration of Fourier series. Boundary value problems. The Laplace transform and applications (including the use of inversion integral and convolution theorem.
3. Introduction of research methods. Selection of a research topic, definition of study problems and objectives; formulation of research hypotheses; Experiment design for collection and analysis of data; writing a research proposal.
4. Linear programming models; primal and dual problems; graphical solutions, simplex methods, post optimality analysis; special algorithms; trans-shipment and assignment problems. Maximal flow, shortest route, minimum spanning tree; travelling salesman problems. Inventory problems.

GEE 322: INTRODUCTION TO ARTIFICIAL INTELLIGENCE, MACHINE LEARNING AND CONVERGENT TECHNOLOGY (2 CREDITS)

Learning Outcomes

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

1. Comprehend the core concepts of human and artificial intelligence, along with various AI paradigms and algorithms, such as search, logic, and learning techniques.
2. Explore the practical applications of machine learning and nature-inspired algorithms in solving engineering problems and gain an understanding of their variants.
3. Master the mathematical and logic foundations of AI, encompassing knowledge representation, elicitation, and the significance of expert systems, automated reasoning, and pattern recognition.
4. Learn how AI is applied in engineering, including distributed systems, data and information security, and intelligent web technologies.

5. Understand the concept of convergent technologies, its relevance in engineering, and the importance of converging different technological fields.
6. Gain insights into neural networks, deep learning, and the use of Python AI libraries for practical AI implementation.

Course Contents

Concepts of human and artificial intelligence; artificial/computational intelligence paradigms; search, logic and learning algorithms. Machine learning and nature-inspired algorithms – examples, their variants and applications to solving engineering problems; understanding natural languages; knowledge representation, knowledge elicitation, mathematical and logic foundations of AI; expert systems, automated reasoning and pattern recognition; distributed systems; data and information security; intelligent web technologies; convergent technologies – definition, significance and engineering applications. Neural networks and deep learning. Introduction to python AI libraries.

GEE 392: HYDROSPATIALENGINEERING I (2 CREDITS)

Learning Outcomes

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

- Understand the fundamentals of hydrography and its applications, including position-fixing methods and bed depth determination in inland waterways.
- Master bathymetric surveys for various engineering projects and learn to measure river flow, including current metering and river gauging.
- Explore oceanographic concepts, such as tides, water levels, currents, and wave measurement, as well as principles of acoustic propagation and marine positioning, both shore-based and satellite-based.
- Comprehend underwater acoustic positioning principles and sounding methods, including ship-borne, single-beam, and multibeam echo sounding, as well as side-scan sonar systems.

- Gain the skills to determine sea level and mean sea level using tide poles and tide gauges, and understand two-dimensional positioning at sea, bathymetry, and positioning accuracies.
- Learn about measurement systems, both optical and electronic, and identify sources of errors in hydrographic and oceanographic measurements.

Course Contents

Introduction to hydrography; Position fixing methods and determination of bed depth in inland water ways, Bathymetric surveys for coastal engineering works, Dams and bridges etc, Measurement of river flow, Current metering and river gauging, Computation of discharge. Elements of oceanography; Tides and water levels, current and wave measurement, Principles of Acoustic propagation, Marine positioning, shore based and Satellite based radio navigation and positioning, underwater acoustic positioning. Principles of sounding, Ship borne, Single beam and multibeam echo sounding, Side scan sonar systems, corrections to observations. Determination of sea level and mean sea level, tide poles and tide gauges. Two-dimensional positioning at sea, bathymetry, positioning accuracies. Measurement systems, optical and electronic methods, sources of errors.

GEE 342: GEODETIC ASTRONOMICAL METHODS (2 CREDITS)

Learning Outcomes

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

- Understand different coordinate systems and their variations in astronomy, including precession, nutation, polar motion, and proper motions of celestial objects. Learn techniques for reducing star positions.
- Comprehend various time systems used in astronomy, such as sidereal and universal time. Explore the use of ephemerides for determining astronomical positions and understand time conversion and variations in astronomical calculations.

- Master the techniques for determining 1st and 2nd order astronomic positions and azimuths. Gain proficiency in instrumentation, theory, and computational analysis of results in astronomical measurements.
- Explore the geodetic uses of astronomic positions and their relevance in geodesy. Learn about astrogeodetic concepts, including the astrogeodetic geoid.

Course Contents

Coordinates system and their variations; Precession, Nutation, Polar and Proper motions, Reduction of star positions. Time systems; Sidereal and universal time, Ephemeris and astronomical positions determinations, Time conversion and variations. Determination of 1st and 2nd order astronomic Positions and azimuths; Instrumentation, Theory and computation analysis of results, Geodetic uses of astronomic position, Astro Geodetic Geoid.

GEE 332: MININIG AND SPECIAL GEOMATICSENGINEERING (2 CREDITS)

Learning Outcomes

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

1. Understand core principles of mining engineering for both open-pit and underground operations.
2. Master modern surveying techniques, including laser and gyrotheodolite usage.
3. Perform tunneling surveys and analyze rock deformation data.
4. Monitor and analyze ground subsidence to ensure safety in mining areas.
5. Utilize integrated deformation surveys and predict ground subsidence.
6. Stay updated on advancements in geodetic and geotechnical instrumentation.
7. Apply the finite element method and optimization in engineering and mining surveys for efficiency and cost-effectiveness.

Course Contents

Introduction to mining Engineering; Mapping of open pits and underground mines, Shaft plumbing, uses of Lasers, uses of Gyrotheodolite, Tunneling surveys, Rock deformation measurements, Monitoring and analysis of ground subsidence, Design and analysis of integrated deformation surveys, Prediction and monitoring of ground subsidence in mining areas, Advancement in geodetic and geotechnical instrumentation, Industrial surveys, Telemetric data acquisition in engineering surveys, Introduction to the finite element method, and pre-analysis and optimization of engineering and mining surveys.

GEE 362: PHOTOGRAMMETRY AND REMOTE SENSING II (2 CREDITS)

Learning Outcomes

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

1. Understand photogrammetric principles and coordinate systems.
2. Apply photogrammetric measurement techniques and requirements.
3. Interpret vertical and tilted photograph geometry and coordinate transformations.
4. Master collinearity and coplanarity conditions in photogrammetry.
5. Achieve proficiency in interior, exterior, relative, and absolute orientations.
6. Learn analytical and digital rectification principles and their applications.
7. Explore the use of LiDAR, UAS, and flight planning in terrain mapping, bathymetry, and deformation studies.

Course Contents

Photogrammetric principles, systems and products; Fundamental photos and model space coordinate system, Photogrammetric measurement and requirement, Geometry of vertical and tilted photographs, Direct and inverse coordinate transformation, Collinearity and Coplanarity conditions. Interior, exterior, relative and absolute orientations, Principles of analytical and digital rectification, DEM generation and ortho-rectification, Concept of aero-triangulation, Air bourn Mapping, Flight planning of photogrammetric projects. Laser Terrain Mapping (LiDAR), definition, History, principle, system, accuracy, application in Terrain, Bathymetry etc. Unmanned Aerial Systems, UAVs, History, principle, system application on Terrain, Bathymetry, Deformation study etc.

GEE 352: GEOMETRIC GEODESY (2 CREDITS)

Learning Outcomes

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

1. Understand the fundamental principles of geodesy, including physical and mathematical models of the Earth.
2. Explain geodetic reference systems, coordinate frames, and the concept of reference ellipsoids and geodetic datums.
3. Comprehend time systems and the basic motions of the Earth, including changes in reference frames.
4. Perform computational processes and coordinate transformations in geodesy.
5. Familiarize yourself with terrestrial, celestial, and positional coordinate systems, as well as curvilinear coordinates on the ellipsoid.
6. Solve problems related to geodetic coordinates, including φ, λ, ψ, ϴ, and radius of curvature (N, M).
7. Learn about height systems, geoidal heights, orthometric heights, Laplace's equation, and deviations of the vertical.

Course Contents

Fundamental principles of geodesy; Physical and mathematical figures of the earth, Geodetic reference systems, Frames and coordinates, Reference ellipsoid, Geodetic datum. Time system, basic motion of the earth, Change of reference frames, Computational processes and coordinates transformation, terrestrial, Celestial and positional Coordinates system, Curvilinear coordinates of the Ellipsoid, Geodetic coordinates φ, λ, reduced latitudeΨ, the relationship between φ and Ψ, the Geocentric latitude ϴ. Radius of Curvature N, M, Normal Section, the Geodesic, the relationship between Normal Section and Geodesic, solution of small spherical Triangles, solution of Direct and inverse Geodetic problems, Deviation of the vertical. Height systems, Geoidal heights, Orthometric heights. Laplace equation.

GEE 372: ADJUSTMENT IN GEOMATICS ENGINEERING (2 CREDITS)

Learning Outcomes

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

1. Differentiate systematic and random measurement errors and assess their impact on accuracy.
2. Apply laws of accidental errors, distinguishing accuracy from precision.
3. Assign appropriate weights to measurements and understand variation calculus.
4. Apply the least squares method to minimize errors in measurements.
5. Utilize weight matrices and variance factors for error analysis.
6. Understand parametric and condition equations for combined adjustments.
7. Master statistical testing, prediction, and constraint functions, along with standard ellipses and curves for quality assessment.

