UNIVERSITY OF NIGERIA, NSUKKA
DEPARTMENT OF GEOINFORMATICS AND SURVEYING
FACULTY OF ENVIRONMENTAL STUDIES
REVISED POSTGRADUATE CURRICULUM

***Postgraduate Diploma (PGD), Master of Science (M.Sc Academic), Master of Geoinformatics (MGIT), Doctor of Philosophy (PhD*)**

Introduction:

Geoinformatics and Surveying is a multi-disciplinary subject, which serves as a foundation discipline in Environmental Studies and Civil Engineering. It provides the geospatial and attribute data necessary for planning and management including location and designing of engineering works, exploitation of natural resources, and land administration. Courses are designed to produce Surveyors and Geomaticians with sound knowledge in the theory and practice of Land Surveying, Geodesy, Photogrammetry, Remote Sensing, Hydrography, Cartography, Geospatial Information System (GIS), and Land Information Management (LIM). The programme ensures adequate knowledge of mathematics, physics, computer science, environmental sciences, and management studies.

Philosophy

The philosophy behind these postgraduate programmes is to provide advanced education and practical training to those students who wish to widen their perspective and expand their knowledge on numerical techniques for acquiring, modelling and applying geospatial data. Successful completion of the curriculum enables them to create and manage intelligent workflows and services. Based on deep theoretical understanding, sophisticated technology and methods can be flexibly adapted to the necessities of specific applications and in providing solution to societal problems

Employment Opportunities

Successful students are equipped for careers in research institutions, tertiary institutions, Federal and State Ministries of Works, Lands and Survey, Housing and Environment, Mineral Resources, Parastatals such as National Independent Power Projects (NIPP) Federal Environmental Protection Agency (FEPA), Nigerian Ports Authority (NPA), Telecommunication companies (MTN, 9mobile, Globacom, Zain, etc) as well as mining companies, and oil prospecting companies such as Shell Nigerian Petroleum Co., ELF, Gulf Oil Co., Agip, social services institutions such as population, planning units, market authorities, etc. In addition Professional PGD holders will be eligible for registration with the Surveyors Registration Council (SURCON) of Nigeria

List of Approved Postgraduate Supervisors

S/N	Name of Lecturer & Rank	Academic/Profess-ional Qualifications	Area/s of Specialization & Research Interest	Remarks
1	Prof. F. I. Okeke **(Professor)**	B.Sc., M.Sc., (Nigeria) Ph.D. (Stuttgart)	Geodesy & Geodynamics, Geographic Information System(GIS), Remote Sensing	**Department of Geoinformatics &Surveying**
2	Prof. O. C. Ojinnaka **(Professor)**	B.Sc., M.Sc., Ph.D. (Nigeria), Diploma Hydro. (Plymounth)	Land Surveying, Engineering Surveying, Hydrography	**Department of Geoinformatics &Surveying**
3	Prof C. Okpala-Okaka, **(Professor)**	B.Sc. (Wisconsin), M.Sc.(Illinois), Ph.D (Unizik), Diploma Cartography ITC (The Netherlands)	Cartography & GIS	**Department of Geoinformatics &Surveying**
4	Prof .R. A. Osemenam, **(Professor)**	M.Sc., Eng. Surveying Ph.D Mining Surveying (Moscow)	Engineering Surveying & Mining Surveying	**Department of Geoinformatics &Surveying**
5	Dr. E. C. Moka **(Senior Lecturer)**	B.Sc., M.Sc. Ph.D. (Nigeria)	Geodesy, Astronomy & Geodynamics	**Department of Geoinformatics &Surveying**
6	Dr. N.V. Uzodinma **(Senior Lecturer)**	B.Sc., M.Sc. Ph.D. (Nigeria	Geodesy, Astronomy & Geodynamics	**Department of Geoinformatics &Surveying**
7	Dr. R.I. Ndukwu **(Senior Lecturer)**	B.Sc., M.Sc. Ph.D. (Nigeria	Geodesy & Geodynamics, Geographic Information System(GIS), Remote Sensing	**Department of Geoinformatics &Surveying**

POSTGRADUATE DIPLOMA (PGD) PROGRAMME

1.0 OBJECTIVES

The objectives of the programmes are as follows:

i) To provide a bridge programme which will enable the Higher National Diploma (HND) holders in Geoinformatics and Surveying to qualify for enrolment in postgraduate courses leading to higher degrees in Geoinformatics & Surveying.

ii) To provide graduates of tertiary institutions with or without basic Geoinformatics & Surveying background the opportunity to master new skills in Geographic Information System (GIS) and geospatial technology. The Philosophy of this program is to provide a curriculum that can equip graduates of tertiary institutions in Engineering, Environmental Sciences, Medicine, Business Administration, Social Sciences, Arts and other disciplines with the knowledge and skills in Geoinformatics to enhance their competence in the application of Geographic Information System (GIS) and Geospatial Technologies in their various work places and interests.

iii) To provide graduates of allied courses to Surveying the opportunity, not only to become Geoinformatics and Surveying Professionals but also become registrable by the Surveyors Council of Nigeria (SURCON). Successful candidate can also enroll for higher degrees.

iv) To produce top-level manpower needed for sustainable development and utilization of land information products and land resources.

2.0 ENTRY REQUIREMENTS

For the PGD programmes the Department offers two options:

Option A: PGD in Geoinformatics and Surveying. For graduates of tertiary institution with qualifications in Surveying and Geoinformatics or cognate disciplines and who desire to pursue a professional career in Surveying and become registered by the Surveyors Council of Nigeria (SURCON) The applicant for this programme should have in addition to the University minimum entry qualification the following:

i) B.Sc degree with 3rd class honours in Surveying (Geoinformatics & Surveying) from UNN or a recognized University.

ii) HND in surveying with at least upper credit pass or equivalent.

iii) BSc degree with a minimum of second class honours in allied courses such as Physics, Mathematics, Computer Science, Statistics, Geography with Mathematics, Engineering, Geology, Geophysics. These candidates will be required to take preliminary PGD courses in surveying and Geoinformatics for two semesters.

iv) Candidates with PGD or MSc in Geoinformatics from UNN or any other recognised university. These candidates:

(a) Will be required to take preliminary PGD courses in surveying and Geoinformatics for two semesters.

(b) May be required to audit relevant courses in Physics and Mathematics

Option B: PGD in Geoinformatics. This is for graduates of tertiary institution with or without basic surveying background and the programme leads to award of PGD in Geoinformatics. This program is designed for those who do not necessarily want to be registered Surveyors but who want to acquire knowledge and skills in Geospatial technology to enhance their competence in the application modern GIS technology in their work place. Holders of this certificate can apply for Master of Geoinformatics programme. The applicant for this programme should have in addition to the University minimum entry qualification the following:

i) B.Sc degree with at least 3rd class in Surveying (Geoinformatics & Surveying)

ii) B.Sc degree with at least 3rd class in Engineering, Environmental Sciences, Medicine and Medical Sciences and Technology, Mathematics, Computer Science, Geology, Geophysics, Physical Sciences, Geography, Town

Planning, Forestry, Estate Management, Banking and Finance, Insurance and Actuarial Sciences and other related fields.

iii) HND with upper credit in related fields as in i) and ii) above.