Course Contents

Theory of errors of measurement; Systematic and random errors of measurement, Laws of accidental errors, Accuracy and precision, Weight of an observation, calculus of variation, Least squares principles, least squares method, Weight matrix, Variance factor, Parametric and condition equations, combined adjustment, Statistical testing, Prediction and filtering, Constraint function, Weighted parameters, Standard ellipse and standard curve and their statistical significance.

GEE 346: BIG DATA COMPUTING (2 CREDITS)

Learning Outcomes

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

1. Set up Big Data environments.
2. Retrieve and query Big Data from various sources.
3. Integrate and manage data using tools like Splunk and Datameer.
4. Process and analyze Big Data using Apache Spark and Hadoop.
5. Explore graph processing in Big Data applications.
6. Learn about Big Data streaming platforms for real-time data.

7. Apply knowledge to practical projects, including Twitter data analysis and cost-efficient, enterprise-scale solutions.

Course Contents

Installation: Cloudera VM, Jupyter server. Big data retrieval and relational querying: Postgres databases, NoSQL data, MongoDB, Aerospike, and Pandas for data aggregation and working with data frames. Big Data Integration: Splunk and Datameer. Big Data Processing: Apache Spark, Hadoop, Spark Core (Spark MLlib and GraphX). Big Data Applications (Graph Processing). Big Data Streaming Platforms for Fast Data. Lab Work: Analyzing Twitter Data using Spark and MongoDB. Learn Big Data analytics skills. Practical procedure for the crafting of an enterprise-scale cost-efficient Big Data and machine learning solution to uncover insights and value from data. Use the practical exercises to bridge the gap between the theoretical world of technology with the practical ground reality of building corporate Big Data and data science platforms. Hands-on exposure to Hadoop and Spark (or any of the BD tools), build machine learning dashboards using R and R Shiny, create web-based apps using NoSQL databases. Practical assignment of BD security.

MEE 362: FLUID MECHANICS II (2 CREDIT)

Learning Outcomes

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

1. Understand the mechanism of viscosity and the equations of motion for viscous Newtonian fluids, including the Navier-Stokes equation for laminar flows.
2. Analyze laminar velocity distribution, elementary channel flow, and be introduced to turbulence in fluid dynamics.
3. Explore fundamental concepts in fluid dynamics, such as circulation, irrotationality, velocity potential, and stream functions, and their applications.
4. Learn about inviscid flows, boundary conditions, Poisson's and Laplace's equations, and elementary solutions.

5. Understand the principle of superposition in fluid dynamics, including lift and drag on cylinders and the Kutta-Joukowsky condition.
6. Gain an introduction to aerofoil theory.
7. Explore power systems, including mechanical, thermal, and hydraulic systems, air conditioning, refrigeration, and the basics of heat transfer and heat exchangers.

Course Contents

Viscous Flow Theory: Mechanism of viscosity; Equation of motion for viscous Newtonian fluids; Naiver-Stokes equation for laminar flows; simplified forms and some exact solution; laminar velocity distribution. Elementary channel flow, introduction to turbulence. Some application of viscous flow theory- the introduction to the concepts of circulation, irrationality, velocity potential and stream functions. Inviscid equation in general forms; boundary conditions for inviscid flows. Poisson's and Laplace's equations and their elementary solutions, elementary flows and the principle of superposition. Lift and drag on cylinders; D'Alenbert's paradox. Kutta-joukoweski condition. Introduction to aerofoil theory. Power systems: Mechanical power systems, their application and operations. Drive requirements for mechanical equipment; pumps fans, machine tools cranes and heitraction. Thermodynamics. Thermal and hydraulic power systems, their principles and operation principles of air conditioning and refrigeration. Introduction to heat transfer. Heat exchangers.

<u>400 LEVEL COURSES</u>

GEE 481: ENGINEERING MATHEMATICS FOR GEOMATICS ENGINEERING (3 CREDITS)

Learning Outcomes

Upon completion of the course, students should be able to:

1. Understand polynomial functions, numerical methods, and interpolation techniques.
2. Learn numerical differentiation and integration methods.
3. Grasp matrix algebra and solving linear equations.
4. Learn iterative methods for linear equations and coordinate transformations.
5. Explore linear programming, the simplex algorithm, duality, and transportation problems.
6. Master complex variables, Cauchy-Riemann equations, and conformal mapping.
7. Understand partial differential equations, boundary value problems, and wave equations.

8. Grasp probability, probability distributions, and statistical concepts.

Course Contents

i. Polynomial and their applications: Numerical solution of polynomials and other non-linear equations: Iterative methods, Linear iterative methods. Newton-Raphson method, Interpolation using polynomials, Lagrangean interpolation, finite difference, Interpolation using finite difference (the Newton Gregory equation) least squares polynomial and curve fitting, Numerical differentiations and integration, Trapezoidal and Simpson rule, Newton-cote's closed formula.

ii. Matrix algebra and linear equations: Matrix algebra, properties of Matrices, transpose of a matrix and their properties. Theory of linear equations, Solution of linear equation by Direct methods: Determinants and their properties, Minor and Cofactors, Solution of linear equation by Cramer's rule and by Gaussian eliminationand least square methods. Matrix partitioning, Addition and multiplication of a partitioned matrix, inverse of a partitioned matrix. Iterative methods of solving linear equations, Jacobis and Gaus – seidel method, Coordinate transformation rotation of axis.

iii. Linear programming: Linear programming, formulation of linear programming problems, graphical Technique and the simplex algorithm for solving linear programming problems. Duality concept, primal, post optimality analysis, Transportation problems.

iv. Complex Analysis: Complex variables, Complex function of a real variable, elementary function of a complex variable. Differentiation of complex variables, Cauchy-Riemann equations, Laplace equations. Analytic and Harmonic functions, Integrations of complex variables Cauchy's integral theorem, Poles and residues, conformal mapping, simple examples of expansion in Taylor and Laurent series.

v. Partial differential equations: Heat conduction equations and elastic string D-Alembert's solution of the wave equation. Two-dimensional wave equation, Initial boundary problem. Introduction to the boundary value problem.

vi. Non-linear differential equations and calculus of variation: Stability of linear system and the phase portraits, Long term behavior of the Solution of non-linear differential equations deducted from related linear systems.

vii. Calculus of Variations: The geometry of curved space, Lagrange's equation and application, Hamilton principles and geodesic problems, Riemannian geometry.

viii. Network techniques: Graphs and Digraphs, Shortest path problems, Optimality principles, Shortest spanning tree, Flow augmenting paths, Maximal flow methods, Management – assignment problem.

ix. Probability and Statistics:

(a) Probability: Probability laws, conditional probability and dependence of events, Discrete and continuous probability distribution, the distribution function, Expected values, Moments, Standard deviations, Binomial, Poison and normal distribution.

(b) Statistics: Regression and correlation, the method of least squares, linear and curvilinear regression. Correlation, total, partial and multiple; large sampling theory. Sampling distribution of mean, Proportion, Difference proportion, Difference of two means and proportions.

(c) Hypothesis testing: Type I and II Errors, Power of a test,large sample testing concerning the mean, Proportion, Difference of two means and proportions.

(d) Quality control.

GEE 443: INTRODUCTION TO SOFTWARE ENGINEERING (2 CREDITS)

Learning Outcomes

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

1. Understand software engineering principles and practices.
2. Explore software processes, models, and metrics.
3. Master software requirements, design, and architecture.
4. Ensure software quality through testing and metrics.
5. Learn about software evolution, maintenance, and reuse.
6. Develop project management skills for software projects.
7. Understand the ethical and legal aspects of 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.

GEE 421: ENGINEERING SURVEYING (2 CREDITS)

Learning Outcomes

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

1. Understand the principles and methods of construction leveling, including longitudinal and cross sectioning, formation levels, and invert levels.
2. Learn to calculate areas using approximate methods, deal with irregular areas, and apply methods like planimeter, Simpson's rule, and trapezoidal rule. Calculate volumes, including earthwork, cross-sectional areas, and volumes from spot heights and contours using various formulae.
3. Master the techniques for route location, horizontal and vertical curve design, sight distance analysis, slope staking, mass haul diagrams, and setting out straight lines and right angles.
4. Gain expertise in alignment and grade setting for roads, drains, sewers, pipelines, as well as setting out surveys for bridges, dams, and buildings.
5. Learn the unique surveying requirements for tunnels and mines, including mapping and safety considerations.
6. Explore mapping techniques using Total Station instruments, and understand the generation of Digital Terrain Models (DTM) and Triangulated Irregular Networks (TIN).

Course Contents

Construction leveling; Longitudinal and cross sectioning, Formation levels, Invert levels. Area and volume: Area by approximate methods, Irregular areas, Areas by planimeter, Simpson and trapezoidal rules. Cross sectional areas, area from coordinates, Volume of earth work, Volume from cross section, Volume from spot heights and contours. Prismoidal and end area formula, Prismoidal excess.