3.0 MODE OF STUDY

The following mode of study applies:

i. By coursework with externally moderated written examinations in registered courses and project reports.

ii. By full-time or part-time study.

4.0 COURSE DURATION

The duration of the programme are as follows;

Full-Time

Options A and B: Minimum of two (2) semesters and maximum of six (4) semesters.

Part-Time

Options A and B: Minimum of four (4) semesters and maximum of six (6) semesters.

4.1 REQUIREMENTS FOR GRADUATION

The Postgraduate Diploma programme for all the options would be prosecuted by course work and project totalling a maximum of 30 credit units

5.0 AREAS OF SPECIALISATION

Since this is a bridge programme, there are no areas of specialisation except as inferred in the various options as follows: Candidates for options A and C will run all the relevant courses leading to award of PGD in Geoinformatics and Surveying, while candidates for option B will take all relevant courses leading to award of PGD in Geoinformatics.

Candidates who hope to further their programme beyond PGD will be expected to chose electives that will reflect their future areas of specialization.

6.0 STRESS AREAS

The 4-digit code numbering of courses reflects the stress areas of the programme. The first digit 0 stands for postgraduate diploma. The second digit stands for the years of study, the third for the stress areas while the fourth stands for the serial number of courses within a stress area.

Stress Areas	**Stress Number**
Practical Computation, Management	0
Land Surveying	1
Geodesy and Geodynamics	2
Photogrammetry and Remote Sensing	3
Hydrographic Surveying	4
Cartography	5
Adjustment Computations	6
Geographic Information System (GIS)	7

7.0 PG DIPLOMA IN GEOINFORMATICS AND SURVEYING

7.1 POSTGRADUATE DIPLOMA IN GEOINFORMATICS & SURVEYING (OPTION A)

FIRST SEMESTER

COURSE NO.	COURSE TITLE	UNITS
GSV 0611	Land Surveying Methods and Applications	2
GSV 0613	Survey Laws and Regulations	2
GSV 0621	Geometrical Geodesy	2
GSV 0631	Aerial Photogrammetric Method	2
GSV 0661	Adjustment Computations	2
GSV 0677	GIS Design and Applications	2
	Electives	4
	Total	**16**

Select Electives of 4 Units from the following Courses:

GSV 0623	Physical Geodesy	2
GSV 0641	Method of Hydrographic Surveying	2
GSV 0651	Elements of Cartography	2
GSV 0675	Introduction to GIS	2

SECOND SEMESTER

COURSE NO.	COURSE TITLE	UNITS
GSV 0602	Computer Application in Geoinformatics & Surveying	2
GSV 0614	Engineering Surveying	2
GSV 0622	Space Geodesy	2
GSV 0632	Theory and Application of Remote Sensing	2
GSV 0690	Project	4
	Electives	2
	Total	**14**

Select Electives of 2 Units from the following Courses:

GSV 0616	Mining Surveying	2
GSV 0642	Marine Survey	2
GSV 0672	Cadastral Land Information Management	2
GSV 0676	Data Integration and Digital Mapping	2

7.2 POST GRADUATE DIPLOMA (PGD) IN GEOINFORMATICS (OPTION B)

FIRST SEMESTER

COURSE NO.	COURSE TITLE	UNITS
GSV 0651	Elements of Cartography	2
GSV 0671	Spatial Statistics	2
GSV 0673	Data Acquisition Systems	2
GSV 0675	Introduction to GIS	2
	Electives	4
	Total	**12**

Select Electives of 4 Units from the following Courses:

GSV 0603	Introduction to Environmental Management	2

GSV	0611	Land Surveying Methods and Applications	2
GSV	0631	Aerial Photogrammetric Method	2
GSV	0679	Spatial Analysis	2

SECOND SEMESTER

COURSE NO.		COURSE TITLE	UNITS
GSV	0602	Computer Applications in Geoinformatics & Surveying	2
GSV	0612	GNSS Surveying	2
GSV	0632	Theory and Application of Remote Sensing	2
GSV	0634	Digital Image Processing	2
GSV	0672	Cadastral land Information System	2
GSV	0674	Data Base Creation	2
GSV	0690	Project	2
		Electives	4
		Total	**18**

Select Electives of 2 Units from the following Courses:

GSV	0604	Introduction to Coastal Management	2
GSV	0614	Engineering Surveying	2
GSV	0616	Mining Surveying	2
GSV	0678	GIS Design and Applications	2

PRELIMINARY COURSES IN PGD GEOINFORMATICS AND SURVEYING

FIRST YEAR

FIRST SEMESTER

COURSE NO.	COURSE TITLE	UNITS
GSV 0511	Cadastral Surveying	2
GSV 0513	Control Surveys	2
GSV 0523	Map Projections	2
GSV 0525	Geodetic Astronomy Theory and practices	2
GSV 0533	Fundamentals of Remote Sensing	2
GSV 0541	Fundamentals of Hydrographic Surveying	2
GSV 0551	Fundamentals of Cartographic Techniques	2
GSV 0561	Adjustment Computations I	2
	Total	**16**

SECOND SEMESTER

COURSE NO.	COURSE TITLE	UNITS
GSV 0502	Computer Applications in Geoinformatics and Surveying	2
GSV 0512	Introduction to Engineering Surveying	2
GSV 0514	Topographic Surveying	2
GSV 0522	Potential Theory	2
GSV 0532	Fundamentals of Photogrammetry	2

GSV 0562	Applied Mathematical Methods in Surveying	2
	Total	**12**

COURSE DETAILS

GSV 0502 Computer Applications to Geoinformatics & Surveying 2 Units

Computer Aided draughting & Design CAD, AutoCAD, Digital Surveying Computations, (Wolfpack) or any appropriate software), GIS Application, (ARCVIEW, ArcGIS,) Remote Sensing Application (Ilwis, Idrisi), Photogrammetry application (Aerosys). Computer Hardware and software for Geoinformatics & Surveying applications. Introduction to some operating Systems. WINDOWS, Linux, Unix, etc. Basic Data structure and file organization. Programming in FORTRAN, VISUAL BASIC MATLAB. Applications Surveying and Geoinformatics. Selected weekly exercises. Use of the computer to solve complex problems in surveying problems including those of data presentation, photogrammetry and ground surveying. Programming in FORTRAN and BASIC Languages.

GSV 0511: Cadastral Surveying (2 units)

Detailed treatment of the techniques and procedures for the production of survey plans for purposes of cadastral recordings, expert evidence in court proceedings, judicial inquiries, legal adjudications, payment of compensations, agricultural subdivisions, mining lease allocations, etc. properties of boundary monuments, re-establishment of lost boundary beacons. Study of theodolite traversing (open, closed and loop traverses); problems created by obstacles to ranging and/or chaining; missing lengths of a traverse. Traverse computations, semi rigorous adjustment and back computation. Error analysis and obtainable accuracy of traverse. Area computation for regular and irregular parcels. Principles and instrumentation of substance traversing and tacheometry, including the use of electronics tacheometers. Reading of Town planner's layout plan and setting out residential, commercial and industrial blocks and plots. Setting out parcels which are subjects of court order.