Route surveying: Route location, Horizontal and vertical curves, Sight distances, Slope staking, Mass haul diagram, Setting out straight lines and right angles, Measurement with obstruction, Setting out surveys, Alignment and grade for roads, drain, sewers and pipelines, Setting out of bridges, Dams and buildings. Tunnels and mines surveys, mapping by Total Station; Generation of DTM and triangulated irregular network (TIN) from Total Station mapping.

GEE 411: HYDROSPATIAL ENGINEERING II (2 CREDITS)

Learning Outcomes

Upon completion of the course, students should be able to:

1. Understand single beam systems, calibration, and sounding reduction techniques.
2. Master acoustic sweeps, sidescan sonar, and data interpretation.
3. Explore multibeam sonar systems, beamforming, and data quality control.
4. Study acoustic backscatter for seafloor feature classification, laser bathymetry, and underwater inspection techniques.
5. Examine oceanographic elements and their impact on port development, and stay updated on hydrography advancements..

Course Contents

Single beam systems and system selection, sounder calibration and sounding reduction, sounding accuracy and IHO standards, depth data interpretation, acoustic sweeps, sidescan sonar and imaging systems, sidescan data interpretation, multibeam sonar systems, beam forming, FFT beamformers and array geometries, bottom detection methods, heave, orientation, and other required complementary sensor information, operational issues, field calibrations, sources of error and quality control, acoustic backscatter and classification methods, multibeam data interpretation, data processing and data management, demonstration on naval platforms, laser bathymetry, remote sensing bathymetry, and diver inspection techniques. Sounding, wave propagation, Mathew's chart, vertical beam, Echo Sounder instrumentation, operation, calibration. Acoustic waves. Ports development and port management, Sweeping, side looking sonar, multibeam sonar, electronic sweeping. Elements of Oceanography, tides, currents, temperature, salinity, and Dredging and Channelization pressure measurement sedimentation, Beach erosion. Modern techniques in Hydrography.

GEE 431: GEODETIC ENGINEERING (2 CREDITS)

Learning Outcomes

Upon completion of the course, students should be able to:

1. Explain the historical development of geodetic surveys in Nigeria, learn about the purpose of triangulation surveys in geodetic measurement, grasp the concepts of trilateration and triangulateration in geodetic surveys;
2. Understand how to select an ideal triangulation station and the significance of reconnaissance, signals, and towers, master the techniques for baseline measurement and angular measurements in triangulation, comprehend the computation and adjustment processes in triangulation and trilateration;
3. Explore instruments and methods used in geodetic leveling, learn about adjustments and error analysis in geodetic leveling, understand the concepts of geoids and ellipsoids, as well as the geodetic and Cartesian coordinate systems;
4. Grasp the principles of astro-geodetic methods, including deflection of the vertical, geoidal undulation, and height anomaly, learn about three-dimensional computations and the determination of the geoid and quasi-geoid using astro-geodetic techniques; and
5. understand the coordinate systems used in GNSS observations, including WGS 84 and ITRF, learn about differential and RTK GNSS, as well as Precise Point Positioning (PPP), explore the development of CORS and their practical applications in control surveys, understand coordinate reference frames like ITRF, AFREF, and NIG NET.

Course Contents

(i) History of Geodetic Surveys in Nigeria. The Nigerian Triangulation network, Purpose of triangulation Surveys, Trilateration and Triangulateration, Strength of figures, Selection of an ideal triangulation station, Reconnaissance, Signals and towers.

(ii) Baseline measurement in Triangulation, Angular measurements, Computation and adjustment in Triangulation and Triangulateration, Satellite station, extension of Base lines, Precise Traverses, reconnaissance surveys in Precise Traverses, Observation and error analysis in precise traverses, computation and adjustments. Geodetic leveling. Instruments and methods in Geodetic leveling, adjustments and error analysis in Geodetic leveling; Geoids and ellipsoids. Geodetic and Cartesian coordinate system. Orthometric and ellipsoidal heights.

(iii) Astro Geodetic methods: Deflection of the Vertical, Geoidal undulation, Height Anomaly, Three-Dimensional Computation, Astro geodetic Determination of Geoid and Quasi Geoid. Orientation of Astro geodetic System, Best fitting Ellipsoids

(iv) Gravity networks; Design, Monumentation, observation and Computation in Gravity Network

(v) GNSS observation: Coordinate system, WGS 84 and ITRF. Differential and RTK GNSS, Precise Point Positioning PPP. GNSS CORS.

(vi) Development of continuous operating reference station CORS: Coordinates reference frames, ITRF, AFREF and NIG NET. Practical application in control surveys.

GEE 461: GEOSPATIAL INFORMATION TECHNOLOGY II(2 CREDITS)

Learning Outcomes

Upon completion of the course, students should be able to:

1. Explain the concept of geospatial information systems and geographic information systems (GIS), comprehend the fundamental components and applications of GIS.

2. Learn about data models used in GIS, including vector and raster data models, understand the principles of relational database design and topology in GIS data modeling, explore geodatabase models for organizing geospatial information.
3. Grasp the importance of data quality in GIS and the role of geospatial data standards, learn about methods and techniques for assessing and improving data quality.
4. Understand geospatial data analysis, including raster geoprocessing and vector geoprocessing methods, learn how to perform statistical computations and spatial data analysis in GIS.
5. Explore overlay functions for combining and analyzing geospatial data layers, learn about process and data flow modeling in GIS.
6. Understand how to visualize geospatial information using GIS in conjunction with CAD systems.
7. Learn about the linkage of GIS to statistical software for advanced analysis, grasp the approaches to digital terrain data sampling and the characteristics of a Digital Elevation Model (DEM) and Triangulated Irregular Network (TIN).

Course Contents

Concept of geospatial information system and geographic information systems (GIS); Data model in GIS, Vector and raster data, Relational database design, Topology, Geodata base model. Data quality in GIS geospatial data standard, Raster geoprocessing and raster geospatial data analysis, Vector geoprocessing methods, Statistical computations and spatial data analysis, Overlay function, Process and data flow modeling, Visualization of geospatial information using GIS in conjunction with CAD system, Linkage of GIS to statistical software, Internet-GIS, digital terrain modeling, Approaches to digital terrain data sampling, Characteristics of a DEM and TIN, Acquisition of digital terrain data from existing maps and imageries, DTM from ground surveys and Lidar mapping.

GEE 451 ADVANCED REMOTE SENSING AND GIS (2 CREDITS)

Learning Outcomes

Upon completion of the course, students should be able to:

1. Understand remote sensing platforms, sensor characteristics, and the distinction between active and passive systems;
2. Grasp sensor resolutions, swath width, and their impact on image quality;
3. Learn image referencing and georeferencing techniques;
4. Explore radiometric and geometric corrections, as well as land cover classification algorithms;
5. Understand how to integrate remote sensing data with Geographic Information Systems (GIS);
6. Learn the fundamentals of entity relationship modeling and extended entity relationship modeling;
7. Differentiate between conventional database structures like relational, network, and hierarchic databases;
8. Master object-oriented data modeling concepts, including object classification, inheritance, and encapsulation; and
9. Apply these modeling techniques to various database applications, such as topographic, cadastral, utility, and environmental databases.

Course Contents

a) Remote sensing platforms, sensor characteristics, active and passive remote sensing systems, concept of Swath, sensor resolutions, image referencing systems, digital imaging sensor system, microwave remote sensing system, active and passive microwave remote sensing systems, Georeferencing of imageries, imaging system Geometrics, radiometric and geometric corrections including registration and land cover classification algorithms, accuracy assessment. Integration of remotely sensed data with GIS.

b) Semantic data modelling: entity relationship and extended entity relationship modelling. Conventional database structures (relational, network and hierarchic). Object Oriented data modelling: object, classification, generalization/ specialization, aggregation, association, inheritance, propagation, encapsulation, persistence, polymorphism and overloading. Object-relational data structure. Applications: topographic, cadastral, utility and environmental database.

CVE 423 ENVIRONMENTAL ENGINEERING (2 CREDIT)

Learning Outcomes

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

1. design conveyors based on fundamental principles;
2. study and design pipelines for gas, liquid, and solid transport, considering construction requirements;
3. understand waterways, including channels regulations, locks, and dams;
4. define harbors and ports, explore harbor types, breakwaters, and harbor structures;
5. plan railways, including track structure, rolling stock, and maintenance;
6. explore airports, their classification, configuration, and geometric design;
7. investigate the history of road development, from early pioneers to modern highway engineering;
8. conduct introductory traffic studies, including traffic inventories and speed measurements;
9. analyze traffic engineering's scope, administration, and traffic stream characteristics; and
10. study vehicle and road user characteristics, traffic flow, and traffic operation.

Course Contents

(i) Definition, scope, and subdivisions of environmental engineering.
The Engineer in Environmental Engineering.

(ii) Water supply: Occurrences, uses and sources of water; physical, chemical and bacteriologic standards for potable water; Effects of various chemical substances and micro-organisms found in water. Laboratory Examination of water

(iii) Wastewater: Sources of wastewater, characteristics of wastewater from domestic, industrial, agricultural, mining, petroleum, petrol-chemical and radio-active sources. Microbiology of wastewater. Laboratory Examination of Wastewater Design of Septic Tanks, Soak way and S warless Toilets Solid Wastes: Sources: the composition and effects.

methods of analysis.

(iv) Air pollution: Classification and extent of air pollution; the occurrence and properties of primary air pollutants in gaseous, viable and non-viable particulates, and radioactive substances.

(v) Noise pollution: Sources, effects and control of noise pollution.

GEE 471: POTENTIAL THEORY FOR EARTH SCIENCES (2 CREDITS)

Learning Outcomes

Upon completion of the course, students should be able to:

1. Understand and apply advanced mathematical concepts, including line, surface, and volume integrals, integral theorems, and potential theory;
2. Gain proficiency in the theory of gravity fields, potential, and Poisson's theorem, allowing for the analysis and modeling of gravitational phenomena;
3. Apply mathematical tools like Gauss integral, Gauss formula for gravity potential, Green's formula, and Stoke's theorem to solve complex problems in potential theory;
4. Learn how to solve boundary value problems using Dirichlet's problem of potential theorem and comprehend Laplace's equation in spherical coordinates;
5. Study advanced topics such as harmonic functions, spherical harmonics, Legendre's functions, and expansion theorems, leading to a deep understanding of potential fields; and
6. Develop an appreciation for orthogonality relations, essential for various applications of potential theory.

Course Contents

Review of line, surface and volume integrals, Fundamentals of potential theory; theory of gravity field, potential, Poisson theorem, Gauss integral, Gauss formula for gravity potential, Green formula and application, Strokes theorem, Dirichlet's problem of potential theorem, Laplace Equation in spherical coordinates, Harmonic Functions, Spherical Harmonics, Surface spherical

Harmonics, Legendre's Functions, Expansion Theorem and Orthogonality relation, potential of a material Surface, Normalization, Neumann problem.

GEM 403: SPATIAL DATA STRUCTURE (2 CREDITS)

Learning Outcomes

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

1. Understand GIS components and functions.
2. Learn database design principles.
3. Master spatial data modeling.
4. Ensure data quality in GIS.
5. Apply GIS in real-world scenarios.

Course Contents

Concept of ICT, and information system, GIS, the evolution of GIS, components of a GIS, GIS functions and architecture, characteristics of GIS, data base and data base design and management systems. Introduction to spatial data modeling and analysis, map projection, geodetic datum, coordinate systems, Georeferencing. Semantic data modelling: entity relationship and extended entity relationship modelling. Conventional database structures (relational, network and hierarchic). Object Oriented data modelling: object, classification, generalization/ specialization, aggregation, association, inheritance, propagation, encapsulation, persistence, polymorphism and overloading. Object-relational data structure. Applications: topographic, cadastral, utility and environmental database, Field-based and object-based concepts of real world. Spatial Data Models: 2D, 3D and 4D Model; tessellation data models; vector data models, tessellation versus vector spatial relationships: metric, topologic and spatial order. Data quality aspect: positional accuracy, attribute accuracy, logical consistency, completeness and lineage.

CVE 431: INTRODUCTION TO TRANSPORTATION ENGINEERING (2 CREDITS)

Learning Outcomes

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

1. design conveyors based on fundamental principles;
2. study and design pipelines for gas, liquid, and solid transport, considering construction requirements;
3. understand waterways, including channels regulations, locks, and dams;
4. define harbors and ports, explore harbor types, breakwaters, and harbor structures;
5. plan railways, including track structure, rolling stock, and maintenance;
6. explore airports, their classification, configuration, and geometric design;
7. investigate the history of road development, from early pioneers to modern highway engineering;
8. conduct introductory traffic studies, including traffic inventories and speed measurements;
9. analyze traffic engineering's scope, administration, and traffic stream characteristics; and
10. study vehicle and road user characteristics, traffic flow, and traffic operation.

Course Contents

(i) Conveyors: Principles of design.

(ii) Pipelines: Gas, liquid and solids, preliminary study, principle of design, construction requirements.

(iii) Waterways: Channels regulations. Locks and dams. Port and harbours.
Definitions of harbor and port, types of harbour – natural, semi – natural and artificial harbours, breakwaters and groins, waves and wave forces, harbor structures – jetty, wharves, quays, piers, fenders and dolphins, Water level.

(iv) Railways: Planning and geometric design of track structure, rails, sleepers, ballast, terminal facilities, rolling stock, siding, crossings and turnouts, rail defects and maintenance.

(v) Airports: Definitions of aerodrome and airport, Classification of airport, Airport configuration, Airport element – runway, taxiway, apron, holding apron, terminal area.

Operational aspects of air transportation, elements affecting location of airport, elements of geometric design, ground facilities, earthworks, drainage, pavements.

(vi) History of road development: Early development – Treasaquet, Metcalf, Telford and macadam construction, modern development, importance of Highway Engineering in relation to socio – economic development.

(vii) Introductory traffic studies – inventories, volume and spot speed studies, traffic and transportation engineering: scope of traffic engineering, Traffic administration and function. Vehicle and road user characteristics. Traffic stream characteristics, flow speed, concentration, headway, fundamentals traffic flow relationship. Traffic studies, measurement of traffic stream characteristic – inventories, volume and speed studies – intersection studies, travel time and delay studies, traffic operation,

CVE 421: HYDRAULIC AND HYDROLOGY (2 CREDITS)

Learning Outcomes

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

1. Understand the purpose and basis of dimensional analysis.
2. apply Buckingham's pi-theorem and dimensionless parameters in model studies for flow scenarios.
3. Define laminar flow and calculate Reynolds numbers.
4. Explain critical velocity and compute resistance coefficients and power requirements.
5. Describe equations for turbulent flow and velocity/pressure distribution.
6. Analyze the relationship between resistance coefficients, Reynolds numbers, and relative roughness in pipes.

Course Contents

i. Dimensional Analysis, similitude, and Hydraulic models.

Definition, purpose and the basis of dimensional analysis, Buckingham pi – theorem, Hunsaker and Rightmire methods of dimensional analysis, similitude and requirement:

dimensionless parameters, their significance and application, model studies of flow with and without free surface.

ii. Laminar flow: laminar flow between parallel stationary and non-stationary plates, in pipes and through annular spaces, Reynolds numbers, critical velocity and resistance coefficient, power requirement.
iii. Turbulent flow: Equation of turbulent flow: velocity and pressure distribution in pipes, Relationship between coefficient of resistance. Reynolds number and the relative roughness.
iv. Boundary layers, separation, lift and drag.
v. Stream function, velocity potential and application to flow nets.
vi. Steady flow in closed conduits: Energy equation, energy and hydraulic lines, primary and minor losses. Equations of pipe flows, pipe in series and parallel, selection of pipe sizes.
vii. Unsteady flow in closed conduit: causes and effect of unsteady flows, surges and water hammers, surge control, incompressible theory, compressible theory for rigid and elastic pipe lines, movement of pressure wave.
viii. Pumps: application and types, Energy and hydraulic grade lines in pumps systems, work done power and efficiencies, inlet and outlet velocity diagrams, pump characteristics, specific speed and performance, choice of pumps, multiple pump systems.
ix. Turbine: application and types, Energy and hydraulic grade line across turbine installations, work done, power efficiencies, inlet and outlet velocity diagrams, Turbine characteristics, specific speed, performance, choice of Turbines.
x. Introduction to Hydrology: Hydrology and application, hydrologic cycle, meteorological data and instrumentation – precipitation, temperature, evaporation, sunshine hours, radiation, humidity and wind speed, methods of estimating means rainfall over catchments – arithmetic Thiessen and Isohyetal methods. Trend estimation from rain data. Methods of estimating Evapo – transpiration. Flood frequency analysis, application of GIS in flood hazard analysis.

GEE 445: INTRODUCTION TO CYBERSECURITY AND STRATEGY (2 CREDITS)

Learning Outcomes

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

1. Understand fundamental cybersecurity principles, including confidentiality, integrity, and availability.
2. Implement security measures, including access control policies, encryption techniques, and intrusion detection systems.
3. Evaluate and mitigate security risks, develop risk management strategies, and create disaster recovery plans.
4. Analyze the evolving landscape of cyber threats, including the history and tactics of cyberattacks.
5. Comprehend the ethical obligations of security professionals and government regulations related to information technology.

Course Contents

Basic concepts: cyber, security, confidentiality, integrity, availability, authentication, access control, non-repudiation and fault-tolerant methodologies for implementing security, security policies, best current practices, testing security, and incident response, risk management, disaster recovery, access control, basic cryptography and software application vulnerabilities. Evolution of cyber-attacks. Operating system protection mechanisms, intrusion detection systems, basic formal models of security, cryptography, steganography, network and Computing 113 New distributed system security, denial of service (and other) attack strategies, worms, viruses, transfer of funds/value across networks, electronic voting, secure applications, cybersecurity policy and guidelines. Government regulation of information technology. Main actors of cyberspace and cyber operations. Impact of cybersecurity on civil and military institutions, privacy, business and government applications; examination of the dimensions of networks, protocols, operating systems, and associated applications. Methods and motives of cybersecurity incident perpetrators, and the countermeasures employed by organisations and agencies to prevent and detect those incidences. Ethical obligations of security professionals. Trends and development in cybersecurity. Software application vulnerabilities. Evolution of cybersecurity and national security strategies, requirements to the typologies of cyber-attacks that require policy tools and domestic response. Cybersecurity strategies evolving in the face of big risk. Role of standards and frameworks.