GSV 0512: Introduction to Engineering Surveying (2 units)

Detailed treatment of the techniques for location and setting out of surface transportation routes, pipelines, buildings and other engineering features and structures including longitudinal and cross sectional profiles; circular, compound, transition and vertical curves. Computation of areas, volumes, slopes and aspects from field measurements and/or topographic maps. Construction of mass diagrams. Error analysis and achievable accuracies. Digital approaches

GSV 0513: Control Surveys (2 units)

Study of the classical methods and techniques of control surveys including traversing; minor triangulation, resection and intersection; trilateration; and levelling. Study of the classical design, construction, adjustment, use and care of the instruments in use such as theodolites, steel tapes; targets; dumpy, tilting and automatic levels; and staves. Introduction to the applications of control points to topographic, cadastral, engineering, utility, route, and environment surveys. Properties of control monuments and bench marks and their emplacement. Definition and of Geoinformatics and Surveying. Historical sketch of the developments in the concepts, instrumentation, methods and techniques of Geoinformatics and Surveying. Geoinformatics and Surveying Products e.g. maps, plans, reports, photographs, images etc. and user needs including the needs of Engineers, Architects, Estate

Managers, Urban and Regional Planners, Navigators, Oceanographers, Physical Scientists, [including Geologists and Geophysicists, Agriculturists, Foresters, Archaeologists, Lawyers, Business Administrators, Land Owners and Land Developers, Environmentalists, Public Administrators, etc]. Introductory explanation of these products, and assessment of these needs as well as the possibilities of satisfying them.

GSV 0514: Topographic Surveying (2 units)
Detailed treatment of the techniques for the production and update of topographic maps. Historical development of the techniques and instrumentation including the use of plane tables, Indian clinometers, optical tachometers, differential/grid levelling; Spot heighting and contouring. Integration of land survey with photogrammetry and remote sensing. Introduction to digital instruments.

GSV 0522: Potential Theory (2 units)
Fundamentals of potential theory: Harmonic functions, Legendre's functions and spherical harmonics. Boundary value problems of potential theory and their applications to the representation of earth's gravity field.

GSV 0523: Map Projections (2 units)
Introduction to the general theory of Map Projections including the theory of distortions of lengths, angles and areas. Definitions mapping Equations of the various and uses of various projections – conformal, Equal area, Equidistant, etc. Detailed treatment of the Mercator, Transverse Mercator (T.N) projections, and modified T. M. projection for Nigeria (NTM) and their practical applications. Issues on NTM and UTM in Nigeria.

GSV 0525: Geodetic Astronomy Theory and Practices (2 units)
Study of the basic formulae of spherical trigonometry. The definition of the celestial sphere and its coordinate systems. Time element in field astronomy. Star charts, catalogues and ephemerals. Field procedures, instrumentation, and error analysis for the determination of azimuth latitudes, longitude and time. The use of solar ephemeris and the apparent places of fundamental stars. Introduction to star up dating, timing systems and instrumentation to higher order determination of azimuths and positions.

GSV 0532: Fundamental Photogrammetry(2 units)
Definition of Photogrammetry. Historical development of the principles and techniques of photogrammetric acquisition of terrain data and information. Monocular and binocular viewing, Stereoscopic observation of single and overlapping photographs. Spatial geometry of vertical and titled photographs; rectification, orthophotography. Procedures and methods of deriving metric data from photographs. Measurements on photographs and parallax heighting. Photo interpretation.

GSV 0533: Fundamental of Remote Sensing (2 units)
Concepts and Basic principles of Satellite Remote Sensing. Remote sensor platforms and systems: photographic, electro-optical and microwave imaging systems. Fundamentals of image processing. Applications of Satellite Remote Sensing.

GSV 0541: Fundamental of Hydrographic Surveying(2 units)

Controls for inland waters and offshore. Bathymetry. Position Fixing; linear and optical methods. Electromagnetic Position Fixing (EPF) system, Global Navigation Satellite Systems (GNSS), etc. Marine Reference level, Gauges, tide observation, chart datum transfer. Fundamentals of underwater acoustics. Echo sounders: principles, data reduction, echo sounder calibrations. Swathe Sounding Systems. The Electronic Chart Display and Information system. Introduction to Marine Information System. (MIS)
Current meters. velocity measurements, discharge measurements for inland waters and estuaries, current meters. Introduction to sediment transport.

GSV 0551:Fundamental Cartographic Techniques (2 units)
Reading and interpretation of maps and charts. Study of methods of referencing of map features: the rationale and the method of choice and change of scale and colour. Methods of relief representation, graphic and mechanical measurements of areas. Data layering. Introduction to computerized techniques.

GSV 0561: Adjustment Computations I (2 units)
Theory of errors with applications to surveying measurement and computation. Functional and stochastic models. Classification of errors and their handling. The normal or Gaussian distribution. Propagation of systematic and random errors. Statistical analysis of observations and derived parameters. Review of matrix algebra and matrices. Theory of least squares. Linearization of functions. Classical and matrix algebra formation. Formation of observation and condition equations with applications in Geoinformatics of Surveying.

GSV 0562: Applied Mathematical Methods in Surveying (2 units)
Definition of the properties of vectors - scalar product, vector product, vector function of a single scalar variable, gradient of a scalar function, the operator; line and surface integration; Divergence and curl, integral theorems of Gauss, Stokes and Green. Definition of the elements of complex numbers and conformal mapping. Analytic function of a complex variable; infinite series in the complex plane. Definition of the finite difference of function; Interpolation formulas, numerical integration and differentiation, numerical solution of differential equations. Definition of Fourier series and integrals. Introduction to graph theory. Applications of applied mathematical concepts to surveying systems.

GSV 0601: Computer Applications in Geoinformatics & Surveying (2 units)
Knowledge of Computer Hardware and software configuration; Review of application software suite; Review of Operating Systems Utility software; Review of Programming languages (Fortran, C++, etc).
Introduction to various application software; Numerical analysis (Numerical recipes, Matlab, etc) Land Surveying packages (Wolfpack, etc), Computer Aided Design and Drafting packages (AutoCAD, MicroStation, etc), GIS packages, Remote Sensing and Image processing packages, Photogrammetric packages (AeroSys, etc),

GSV 0603: Introduction to Environmental Management (2 units)
The Nigerian Environmental Problems: Erosion, desertification, flooding, deforestation, sedimentation, pollution from agricultural activities, gas flaring and other national and human induced impacts. Global environmental issues: climate change including greenhouse gases and ozone depletion, sea level rise and the impacts etc. Regional environmental problems such as fish depletion, erosion and subsidence. Management strategies: Data Collection,

processing, monitoring, laws and regulations, integrated management and environmental impact assessment.

GSV 0604: Introduction to Coastal Management (2 units)
Introduction - Definition; Coasts, coastline, the Nigerian Coast; the dynamics of the Nigerian Coast - tides, waves, geology, geomorphology, topography, presence of canyons subsidence, global / relative sea level rise extreme sea level etc. Sedimentary coastal dynamic. Sea level changes along the West Africa Coast, specific studies of some beaches along the coastal areas of West Africa/ Nigeria. Human Activities and their impacts on the Nigerian coast. Design of a Coastal Management programme for Nigeria: data requirements; legal and management needs; and monitoring and enforcement. Application of GIS in coastal Management. Environmental Impact assessment of development activities on the Nigerian coast.
impact assessment.

GSV 0611: Land Surveying Methods and Application (2 units)
Various objectives and applications of Land Surveying - Mapping control, Topographic Surveying, Cadastral system, Engineering planning and construction; Archaeology, GIS/LIS, Agriculture, Power distribution, Environmental Management, Mining and Petrochemical exploration and exploitation, Telecommunication, etc. Review of classical methods of control establishment: traversing, triangulation, trilateration, intersection, etc. Heightening techniques; bench marks, trigonometrical leveling and precise spirit levelling, barometric leveling. Control Establishment with GPS. Route Survey: Computation and setting out. Application of total stations, and laser levels. Detailed Survey. On-line survey production.

GSV 0612: GNSS Surveying 2 units)
Concept and application of Global Positioning System (GPS); Operation of hand-held GPS receivers, Operation and set up of GPS receivers. Map interpretation, Review of Datums and Coordinate Systems, Coordinate transformation. Satellites and Receivers, Error sources and their control; Error model development.

GSV 0613: Survey Laws and Regulations (2 units)
Nigerian Survey Laws and Regulation. Acts, Decrees, Edicts and Instructions relating to survey profession. CAP 194 and other relevant Survey legislations and decrees including their amendments. Surveys Laws in Mining Surveys. Town Planning, etc. The Land Use Etc.

GSV 0614: Engineering Survey (2 units)
Surveys for the investigation and planning, design and construction stages of technical engineering projects; Control surveys in engineering; Quality Assurance; Procedures for setting out, measurement and surveying in construction; Laser based surveying instrumentation and methods; Survey Evaluation of excavation, haulage and embankment construction, including criteria for selection of construction equipment. Introduction to construction operations management; Mining, tunneling and underground surveys; Project surveying, including buildings, dams, roads, railways, bridges, canals, airport obstructions.

GSV 0616: Mining Survey (2 units)
Surface and underground measurements; Planning the development and future of mineral workings; Preparation of quarterly and annual prospective mining plans; Management and evaluation of mineral estate; Planning applications and appeals, mining laws and working rights; Estimation of mineral reserves. Survey and study of oil well, oil prospecting, and underground water resources.

GSV 0621: Geometrical Geodesy (2 units)
The Principal aims of Geodesy. Historical sketch and development of the concepts and methods of discerning the figure of the earth. Definitions and derivations for geometry of the earth's ellipsoid: radii of curvature, normal sections and the geodesics. Mathematics of small spherical triangle. Computation of geodetic positions. Direct and inverse geodetic problem. The concept of datum and datum transformation. Clark 1880 and the WGS 67, 72, 80, 84, GPS.

GSV 0622: Space Geodesy (2 units)
Variations on the celestial coordinates – precession, nutation, polar motion, aberration, parallax, refraction, proper motion and reduction of star positions. The Astronomical Almanac, the solar and lunar ephemerides. Geometric and dynamic methods of earth's figure and gravity field determination using observations to or from artificial satellites – Doppler and GPS, GNSS and Satellite Altimeter systems. Very long Base Line Interferometry (VLBI).

GSV 0623: Physical Geodesy (2 units)
Representation of the earth's gravity field by spherical harmonics. Level ellipsoid and its gravity potential. Normal gravity formulas. The anomalous gravity field and geoid determinations. Measurement of gravity values; absolute and relative methods. Reduction of gravity values to the geoid. Height systems and their determinations.

GSV 0631: Aerial Photogrammetric Methods (2 units)
Map compilation with analogue stereo plotter: relative and absolute orientation, plotting of stereo-models. Stereo plotting instruments. Analogue Aero triangulation methods. Introduction to Analytical Photogrammetry: Photo coordinate measurements; coordinate refinement. Analytical Relative orientation and Absolute orientation. Introduction to digital Photogrammetry.

GSV 0632: Theory and Application of Remote Sensing (2 units)
Review of basic principles of remote sensing. Energy sources and spectral signatures, Cameras: single lens, multiple lens, strip, panographic. Remote Sensing including photographic, electro-optical and micro-ware imaging systems, Earth Resource satellites; landsat, SPOT etc. Data measurement: temperature, depth etc. Image interpretation and classification: Change detection analysis, Data Presentation.

GSV 0634: Digital Image Processing (2 units)
Fundamentals of digital image processing, Image formation and restoration, Basic Satellite Image Processing, Application of algorithms for pattern recognition and image analyses. Image correction and enhancement for visual interpretation.

GSV 0641: Methods of Hydrographic Surveying (2 units)
Position fixing method: linear, Optical, Electromagnetic Position Fixing System, Global Positioning Systems, transponders. Integrated Systems. Underwater acoustics, echo sounders, swathe sounders, side scan solars. Discharge measurements. Tides: observation, analysis and prediction.

GSV 0642: Marine Surveying and Applications (2 units)

Survey for Coastal Engineering: Erosion monitoring and control. Siltation. Coastal stability: effect of tidal motion and waves. Coastal zone management. Habour Laws. Large scale survey: dredging, demarcation for habour limits. Oceanographic equipment. Introduction to Marine Information Systems.

GSV 0651: Elements of Cartography (2 units)
Fundamentals and design of graphic perception. Cartographic communication and graphic design in map making. Typography and map lettering. Design and arrangement of map layout including symbolism, semiology, colours and patterns. Map reproduction and preparations for colour separation and printing. Introduction to Digital Cartography.

GSV 0661: Adjustment Computations (2 units)
Theory of errors with application to surveying measurements and computations. Propagation of errors. Review of matrix algebra. Formation of observation equations, condition equations and normal equations. Solution of normal equations: Gauss-Doolittle, Banachiewicz, Choleski methods. Error ellipse and statistical testing. Applications in spatial data analyses

GSV 0672: Land Information Management (LIM) (2 Units)
Land use classification; suitability evaluation. Change/growth monitoring. Multi-purpose cadastre: data types and data capture. Digital Data storage. Information management and data retrieval. Updating, security and classified information.

GSV 0671: Spatial Statistics(2 units)
Basic descriptive statistics and graphics. Correlation and regression. Spatial interpolation. Analysis of spatial pattern. Graphic representation of spatial distribution. Contouring and interpolation methods.