500 LEVEL FIRST SEMESTER COURSES

PRE 571: ENGINEERING MANAGEMENT, ECONOMICS AND ADMINISTRATION: (2CREDITS)

Learning Outcomes

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

1. explain the basics of project management as it relates to the Engineering discipline;
2. demonstrate knowledge and understanding of engineering, management and financial principles and apply these to their own work, as a member and/or leader in a team, to manage projects and in multi-disciplinary environments;
3. conduct, manage and execute projects in multi-disciplinary areas;
4. possess the skills needed for project management; and
5. work within the budget when executing a project for proper management.

Course Contents

The management Environment – Formation of a company, sources of finance, money and credit. Insurance, National policies, GDP growth rate and prediction. Balance of payment, Legal liabilities under company law, legal and contractual obligations to employees and public, contractual obligations.

Organization Management – Principles of organization, span of control; Element of organization, Types, principle of management, School of thought, Management by objectives.

Financial Management – Accounting methods, financial statement, Element of costing, Costing planning and control, Budget and budgetary control, Cost reduction programmes, Depreciation accounting, valuation of assets.

Personal Management – Selection, recruitment and training. Job evaluation, Merit rating, Incentive schemes, Trade unions and collective bargaining.
Industrial psychology – Individual and group behaviors, the learning process, Motivation and moral, Influence of the industrial Environment.

GEE 531: ENGINEERING GEODESY (2 CREDITS)

Learning Outcomes

Students will be able to:

1. accurately calibrate and operate precise surveying instruments, such as theodolites and Total Stations.
2. demonstrate proficiency in linear angular intersection methods for surveying.
3. apply instrument calibration techniques and perform precise observation procedures.
4. effectively use strain gauges, extensometers, and crack detection methods for deformation monitoring.
5. apply GNSS technology for deformation analysis in geotechnical, structural engineering, and geodetic contexts.
6. solve one, two, and three-dimensional engineering problems using finite element analysis.
7. demonstrate understanding of matrices algebra and its application in engineering problem-solving, including mesh generation and Galerkin methods.

Course Contents

1. Instrument, systems and procedures for engineering surveys; precise levels, high precision Theodolites, and Total Station, Terrestrial Laser scanners. Gyro- Instruments,

Heighting, Triangulation, linear angular intersection method, Instrument calibration, Observation procedures and reductions.

2. Deformation measurements and analysis; Geotechnical, Structural Engineering and Geodetic network methods of deformation measurement, use of strain gauges and extensometer, Crack detection methods, Application of GNSS in deformation monitoring and analysis.
3. Review of matrices algebra: Finite Element Analysis: One, Two- and Three-Dimensional Problem, Finite Element Solution of Stochastic Problem, bar, beam and truss problem. Mesh Generation, Galakin, Petrov – Galerkin Methods, Sobolev Spaces.
4. Coordinate Transformations: 2D conformal coordinate transformation, Equation development, Application of Least squares, 2D Affine Coordinate Transformation, 2D Projection coordinate Transformation, 3D conformal coordinate Transformation, Statistically Valid parameters.

GEE 521: SPACE AND SATTELITE GEODESY (2 CREDITS)

Learning Outcomes

Students will be able to:

1. Explain celestial sphere and coordinate systems.
2. Perform star observations and use celestial navigation.
3. Understand GNSS, signal characteristics, and constellations.
4. Identify and mitigate GNSS errors.
5. Master positioning and navigation techniques.

Course Contents

Principles of satellite Geodesy; The Celestial sphere, its Coordinate systems and variation in coordinate system, Star observations, Time system overview of space positioning and navigation systems, Concept and general descriptions. Global Navigation Satellite System, GNSS; signal characteristics, Receiver and antennae characteristics and capabilities, GNSS error sources and biases, Atmospheric delays, Signal reflection and cut angles, Mathematical model for static and relative positioning, Kinematic single point positioning and differential positioning, Real time positioning, Navigation and location, Augmentations methods.

GEE 561: PHYSICAL GEODESYAND GEODYNAMICS (2 CREDITS)

Learning Outcomes

Students will be able to:

1. understand the concept of the gravity field of the Earth, its components, and its variations.
2. demonstrate knowledge of the level surface and the plumb line in geodetic measurements.
3. explain the significance and applications of spherical harmonics in modeling the Earth's gravity field.
4. Students will master the methods used in gravimetry and gravity determination, including their principles and practical applications.
5. calculate deflection of the vertical, geoidal undulation, and height anomalies in geodetic measurements.
6. understand the concept of the geodetic boundary-value problem and its importance in geodetic calculations.
7. solve the geodetic boundary-value problem and interpret gravity anomalies in geodetic measurements.

Course Contents

The gravity field of the earth, level surface and plumb line, spherical harmonies, gravity field, Earth tides. Gravimetry and method of gravity determination, Deflection of the vertical, Geoidal undulation, Height anomaly, Geodetic boundary – value problem, Gravity anomaly, solution of the geodetic boundary value problem, Introduction to geodynamics.

GEE 541: MAPPING CONCEPTS AND GEOGRAPHIC DATA MANAGEMENT (2CREDITS)

Learning Outcomes

Students should be able to:

1. Design effective database models for geographic information using entity-relationship diagrams and UML.
2. Implement logical database models suitable for managing spatial data within GIS.
3. Utilize spatial indexing techniques to optimize spatial data retrieval and query performance.
4. Apply spatial algorithms for geographic data analysis, including proximity and network analysis.
5. Understand and apply spatio-temporal modeling techniques to analyze dynamic geographic data and address evolving spatial phenomena.

Course Contents

Mapping concepts: cartographic generalization and multiple representation, representation of the terrain (DEM/DTM/DSM/nDSM/Point Clouds, 3D city models), interpolations methods, map design and interactive visualization; (b) Geographic Data Management and Analysis: database design theory, conceptual models (entity relationship model, UML), logical models (relational, object and object relational model), physical models, spatial index structures, algorithms for analysis of geographic data, graph theory, introduction to XML and XML-based languages for GIS, Spatio-temporal modelling in GIS.

CVE 521: CIVIL ENGINEERING HYDRAULICS (2 CREDITS)

Learning Outcomes

Students will be able to:

(i) Introduction to open channel flow; flow regimes. Comparison of open-conduit to closed conduct flow.

(ii) Uniform flow: Derivation of the Chezy equation; Darcy equation; Relationship between the function factor for pipe flow and the roughness factor for open-channel.

(iii) Uniform flow computation: Steady gradually varied flow: Specific energy principle, critical depth; Momentum principle; Attainment of critical depth, Gradually-varied flow equation;

classification of water surface; computation of surface profiles.

(iv) Hydraulic jump: Definition; uses and types conjugate depth, energy loss.

(v) Control structures- Dams, weirs, spillways, gates and outlet works, stilling basins, cofferdams, etc.

(vi) Design on municipal storm drains: land drainage systems, culverts and bridges. Design of inlets, manholes and catch basins.

(vii)Introduction to multiple purpose reservoir design for food control, water supply, irrigation, recreation, navigation and erosion control.

(viii)Unsteady open channel flow, occurrences, positive and negative surge wave analysis, the dam break problem.

Course Contents

(i) Introduction to open channel flow; flow regimes. Comparison of open conduit to closed. conduct flow.

(ii) Uniform flow: Derivation of the Chezy equation; Darcy equation; Relationship between the function factor for pipe flow and the roughness factor for open channel.

(iii) Uniform flow computation: Steady gradually varied flow: Specific energy principle, critical depth; Momentum principle; Attainment of critical depth, gradually varied flow equation; classification of water surface; computation of surface profiles.

(iv) Hydraulic jump: Definition; uses and types of conjugate depth, energy loss.

(v) Control structures- Dams, weirs, spillways, gates and outlet works, stilling basins, cofferdams, etc.

(vi) Design of municipal storm drains: land drainage systems, culverts and bridges. Design of inlets, manholes and catch basins.

(vii)Introduction to multiple purpose reservoir design for food control, water supply, irrigation, recreation, navigation and erosion control.

(viii)Unsteady open channel flow, occurrences, positive and negative surge wave analysis, the dam break problem.

GEE 511: GEO-ENVIRONMENTAL ENGINEERING (2 CREDITS)

Learning Outcomes

Students will be able to:

1. demonstrate proficiency in mapping techniques for recycling facilities, health facilities, and disease vectors, including the use of GIS tools.
2. understand the principles of climate change and its impact on environmental mapping.
3. map and manage water reclamation facilities and waste-to-energy facilities effectively.
4. understand and apply principles of environmental remediation to project sites, including landfills and hazardous waste management facilities.
5. demonstrate the ability to map and manage municipal and industrial water supply facilities.
6. have proficient skill in planning and mapping industrial wastewater treatment plants and related route locations.

Course Contents

Mapping of recycling facilities, health facilities and epidemics including disease vector, climate change, principles of climate change, water reclamation facilities, waste to energy facilities, environmental remediation project sites.