GSV 0673: Data Acquisition Systems
Optical and Digital levels, Digital Theodolites, Total Stations, Laser instruments. Data storage systems. Plotters and Scanners. Global Positioning System, Earth Resource Satellites including Synthetic Aperture Radar Interferometer(InSAR). Air-borne Remote Sensing Systems including LIDAR (Light Detection and Ranging), Electronic Position Fixing Systems. Digitizing and scanning.

GSV 0674: Database Creation (2 units)
Database design: Conceptual data modelling: tessellation, vector and object oriented. Logical data modelling, Data structure: relational, geo-relational, object oriented, object-relational. Physical design: Data entry, compatibility with GIS software. Database creation and maintenance. Structured Query Language (SQL), Data accessibility and updating.

GSV 0675: Introduction to GIS (2 units)
Basic GIS functions, Basic GIS designs and methods, Project design and development , GIS and its applications, Benefits of its implementation, data sources, data structures, data standards, data quality, features of GIS databases, GIS and its social and organisational context. Specific study of a topic under one of the following three areas: (student is required to submit a term paper on the chosen topic e.g.): (a) Topographic Information System (b) Cadastral Information System (c) Environmental Information System. For the chosen area, the study must focus on concept, design considerations

(factors and design phases), data requirements and modelling, and selection of implementation hardware and software

GSV 0676: Data Integration and Digital Mapping (2 units)
Computer assisted mapping; map production from digital databases. Coordinate systems, and coordinate transformations. Vector-to-raster and raster-to-vector conversion, interfaces between GIS systems. Integration of Remote sensing, Photogrammetry, Surveying and Cartography Data for GIS, Data Import/conversion, data acquisition, topographic mapping, thematic mapping, statistical mapping, desktop mapping and internet mapping. Surveying and Mapping in Oil Industries. Map updating. Project planning, time evaluation and costing, quality control. Implementation and exercises using computer mapping software.

GSV 0677: GIS Design and Applications (2 units)
GIS need analysis, pilot projects design, general system design principles, system design models, and formal GIS design methodology, GIS implementation planning, system verification and validation. Introduction of some of the popular GIS software systems currently being used, including: ArcView, ArcGIS, MapInfo, Idrisi, ILWIS, etc. GIS applications in: Mapping for construction of engineering structures; Coastal management and mineral exploitation; Urban planning; Utility distribution; Agriculture; Transportation; road network maintenance; Census programme; Micro and Macro scale housing programmes; Environmental Impact Assessment (EIA); Resource inventory and monitoring. Each student will complete a practical GIS design project.

GSV 0679: Spatial Analysis (2 units)
Introduction of the fundamental concepts, techniques and applications of spatial analysis in GIS: GIS functionality for spatial analysis, Map Algebra, measurement, single and multi-map operations, surface modelling, Interpolating Surfaces, spatial interpolation and network analysis.

M.Sc. & Ph.D. PROGRAMMES

1.0 Objectives
The objectives of the programme include the following:
(a) To educate future decision makers and senior engineers of information and land management projects, natural resource managers, national authorities for measuring, modelling and presentation of geospatial data and processes, with photogrammetry and remote sensing, geodesy, hydrography, GIS and cartographic tools.
(b) To provide expertise for understanding the basic principles of Earth observation and analysis/interpretation of natural phenomena such as ocean currents, sea level rise, the world's hydrological cycles, atmospheric conditions, global climate change, post-glacial rebound, and elastic deformation, particularly as it relates to natural hazards, such as earthquakes, volcanoes, and flooding.
(c) To train persons capable of teaching in our universities with excellent ability to impart knowledge into others; and with the ability to do good quality research capable of competing with any other university in the world.
(d) To produce practical-orientated professionals with broad knowledge in the field of Geoinformatics and Surveying who can serve as consultants in the various aspects of engineering and environmental project; as well as contribute to the objectives of international organizations such as the International Federation of Surveyors (FIG), the

International Society of Photogrammetry and Remote Sensing (ISPRS), the International Union of Geodesy and Geophysics (IUGG), the International Cartographic Association (ICA) and the International Hydrographic Organization (IHO), among others.

1.1 Scope

The programme leads to the award of the Master of Science (M.Sc) / Doctor of Philosophy (PhD) degrees in the following areas: Land Surveying, Geographic/Land Information Systems, Geodesy and Geodynamics, Hydrography, Photogrammetry and Remote Sensing, and Cartography. The department also offers a professional degree of Master of Geoinformatics.

2.0 ENTRY REQUIREMENTS

2.1Master of Science (MSc) in Geoinformatics and Surveying

i) Graduates of the University of Nigeria and other approved universities with a minimum of Second Class Honours with GPA of 2.5 on 5.0 –point scale or its equivalent in Surveying (Geoinformatics and Surveying).

ii) Other graduates who have post-graduate diploma (PGD) in Surveying (Geoinformatics and Surveying) of the University of Nigeria or its equivalent with a minimum grade point average (GPA) of 3.5 on 5 point scale or 2.5 on a 4 point scale. In addition such, candidates must have obtained Second Class Honours with GPA of 2.5 on 5.0 –point scale or its equivalent

2.2Master of Geoinformatics (MGIT)

i) This program is for those who do not necessarily have background in Geoinformatics and Surveying. Eligibility is for graduates of the University of Nigeria and other approved universities with a minimum of Second Class Honours 2.5 on 5-point scale or its equivalent in Surveying, Engineering, Mathematics, Computer Science, Physical Sciences, Geography, Town Planning, Forestry , Estate Management, Banking and Finance, Insurance and actuarial sciences, Environmental Sciences and related fields.

ii) Other graduates who have post-graduate diploma (PGD) in Geoinformatics of the University of Nigeria or its equivalent with a minimum grade point average (GPA) of 3.5 on 5 point scale or 2.5 on a 4 point scale. In addition, such candidates must have obtained Second Class Honours with GPA of 2.5 on 5.0 –point scale or its equivalent

2.3Doctor of Philosophy (PhD) in Geoinformatics and Surveying

i) M.Sc/Ph.D Programme

A First Class Honours degree in Surveying (Geoinformatics and Surveying) from University of Nigeria or any approved and accredited University or an M.Sc degree by comprehensive research and passed with minimum of grade of "B" average.

A candidate on successful completion of M.Sc with a minimum of 3.50 grade point average on 5-point scale or 3.0 on the 4-point scale will proceed straight to Ph.D programme. Alternatively if the candidate makes GPA of 3.50 on 5-point scale or 3.0 on the 4-point scale after the first two semesters of being on the M.Sc/Ph.D programme, and shows sufficient ability for research work at Ph.D level, the candidate may be recommended to proceed to Ph.D programme without fully completing the M.Sc programme.

ii) Ph.D. Programme

Graduates of Geoinformatics and Surveying or Geoinformatics of the University of Nigeria or other recognised Universities who have obtained the degree of M.Sc (with specialty in any of the stress areas of Land Surveying and Mining Surveying, Geodesy and Geodynamics,

Photogrammetry and Remote Sensing, Hydrography, Navigation, Cartography, and GIS) with a minimum of 3.50 grade point average on 5-point scale or 3.0 on the 4-point scale, provided that satisfactory research work formed part of the M.Sc degree. In addition to the mandatory course work, the Department may, as the case may be, select some advanced courses/seminar, which a Ph.D candidate must pass before graduation. Such courses/seminars shall, however, not count in the final assessment for the award of the Ph.D degree.

3.0 MODE OF STUDY

All Masters Students should pass the Course on ICT and Priority Advanced Research Methodology or Technology for development of research skills. This shall include a Workshop to be organized by the School of Postgraduate Studies with a Certificate of Participation without which the result is incomplete.

3.1 Master of Science (MSc) in Geoinformatics and Surveying

A candidate for Master's degree under this mode should take a total minimum 30 credit units spread over the course duration. A minimum of 6 units of project should form part of the total credit unit. Each candidate is supposed to present two seminar papers before final examination. The mode of study for the Master of Science in Geoinformaics and Surveying will be by course work to be examined in written papers with research work to be presented in a project report. A candidate for Master of Science in Geoinformatics and Surveying shall take all the compulsory courses and relevant courses from his area of specialization

3.2 Master of Geoinformatics (MGIT)

A candidate for Master of Geoinformaticss degree should take a total minimum of 30 credit units spread over the course duration. A minimum of 6 units of project should form part of the total credit unit. Each candidate is supposed to present two seminar papers before final examination. The mode of study for the Master of Geoinformaics will be by course work to be examined in written papers with research work to be presented in a project report. A candidate for Master of Science in Geoinformatics shall take all the compulsory courses and relevant courses from his area of specialization.

4.0 DURATION OF PROGRAMMES

4.1Master of Science (MSc) in Geoinformatics and Surveying

Full-time: A minimum of three (3) semesters.
A maximum of five (5) semesters
Part-time: Minimum of four (4) semesters.
Maximum of six (6) semesters.

4.2Master of Geoinformatics (MGIT)

Full-time: A minimum of three (3) semesters.
A maximum of five (5) semesters
Part-time: Minimum of four (4) semesters.
Maximum of six (6) semesters.

4.3Doctor of Philosophy (PhD)

i.) M.Sc/Ph.D:

Full-time: A minimum of eight (8) semesters
A maximum of twelve (12) semesters.
Part-time: A minimum of ten (10) semesters
A maximum of fourteen (14) semesters.

ii.) Ph.D: (after masters)

Full-time: A minimum of six (6) semesters
A maximum of ten (10) semesters.

Part-time: A minimum of eight (8) semesters
A maximum of twelve (12) semesters.

6.0 AREAS OF SPECIALISATION

A candidate for a higher degree may specialize in any of the following areas by appropriate choice of electives: Geodesy; Photogrammetry and Remote Sensing; Land Surveying; Hydrography; Geographic Information System (GIS); and Cartography.

7.0 STRESS AREAS

The 3-digit code numbering of courses reflects the stress areas of the programme. The first digit stands for the years of study, the second for the stress areas while the third stands for the serial number of courses within a stress area

Stress Area	**Stress Number**
ICT/Research Method/Synopsis and Research Grant writing, Statistics, and Practical Computation	0
Land Surveying and Mining Surveying	1
Geodesy and Geodynamics	2
Photogrammetry and Remote Sensing	3
Hydrographic Surveying	4
Cartography	5
Adjustment Computations	6
Geographic Information System (GIS)	7
Seminars	8
Project Report/Thesis	9

8.0 M.Sc PROGRAMME IN GEOINFORMATICS AND SURVEYING

FIRST SEMESTER

COURSE NO.	COURSE TITLE	UNITS
PGC 601	Research Methodology & Application of ICT in Research	3
GSV 603	Advanced Practical Computations	2
GSV 611	Advanced Land Surveying Methods & Applications	2
	Electives	6
	Total	**13**

Select 6 units of Electives from the following Courses for First Semester:

COURSE NO.	COURSE TITLE	UNITS
GSV 607	Spatial Statistics	2
GSV 621	Advanced Physical Geodesy	2
GSV 623	Advanced Celestial Geodesy	2
GSV 627	Optimisation and Design of Geodetic Networks	2
GSV 631	Advanced Digital Photogrammetry	2

GSV 633	Applied Remote Sensing	2
GSV 641	Advanced Hydrographic Surveying	2
GSV 651	Advanced Cartography	2
GSV 671	Database Management Systems	2
GSV 673	GIS Implementation, Strategy and Procedure	2
GSV 675	3D GIS	2

SECOND SEMESTER

COURSE NO.	COURSE TITLE	UNITS
GSV 612	GNSS and Inertial Surveying	2
GSV 662	Advanced Adjustment Computations	2
GSV 680	Seminar I	2
	Electives	6
	Total	**12**

Select 6 units of Elective from the following Courses for Second Semester:

COURSE NO.	COURSE TITLE	UNITS
GSV 602	Advanced Mathematical Methods	2
GSV 614	Deformation Analysis	2
GSV 616	Advanced Engineering Surveying	2
GSV 618	Advanced Mining Surveying	2
GSV 622	Advanced Geometrical Geodesy	2
GSV 628	Global Geodetic Observation System (GGOS)	2
GSV 632	UAS Application and Data Processing	2
GSV 634	Digital Image Processing	2
GSV 642	Ocean Dynamics and Coastal Erosions	2
GSV 652	Digital Cartography	2
GSV 672	Web GIS	2
GSV 674	Advanced Land Information Management	2
GSV 676	Mobile GIS	2
GSV 678	GIS Programming	2

THIRD SEMESTER

COURSE NO.	COURSE TITLE	UNITS
GSV 681	Seminar II	2
GSV 691	Master's Project Report I	4
	Total	**6**

FOURTH SEMESTER

COURSE NO.	COURSE TITLE	UNITS
GSV 692	Master's Project Report II	8
	Total	**8**

9.0 MASTER OF GEOINFORMATICS (MGIT)

FIRST SEMESTER

COURSE NO.	COURSE TITLE	UNITS
PGC 601	Research Methodology & Application of ICT in Research	3
GSV 603	Advanced Practical Computations	2
GSV 673	GIS Implementation, strategy and procedure	2
GSV 675	3D GIS	2
	Electives	4
	Total	**13**

Select Electives of 4 Units from the following Courses for First Semester:

COURSE NO.	COURSE TITLE	UNITS
GSV 611	Advanced Land Surveying Methods & Applications	2
GSV 621	Advanced Physical Geodesy	2
GSV 623	Advanced Celestial Geodesy	2
GSV 627	Optimisation and Design of Geodetic Networks	2
GSV 631	Advanced Digital Photogrammetry	2
GSV 641	Advanced Hydrographic Surveying	2
GSV 651	Advanced Cartography	2
GSV 661	Advanced Adjustment Computations	2
GSV 671	Database Management Systems	2