Landfills, As-built surveys of industrial and municipal waste sites, mapping of hazardous waste management facilities, municipal and industrial water supply facilities mapping and management, Industrial waste water treatment plants and route location planning and mapping.

GEE 551: APPLIED BUILDING INFORMATION MODELLING (2 CREDITS)

Learning Outcomes

At the end of the course, student will be able to:

1. Explain how surveying principles underpin the accurate representation of physical structures and objects in BIM.
2. Analyze the role of precise survey data in the construction, renovation, and maintenance phases of a building project.
3. Evaluate various surveying equipment and techniques for their applicability in BIM workflows.
4. Operate Terrestrial Laser Scanners proficiently to capture high-resolution 3D point cloud data.
5. Acquire data using Terrestrial Laser Scanning and other relevant technologies for BIM modeling.
6. Embed non-geometric information, such as metadata, material specifications, and equipment details, into BIM models.
7. Recognize the importance of semantic data in enhancing facility management, operations, and maintenance throughout a building's lifecycle.
8. Seamlessly integrate Computer-Aided Design (CAD) data with BIM models to facilitate interdisciplinary collaboration.

Course Contents

3D data capture for a BIM using Terrestrial Laser Scanning etc., principles of surveying in Building up to an integrated BIM . Geometry from multiple data sources, Data Processing and features extraction, processing of point cloud data, Data management for BIM: information theory, storing and sharing BIM data by multiple users, addition of semantic information, integration of CAD, BIM and 3D GIS.

GEE 557: SOFTWARE ENGINEERING (2 CREDITS)

Learning Outcomes

At the end of the course, student will be able to:

1. Understand classic and modern software development methods for effective project planning.
2. Identify and resolve common software development challenges, enhancing project success.
3. Navigate the software development process from requirements to maintenance.
4. Create structured software designs using techniques like flowcharts and diagrams.
5. Apply testing strategies to ensure software quality and reliability.
6. Implement Agile methodologies like Scrum for iterative, collaborative software development.

Course Contents

Classic and modern object-oriented development methods. Problems in software development, the software development process, structured analysis and design techniques (e.g. flow charts, Jackson-diagram), object oriented modeling, UML, software testing, and project management. More detailed, the module covers: basics, software development process, software requirements, structured analysis and structured design technique, object-oriented analysis and object-oriented design technique, UML, software validation, project management, agile software development and Scrum. Concrete tasks and project teamwork ensures experience in usage and handling of tools from software engineering.

CVE 523: ENGINEERING HYDROLOGY I (2 CREDITS)

Learning Outcomes

Students will be able to:

1. forecast population growth and calculate per capita water consumption for various purposes, including domestic, public, commercial, industrial, and agricultural use.
2. analyze and determine water requirements for different sectors to develop sustainable water management strategies.
3. demonstrate proficiency in collecting rainwater from roofs and calculate the storage capacity required for small individual water supplies.

4. differentiate between surface water sources (reservoirs and rivers), groundwater sources, and understand the design of intake structures for each.
5. develop comprehensive flow diagrams for the treatment of both surface and groundwater sources, including preliminary treatment, screening, coagulation, flocculation, sedimentation, and filtration methods (slow sand, rapid sand, pressure filters).
6. apply effective disinfection methods and understand techniques for water softening, as well as the removal of iron and manganese, utilizing appropriate chemicals for water treatment.
7. design storage tanks and service reservoirs and develop an understanding of the layout and maintenance of mains, pipelines, and distribution networks.
8. demonstrate proficiency in working with valves, meters, service pipes, pumps, and pumping stations for effective water distribution.
9. engage in laboratory experiments and coursework to apply the theoretical knowledge acquired during the course and gain practical experience in water management and treatment.

Course Contents

(i) Quantity: Population forecasting and per capital consumption; water requirements for domestic, public, commercial, industrial and agricultural purposes.

(ii) Collection: Rainwater from roofs, determination of storage capacity for small individual supplies; surface water from reservoirs, rivers. Intake structures; Groundwater. Transmission conducts.

(iii) Treatment: Flow diagrams for the treatment of surface and ground water, preliminary treatment, screening, coagulation flocculation and sediment slow sand, rapid sand, and pressure filters. Disinfection; water softening, iron and manganese removal; chemical for water treatment.

(iv) Distribution: Storage tanks and service reservoirs. Mains, pipelines, and distribution network. Valves meters and services pipes pumps pumping stations.

(i) Laboratory and course work.

CVE 541: GEOTECHNICAL ENGINEERING I (2 CREDITS)

Learning Outcomes

Students will be able to:

1. understand the concept of settlement and differentiate between immediate (elastic), consolidation settlement, and secondary compression.
2. calculate settlement of structures on cohesionless soil using Schwartzman's method and evaluate the elastic settlement of structures on clay.
3. Perform one-dimensional consolidation calculations and analyze results.
4. conduct Odometer tests to determine pre-consolidation pressure, primary and secondary consolidation, and analyze the total and time rate of settlement.
5. comprehend the general principles of shear strength and state of stress at a point, including the Mohr stress circle.
6. apply the Mohr-Coulomb theory of failure and perform various shear tests, such as the vane shear test, direct shear test, and triaxial test (UU, CU, CO).
7. determine shear strength parameters for saturated clays and compacted unsaturated clays.
8. Understand soil sensitivity and residual shear strength parameters.
9. calculate geostatic stresses, analyze isostress surfaces, and determine total and effective applied stress distributions in soil.
10. understand the concepts of modulus of elasticity and Poisson's ratio in the context of soil mechanics.
11. apply compatibility of strain requirements and analyze stress distribution in layered soil systems.
12. utilize Boussinesq's approach, Westergard's method, and Newmark's chart for stress analysis and settlement calculations.

Course Contents

i) Consolidation and Settlement: Settlement of structures on solids, immediate (elastic), Consolidation settlement and secondary compression. Settlement of structure on cohesionlesssoil using Schwartzman's method. Elastic settlement of structures on clay; one dimensional consolidation. The Odometer test; Determination of pre-consolidation Pressure, Primary and secondary consolidation, Analysis of total and time rate of settlement;

ii) Shear strength of soils: General strength consolidation, State of stress at a point and Mohr stress circle,Mohr Coulomb theory of failure. Shear tests; Vane shear test, Direct shear test, Triaxial test (UU CU CO), Shear strength of saturated clays, Shear strength of compacted unsaturated clays, Sensitivity of soils, Residual strength parameter.

iii) Stresses in Soil; Geostatic stresses, Isostress surface, Total and effective applied stress distribution in soil, Modulus of elasticity, Poisson's ration, Compatibility of strain requirements, Stress distribution in Layered soil system, Boussinesq's approach, Westergard's method, Newmark's chart, the characteristics, Sketching and applications.

GEE 553: NON-TOPOGRAPHIC PHOTOGRAMMETRY (2 CREDITS)

Learning Outcomes

Students will be able to:

1. Develop a foundational understanding of terrestrial photogrammetry and its applications.
2. Explore types of terrestrial cameras, types of photographs, and the considerations for exposure station location and camera axis direction.
3. Learn about control techniques in terrestrial photogrammetry and how to plan for close-range photogrammetric projects.
4. Understand the process of photogrammetric camera calibration and the mathematical formulation behind terrestrial photogrammetry.
5. Grasp image geometry concepts and the design of photogrammetric networks, along with post-adjustment analysis.

6. Gain insights into practical applications of terrestrial photogrammetry, including building modeling, structure analysis, engineering applications, traffic analysis, and alert architecture.

Course Contents

Introduction to terrestrial Photogrammetry; Terrestrial cameras, Types of photographs, Exposure station location and camera axis direction, Control for terrestrial photogrammetry, Planning for close range photogrammetry, Photogrammetric camera calibration, Mathematical formulation, Image geometry, Photogrammetric network design and post adjustments analysis, Overview of practical application including building modeling structures, Engineering X-ray machine, Traffic analysis, Alert architecture, etc.

CVE 531: HIGHWAY DESIGN (3 CREDITS)

Learning Outcomes

Students will be able to:

1. Students will be able to conduct soil tests and analyze borehole data to assess soil properties for highway construction.
2. Students will understand the principles of soil compaction and be proficient in selecting effective compaction equipment.
3. Students will demonstrate knowledge of soil stabilization techniques and their applications in highway construction.
4. Students will be able to design and implement effective soil and highway drainage systems.
5. comprehend the factors influencing highway alignments and geometric plan elements.
6. calculate sight distances and determine appropriate design speeds for highway segments.
7. design horizontal alignments, including simple circular and transition curves, considering super-elevation and pavement widening.

8. vertical alignments, including gradient limits, curve types, summit curves, valley curves, and coordinate horizontal and vertical alignments.
9. design highway cross-section elements, including cross slopes and shoulders, and understand the principles of designing roundabout or rotary intersections.
10. understand different pavement types and the functions of various pavement layers.
11. develop proficient skill in designing flexible pavements, considering factors affecting design and using methods such as the CBR method, Asphalt Institute method, and current British methods.
12. design rigid pavements using methods such as the Portland Cement Association method and current British methods.