SECOND SEMESTER

COURSE NO.		COURSE TITLE	UNITS
GSV	634	Digital Image Processing	2
GSV	672	Web GIS	2
GSV	674	Advanced Land Information Management	2
GSV	678	GIS Programming	2

GSV	680	Seminar I	2
		Electives	4
		Total	**14**

Select Electives of 4 Units from the following Courses for Second Semester:

COURSE NO.	COURSE TITLE	UNITS
GSV 602	Advanced Mathematical Methods	2
GSV612	GNSS and Inertial Surveying	2
GSV 614	Deformation Analysis	2
GSV 616	Advanced Engineering Surveying	2
GSV 618	Advanced Mining Surveying	2
GSV 622	Advanced Geometrical Geodesy	2
GSV 628	Global Geodetic Observation System (GGOS)	2
GSV 632	UAS Application and Data Processing	2
GSV 642	Ocean Dynamics and Coastal Erosions	2
GSV 652	Digital Cartography	2
GSV 662	Advanced Adjustment Computation	2
GSV 676	Mobile GIS	2

THIRD SEMESTER

COURSE NO.	COURSE TITLE	UNITS
GSV 607	Spatial Statistics	2
GSV 633	Advanced Remote Sensing	2
GSV 681	Seminar II	2
GSV 691	Master's Project Report I	4
	Total	**10**

FOURTH SEMESTER

COURSE NO.	COURSE TITLE	UNITS
GSV 692	Master's Project Report II	8
	Total	**8**

10.0 COURSE DESCRIPTION

PGC 601: RESEARCH METHODOLOGY AND APPLICATION OF ICT IN RESEARCH (3 units)

Definition of Research; Types of Research; Research Process: Selection of problem and Literature Review: including sources; organization; steps in conducting a review of literature and citation styles. Study of various research designs. Research Proposal & Costing. Pre-analysis of planned measurements. Methods of Data collection: Primary and Secondary data. The measurement process, blunders, systematic errors, precision, and accuracy. Statistical techniques for describing and drawing inference from research data: including frequency

distributions, bar charts and histograms; measures of central tendency, measures of variability, correlation; Hypothesis Testing.
Mathematical modelling of real life problems. Types and steps of modelling. Statistical Analysis and Interpretation of results.
The Use of ICT tools in the accomplishment of the above processes. ICT Terminologies: Hardware and Software components; Internet and World Wide Web; Web Browsers and Search utilities; Text processing and Presentation tools, ICT Research Tools.
Methods of project/dissertation writing. Theformat for presenting research results (from designing the table of contents to referencing, bibliography and appendix).
All registered Masters Degree students must attend a solution-based interactive workshop to be organized by the School of Postgraduate Studies for a practical demonstration and application of the knowledge acquired from the course, conducted by selected experts.

GSV 602: Advanced Mathematical Methods (2 Units)
Application of linear algebra and concept of vector spaces in the formulation, solution and analysis of problems in Geoinformatics and Surveying. Special characteristics of matrices including generalised inverse. Linear transformation, eigen-values and eigen-vectors, inner product spaces, orthogonal and orthonormal systems, similarity transformation and diagonalisation, bilinear and quadratic forms. Introduction to linear and non-linear programming and their application to Geoinformatics and Surveying problems.

GSV 603: Advanced Practical Computations (2 Unit)
Review of Application software suite (e.g. Ms Office, Corel Draw, Word perfect), Review Operating Systems, Utility software, Review of Programming languages (Fortran, C++, etc). Use of various application software in: Numerical analysis, (Numerical recipes, Matlab, etc); Land Surveying packages (Wolfpack, etc); Computer Aided Design and Drafting packages (AutoCAD, MicroStation, etc); GIS packages (ArcView, ArcGIS, etc); Remote Sensing and Image processing packages (IDRISI, ILWIS, Erdas Imagine, etc); The use of the computer in practical solution of various problems encountered in surveying, geodesy, photogrammetry and remote sensing, hydrography, etc.

GSV 607: Spatial Statistics (2 Unit)

Descriptive statistics and graphics. Components of Spatial Statistics: Geostatistics, Lattice data and Spatial Point Pattern, Correlation and regression, Exploratory Spatial Data Analysis, Spatial interpolation, Surface modelling, Examples and Case Studies using different software (i.e. ArcGIS, Crime Stat, etc)

GSV 611: Advanced Land Surveying Methods and Applications (3 Units)
Advanced applications of Land Surveying - Mapping control, Topographic Surveying, Cadastral system, Engineering planning and construction; Archaeology, GIS/LIS, Agriculture, Power distribution, Environmental Management, Mining and Petrochemical exploration and exploitation, Telecommunication, etc.; Cost-benefit analysis of various surveying application methods. Advanced Surveying methods in construction industry: control of vertical structures, dam monitoring, tunnelling, electrical installation and under-ground utilities. High Definition Surveying (HDS) using Leica Scan Station 2; 3D Point Cloud Processing; Use of Digital Tachometry, Digital levelling, (trigonometrical, spirit levelling), Digital theodolite, Total Stations (Leica, Sokkia, etc).
GSV 612: GNSS and Inertial Surveying (2 Units)

Concept and applications of Global Navigation Satellite System (GNSS), Operation of hand-held GPS receivers, Operation and set up of survey grade GPS receivers. Datums and coordinate transformation, Concept and applications of Inertial Navigation System (INS), instrumentation and operation systems, GPS/INS Integration.

GSV 614: Deformation Analysis (2 Units)
Review of elasticity theory of stress and strain tensors. Land and structural deformation studies: deformation of highways, bridges, and buildings. Methods of crustal deformation studies. Applications to the study of survey network strength and deformation.

GSV 616: Advanced Engineering Surveying (2 units)
Introduction to construction operations management; Construction framework formulation and analysis; Construction engineering fundamentals; Mining, tunneling and underground surveys; Project surveying management in buildings, dams, roads, railways, bridges, canals, airport obstructions.

GSV 618: Advanced Mining Surveying (2 units)
Advanced Study of mine geometry; Surface and underground mining technology;
Planning applications and appeals, mining laws and working rights; Estimation of mineral reserve; Control of drilling and blasting; Planning subsidence survey, Study of environmental effects of mines and rehabilitation of derelict land; Advanced Survey and study of oil well, oil prospecting, and underground water resources.

GSV 621: Advanced Physical Geodesy (2 units)
Fundamentals of potential theory. Study of the external gravity field and figure of the earth. Boundary value problems. Comparative study of various methods of representation of the earth's gravity potential including spherical harmonics, point masses, surface layers, gravity anomalies. Methods of evaluation of integral functions. Introduction to statistical methods in physical geodesy. Methods of Satellite altimetry, Satellite-to-Satellite Tracking (SST), and gravity gradiometer.

GSV 622: Advanced Geometrical Geodesy (2 units)
Coordinate systems for terrestrial geodesy. Coordinate transformations. Derivation of formulas used in computation on ellipsoid. Direct and inverse geodetic problems for short, medium and long lines. Geometric method for the determination of figure of the earth. Datum establishment and transformation. The theory of 3-D geodesy and its application to terrestrial network. Rigorous representation of geodetic positions on the conformal plane. The Universal Transverse Mercator Projection.