Course Contents

(i) Soil engineering aspect of highways: soil test and borehole analysis; compaction and effective compaction equipment. Soil stabilization and various soil stabilization processes. Soil and highway drainage

(ii) Highway Geometrics: factors controlling alignments, geometric plan elements-sight distances; design speed; horizontal alignment; simple circular and transition curves; horizontal curves super-elevation and pavement widening; vertical alignment-gradient limits, curve types, summit curves and valley curves; co-ordination of horizontal and vertical alignment-highway cross-section elements, cross slopes and shoulders. Design of roundabout or rotary intersections.

(iii) Pavement structures and Design: pavement types, pavement layers and their functions; highway flexible pavements-factors affecting design, CBR method for flexible pavement, Asphalt institutes method of design of flexible highway pavement; current British method of flexible pavement design; Portland cement Association for airport rigid design. Current British method of rigid pavement design.

(iv) Laboratory: It is presumed that the needed laboratory test will be covered by the requirements stipulated in the courses of civil engineering materials and soil mechanics.

GEE 555: POSITIONING, NAVIGATION AND WIRELESS LOCATION (2 CREDITS)

Learning Outcomes

Students will be able to:

1. understand the fundamental principles of positioning and navigation systems, including their applications in land, marine, airborne, and indoor settings.
2. analyze the role and significance of augmentation methods in enhancing the accuracy and reliability of positioning systems.
3. grasp the principles of radio frequency positioning and its application in positioning and navigation.
4. develop a comprehensive understanding of inertia systems, gyroscopes, and accelerometers as integral components of navigation systems.
5. learn about assisted Global Navigation Satellite Systems (GNSS) and how they enhance positioning accuracy.
6. explain the techniques and technologies involved in cellular telephone location for outdoor and indoor applications.
7. understand the principles and methodologies for determining location with wireless computer networks.
8. analyze the challenges and solutions related to outdoor and indoor location systems.

Course Contents

Positioning and navigation systems; Augmentations methods, land, marine airborne and indoor application, principles of radio frequency positioning, inertia system, Gyro and accelerometers, assisted GNSS, Cellular telephone location techniques, Location with wireless computer networks, Outdoor and indoor location systems.

500 LEVEL SECOND SEMESTER

GEE 528: WATER RESOURCES AND ENVIRONMENTAL ENGINEERING (2 CREDITS)

Learning Outcomes
Students will be able to:

1. Understand solid waste collection, transportation, and cost considerations.
2. Explore various solid waste disposal methods and recycling.
3. Study the effects of air pollution on the atmosphere, living organisms, and materials.
4. Gain practical experience through laboratory work and coursework.

Course Contents

Solid Waste Collection: Solid waste surveys, the planning and details; storage, collection and transportation; criteria; collections costs.
Solid Waste Collection: Mechanical compaction, incineration, pyrolysis, composting, and sanitary landfill; river and ocean dumping; Recycle re-use, Design of Solid Waste Disposal systems.
Air pollution and Control Effects on the physical properties of the atmosphere. Effects on humans, animals and plant life. Effects on economic materials and structures.
Laboratory and Course work.

GEE 516: MAPPING LAWS AND CODE OF PROFESSIONAL PRACTICE FOR GEOMATICS AND CIVIL ENGINEERING (2 CREDITS)

Learning Outcomes

Students will be able to:

1. describe and explain the basic concept, sources and aspects of law;
2. describe and explain the major differences between the various categories of law, courts and legal jurisdictions;
3. describe and explain legal principles and their application in professional engineering design and management services and their professional liability implications; and

4. develop reasoned analysis of real-life or hypothetical engineering scenarios using the legal principles undertake critical analysis of reliable information to develop, and practically present technical reports for use in varying judicial/quasi-judicial settings including as an expert witness.

Course Contents

a. Cadastral survey records, Riparian and littoral rights, Interstate and national boundaries, Mine field surveys, Mineral ordinance, Mining laws, Oil prospecting laws, Survey laws and regulations, Property laws, CAP 194 including relevant Survey legislations and decrees with their corresponding amendments, Towns and country planning laws, the Land Use Act, Professional practice, Code of ethics for survey practice, Costing of Geomatics projects.
b. Civil Engineering Practice: Type of contracts and sub-contracts, works construction and supervision job planning and control programme charts – Bar charts, critical path methods, etc. Construction machinery and equipment construction management. Applications/Case Study – dams, foundations, bridges, highways, industrial buildings, sewage works.
c. Law
    i General introduction to Law and Building Contracts, Common Law-Equity stature (Acts Ordinances, Decrees, Edict, Statutory instruments, Byelaws). Area of legal Liabilities; Law of Contract, Law of Torts, Land Law, Administrative law, Principles of Law of Contract.
    ii Formation of contracts: Offer and Acceptance, Consideration, etc.
    iii Nature of Building Contracts: Tender, express term implied term, standard form of contract. Function of bills of quantities, contract of guarantee (del credere),

agent and principal remedies for breach of contracts. Avoidance of contract mistake, Misinterpretation, illegality.

iv Special problems relating to building contract, subcontractors, variations defects, clauses. Tertio's liability of employer's contractors, suppliers and their agents.

v Types of contracts and contract documents, Requirements of building regulations and bye-laws. Factory Acts, safety requirements in building and construction sites. Fire and accidents protection

d. Appraisal and control of projects: Integration and application of methods and procedures for planning and controlling the design and construction of projects. Study of computer applications, relationships of information system to organizational structure. Project scheduling and resource allocation and control.

GEE 514: MARINE GEODESY (2CREDITS)

Learning Outcomes

Students will be able to:

1. Students will gain a thorough understanding of coastal zones and continental shelves, including their characteristics and significance in oceanography.
2. Students will be proficient in conducting tidal observations and making accurate tidal predictions using relevant data and tools.
3. conduct comprehensive studies on coastal erosion and propose effective mitigation strategies.
4. learn how to plan, execute, and analyze hydrographic surveys for various oceanographic applications, ensuring accurate data collection.
5. understand and apply underwater acoustic positioning methods for oceanographic research, navigation, and mapping.
6. gain the knowledge and skills necessary to plan and conduct surveys for offshore pipeline routes and accurately position drilling rigs in marine environments.

7. grasp the principles and methodologies involved in maritime boundary delimitation, along with a solid understanding of relevant international legal frameworks.

Course Contents

Principles of oceanography; Coastal zones and continental shelf, Vertical reference surfaces, Tidal observation and tidal predictions, Tidal zoning including coastal hydrodynamic models, Studying of deposition and erosion on the sea floor, Coastal erosion studies, Planning measurement and analysis of hydrographic surveys, Radio navigation and dynamic positioning by GNSS, Underwater acoustic positioning methods, Echo sounding and solar systems, Offshore pipeline route surveys and drilling rig positioning, Harbour and port construction surveys, Maritime boundary delimitations.

GEE 522: DIGITAL IMAGE PROCESSING (2 CREDITS)

Learning Outcomes

At the end of the course content delivery, students will be able to:

1. develop a solid understanding of the fundamental concepts in digital image processing and computer vision, including terminology and core principles.
2. proficient in the process of digital image acquisition, sampling, and the factors influencing image quality.
3. gain the skills to write, compile, and run software codes for image processing tasks, enabling them to implement algorithms and manipulate image data effectively.
4. enhance and restore digital images using various techniques, improving image quality and removing noise or artifacts.
5. understand and apply mathematical morphology for image analysis and segmentation, separating objects of interest in images.
6. analyze and manipulate texture, wavelength, and perform image matching for various computer vision applications.
7. gain an introduction to image compression techniques, understanding the principles of data reduction for efficient storage and transmission of images

Course Contents

Digital image processing (IP) and computer vision (CV) concepts, digital image acquisition and sampling, image data formation; software code for input and output images. Writing, compiling and running of software codes, image enhancement and restoration, mathematical morphology, Image segmentation, texture, wavelength, image matching, Fuzzy logic, Introduction to image compression.

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GEE 532: MACHINE LEARNING AND ARTIFICIAL INTELLIGENCE (2CREDITS)

Learning Outcomes

At the end of the course content delivery, students will be able to:

1. gain a comprehensive understanding of the fundamental concepts, algorithms, and applications of machine learning and artificial intelligence in the context of geospatial data analysis.;
2. proficient in supervised learning techniques, enabling them to develop predictive models for geospatial data with labeled examples.;
3. have the ability to apply unsupervised learning methods to discover patterns, clusters, and structures in geospatial data without labeled information.;
4. understand and apply fuzzy logic and wavelet transformation in geospatial data analysis, enhancing their capability to handle uncertainty and perform multiresolution analysis.;
5. have skilled in designing and training artificial neural networks for geospatial data processing, feature extraction, and pattern recognition.;
6. have the knowledge and skills to apply deep learning techniques in geospatial data analysis, including convolutional neural networks (CNNs) and recurrent neural networks (RNNs).; and
7. use machine learning and AI methods to perform classification, association rule mining, and regression analysis on geospatial data, making informed decisions and predictions.

Course Contents

Fundamentals, algorithms, and applications of widely used ML and AI methods in geospatial data analysis, supervised learning, unsupervised learning, fuzzy logic, wavelet transformation, Artificial Neural Network, and Deep Learning, Classification, Association, Regression.

GEE 524: ADJUSTMENT AND MATHEMATICALANALYSIS (2CREDITS)

Learning Outcomes

At the end of the course content delivery, students will be able to:

1. gain a solid understanding of matrix theory and its application to solving linear systems in geodetic data analysis.
2. proficient in using the Hilbert space approach to adjust geodetic measurements, enhancing the accuracy of geospatial data.;
3. have the knowledge and skills to apply probability and statistical methods to geomatics, enabling them to analyze and interpret data with uncertainty.;
4. identify biases in measured data sets and perform least square estimation to analyze geodetic data.;
5. apply statistical testing procedures and understanding random processes in the context of geomatics.; and
6. understand constraint functions and how to apply weighted parameterization in geomatics.

Course Contents

a. Fundamentals of matrix theory; Linear systems, Hilbert space approach to adjustment, probability and statistics, data classification and analysis, Bias identification in measured data set, Least square estimation and analysis of geodetic data, Statistical testing procedures, Random processes,
b. Constraint function and weighted parameter, Signal processing and time series analysis, Application to geodetic measurement, Bayesian algebra, Fuzzy logic Monte Carlo techniques, and their application in Geomatics.

c. Error analysis and advanced statistical testing methods. Linear and non-linear dynamic models, signal processing and Time series analysis.

d. Kalman filtering and real time data analysis, Kinematic modeling; the Kalman filter equation, Implementation aspect of the Kalman filtering in extension and stochastic approximation, classical and model approximation concept of signals and Least square collocation, robust estimation, and analysis.

e. Tensor Analysis.

GEE 522: HEALTH SAFETY AND ENVIRONMENTAL MANAGEMENT SYSTEM (HSEMS)

(2CREDITS)

Learning Outcomes

At the end of the course content delivery, students will be able to:

1. develop a comprehensive understanding of safety, health, and environmental policies, including their significance in various industries.
2. have an overview of industrial safety principles and practices, emphasizing the importance of a safe work environment.
3. have familiar knowledge of the legal aspects of safety, including relevant regulations and compliance requirements, and the consequences of non-compliance.
4. gain knowledge of safe working policies and procedures, with a focus on promoting workplace safety and accident prevention.
5. proficient in selecting, using, and maintaining personal protective equipment and protective wear for various workplace hazards.
6. understand electrical safety measures and how to prevent electric shocks in different industrial settings.
7. have the skills to assess and address occupational health concerns, provide basic first aid, and ensure industrial hygiene for a safe and healthy work environment.

Course Contents

Safety, Health and environment policy; Overview of industrial safety, Legal aspect of safety, Safe working policies, Personal protective equipment and protective wears, Electrical safety, Electric shocks and their prevention, safety in hazardous areas, Work permit systems, occupational health, First aid, Industrial hygiene. Environmental guidelines for large projects; Environmental impact studies and environmental evaluation report, Environmental Audit, Introduction to disaster management.

GME 514: SENSOR WEB AND INTERNET OF THINGS (2 CREDITS)

Learning Outcomes

At the end of the course content delivery, students will be able to:

1. gain a comprehensive understanding of the architecture of the Sensor Web, including its components and how sensors are integrated into a network.
2. get familiar with IoT concepts and how sensor data is a crucial part of the IoT ecosystem.
3. effectively managing sensor data, including data collection, storage, retrieval, and processing within the Sensor Web framework.
4. have skills to search for and discover sensor data sources and resources available on the Sensor Web.
5. learn how to design and implement Sensor Web servers, ensuring reliable and efficient data distribution and accessibility.
6. understand the interoperability issues in the Sensor Web and IoT domain and explore solutions to ensure seamless communication among heterogeneous sensors and platforms.
7. proficient in analyzing and visualizing sensor data, providing valuable insights and decision support through data analytics and visualization tools.

Overview of the Sensor Web Architecture, Internet of Things, Sensor Web Data Management, Sensor Web Search and Discovery, Sensor Web Server Design and Implementation, Interoperability Problems and Solutions, Sensor Based Analytics and Visualization, Introduction to Sensor Networks, Trends in Sensor Web and Internet of Things.

GEE 562: ENVIRONMENTAL REMOTE SENSING AND GIS (2 CREDITS)

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

1. Understand the principles of multispectral and microwave remote sensing systems.
2. Demonstrate proficiency in collecting multispectral data and using remote sensing instruments.
3. Differentiate between active and passive microwave remote sensing systems and their applications.
4. Apply remote sensing techniques to study and analyze vegetation cover, surface water, and urban landscapes.
5. Utilize remote sensing for environmental assessments, including soil

Course Contents

Multi spectral and microwave remote sensing system, multispectral data collection, Active and passive microwave system study of vegetation cover, Surface water biophysical characteristics and urban landscape using remote sensing, Remote sensing of soils, Minerals and geomorphology, Spectral reflectance of materials, Environmental Information system, Data collection and input, Data storage and analysis, Data manipulation, Visualization and reporting, DBMS.

GEE 572: SOFTWARE ARCHITECTURAL DESIGN (2 CREDITS)

Learning Outcomes

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

1. Understand multispectral and microwave remote sensing systems and their applications.
2. Master data collection, preprocessing, and analysis techniques.
3. Differentiate between active and passive microwave systems for environmental studies.
4. Apply remote sensing for vegetation, water, and urban analysis.

5. Use remote sensing in geoscientific studies, including soils, minerals, and spectral analysis.
6. Learn data management, visualization, and reporting, including Database Management Systems (DBMS).

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.

GEE 556: ENVIRONMENTAL MONITORING AND MANAGEMENT (2 CREDITS)

Learning Outcomes

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

1. Analyze and address Nigerian environmental challenges, including flooding, erosion, and deforestation.
2. Master environmental data collection and analysis techniques.
3. Understand global environmental issues like climate change and coastal erosion.
4. Explore monitoring methods for land movement and sea-level changes.
5. Evaluate regional environmental problems and management approaches.
6. Apply Space Geodesy for environmental monitoring and early warning systems.

Course Contents

Environmental problems in Nigeria; Flooding and erosion, Sedimentation, Desertification and deforestation, Data collection, Processing and analysis. Global Environmental issues; Climate change including greenhouse effects and ozone depletion, Coastal erosion and land subsidence, monitoring vertical land movement and changes in sea level using GNSS technologies, Geodetic leveling and tidal measurements. Regional environmental problems; monitoring laws and integrated management. Application of Space Geodesy in environmental monitoring, Development of early warning systems.

GEE 558: BIG DATA ANALYSIS (2 CREDITS)

Learning Outcomes

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

1. Understand essential mathematical models for Big Data Analytics, including Graph Theory and Matrices, Numerical Linear Algebra, Statistics, and Optimization Theory.
2. Implement and test these models using MATLAB.
3. Apply mathematical models to solve real-world data analytics problems.
4. Develop and test self-designed programs for complex data analytics tasks.
5. Gain proficiency in algorithm implementation and analysis.
6. Apply mathematical models to address complex challenges in the field of Big Data Analytics.

Course Contents

In this module basic mathematical models in the field of Big Data Analytics are presented, e.g. methods of Graph Theory and Matrices (esp. Adjacency Matrices and Thin Matrices), Numerical Linear Algebra (esp. Matrix Factorization, Conditioning of a problem), Statistics and Optimization Theory (esp. Stochastic Mixed-Integer Programming). All Algorithms are implemented and tested by the students in MATLAB. A self-developed program for a more complex task with the associated test completes the course.

CVE542: GEOTECHNICAL ENGINEERING II (2 CREDITS)

Learning Outcomes

Students will be able to:

1. understand the concept of settlement and differentiate between immediate (elastic), consolidation settlement, and secondary compression.
2. calculate settlement of structures on cohesionless soil using Schwartzman's method and evaluate the elastic settlement of structures on clay.
3. Perform one-dimensional consolidation calculations and analyze results.
4. conduct Odometer tests to determine pre-consolidation pressure, primary and secondary consolidation, and analyze the total and time rate of settlement.
5. comprehend the general principles of shear strength and state of stress at a point, including the Mohr stress circle.

10. apply the Mohr-Coulomb theory of failure and perform various shear tests, such as the vane shear test, direct shear test, and triaxial test (UU, CU, CO).

Course Contents

(i) Bearing Capacity: Ultimate, safe and allowable bearing capacities, Bearing and capacity factor. Case of shallow and deep foundations, factor of safety, shape effect; footings under eccentric and inclined loads.

(ii) Foundations: Types and choice of foundations: footings, rafts and pipe. Use general characteristics of pipes, pile in sand, piles in clay, Negative skin friction; pile groups, bearing capacity and settlement of pile groups; Efficiency of pile groups.

(iii) Earth pressure: pressure equilibrium, active, passive and at-rest pressure, Earth pressure coefficients, computation of earth pressure using the Rankine and Coulomb wedge theories, and Cullman’s method. Earth pressure on retaining walls. Types and analysis of retaining walls. The use of bracing as lateral support in open cuts, Anchored bulkheads, free earth support method of analysis.

(iv) Slope stability: Types and mechanics of slope failures. Theoretical and graphical solutions to slope stability problems. Effects of tension on slope stability. Ordinary method of slices.