GSV 623: Advanced Celestial Geodesy (2 Units)
Short theories of precession, nutation and polar motion of the earth. Star Catalogues and their construction. Precise Latitude and Longitude and Azimuth Determination. Time determination, coordination and dissemination. Theories of the orbital motion of near earth Satellites. Geometric and dynamic applications of Satellites in Geodesy and Mapping, earth physics and ocean dynamics. Determination of station position from satellite data including the techniques of satellite Laser Ranging (SLR), Satellite-to-Satellite Tracking (SST) and satellite Altimetey. The theory and practice of Very Long Base Line Inter-ferometry (VLBI). Lunar Laser Ranging (LLR).

GSV 627: Optimisation and Design of Geodetic Networks (2 Units)
Definition and objectives of network optimisation and design including the criteria, objective (risk) functions, formulation of design problems and their solutions. Design orders: zero, first, second and third order designs. Treatment of various solution strategies including the application of generalised inverses, linear and non-linear programming, sequential least squares and computer simulation. Applications to various branches of surveying and geodesy.

GSV 628: Global Geodetic Observation System (GGOS) (2 units)
GGOS (Global Geodetic Observation System (GGOS) Goals and vision Relationships between GGOS, IAG (International Association of Geodesy) and GEOSS (Global Earth Observing System of Systems), GGOS observation systems, observation techniques, ground based infrastructure and data flow.

GSV 631: Advanced Digital Photogrammetry (2 units)
Digital camera systems, Digital imagery, Digital image processing resampling, compression and measurement, Digital aerotriangulation, Digital Orthophoto, Digital survey planning and logistics, Principles and method of digital photogrammetry, Digital survey missions: profiles and their application, Lidar Survey and data processing. Laboratory exercises include the use of softcopy photogrammetry methods to develop contour maps, digital elevation models, and digital orthophotographs from a block of photographs.

GSV 632: UAS Applications and Data Processing (2 units)
Study of various categories of Unmanned Aircraft Systems (UAS) applications for Aerial Surveying and Mapping, including applications for topographic mapping, boundary surveys, site and route planning, progress monitoring, as-built surveys, volume determination, vegetation health analysis; Flight planning and data processing for UAS

GSV 633: Applied Remote Sensing (2 units)
Digital processing of remotely sensed imageries. Feature extraction, image classification and change detection. RADAR Remote Sensing, LIDAR Remote Sensing, Applications of remote sensing technology to resource development, environmental monitoring, demography (human population studies and estimation etc), atmospheric studies, geology, hydrology, mineral exploration, renewable energy suitability analysis, agriculture etc.

GSV 634: Digital Image Processing (2 Units)
Concepts and methods of acquisition of digital imagery, Image Transform, Image Restoration, Image Compression Techniques, Colour spaces and colour image processing, Principles of digital surface modelling and applications, Satellite Image Processing

GSV 641: Advanced Hydrographic Surveying (2 units)
Application of Electronic Position Fixing Systems (EPFS). Principles and operations, choice of systems. Automation and computer application. Underwater acoustics: velocity of sound, ray theory, ray tracing, sonar equation. Sonar system: principles of acoustic transponder, long base line, short base line, super short base line, GPS Intelligent Buoys. Ellipsoidal referenced bathymetry, integrated acoustic systems.

GSV 642: Ocean Dynamics and Coastal Erosion (2 units)
Tides: Harmonic analysis for long period observations: Fourier Series and Least Squares method. Tidal prediction. Study of ocean waves. Influence of waves and tides on coastal erosion. Realisation of national and International vertical geodetic datum. Comparative study of methods of monitoring, analysis and control of coastal erosion.

GSV 651: Advanced Cartography (2 units)
Review of fundamental elements of cartography. Electronic displays: screen display formats, colours, codes. Integration of electronic maps: scale, datum, projection, coordinate system, reliability etc, Web cartography. Desk top cartography.

GSV 652: Digital Cartography
Analog vs Digital Cartography, Data entry for spatial data, attribute mapping, data collection and representation, limits and boundaries. Encoding of data. Data storage formats. The data highway. Data recovery from digital system. Data updating.

GSV 661:Advanced Adjustment Computations (2 units)
Mathematical Basis for adjustment calculus. Choice of mathematical models; observation equations, condition equations, mixed models. Adjustment with functional constraints, generalized and sequential least squares solution of hybrid data. Least squares collocation and filtering methods. Application of Normal distribution, minimum variance, unbiased estimation, central limit theorem, multivariate normal distribution. Statistical analysis. Helmert blocking techniques.

GSV 671: Database Management Systems (2 units)
Data modeling: definition, purpose, components, methodology of raster and vector data models. Database design: Conceptual data modeling: tessellation, vector and object oriented. Logical data modeling, Data structure: relational, geo-relational, object oriented, object-relational, deductive. Physical design: Data entry, compatibility with GIS software. Database creation and maintenance; Data accessibility and updating; Database query and manipulation; Producing implementation details and exercises using Microsoft Access, Microsoft SQL Server, MySQL, Postgre SQL, ArcGIS, QGIS, etc.

GSV 672: Web GIS (3 units)

Web GIS Basic Architecture and Components, Web contents functions and Interfaces, Mashup implementation and design, Cloud GIS, Geospatial Web service basics, Volunteered Geographic Information Web-based data editing, Web GIS applications in E-Business, E-Government, etc

GSV 673: GIS Implementation, Strategy and Procedure (3 units)
User needs definition and GIS product requirements, requirement analysis and feasibility evaluation, developing a workable solution and implementation plan, system implementation, system design, database design, system installation, Data Integration. Field Data capture Data verification. GIS updating. GIS design and analysis. GIS Case studies. Implementation details and exercises using ArcGIS, QGIS, etc. GIS legal issues, access to data, and cost; Economic evaluation of GIS, cost benefit analysis,

GSV 674: Advanced Land Information Management (2 units)

Concept of a multipurpose cadastre; Land Information Systems; cadastral database design and implementation; framework for spatial data presentation; Integrated Surveys. Digital Mapping, Land Tenure Systems, Land Registration, Principles of Land Administration and Economy. Building of Cadastral Information System: GIS Application in Environmental management. Economic and Institutional concern. Cost benefits analysis on land Information Systems.

GSV 675: 3D GIS (2 Units)
Introduction to 3D models, Representation of Digital Surfaces (DEM, TIN, GRID, etc), Spatial interpolation, 3D Model Classification (small scale, medium scale, large scale).
Model Creation and Editing: City Model Creation Workflow, Lidar DSM and DTM, Texturing; 3D GIS Storage formats; 3D Model Visualization: 3D Maps from LIDAR data; GNSS data; Terrestrial Laser Scanner data, and GPS measurements. Software: Google Building Maker,Google Sketch up, ArcGIS 3D Analys, SURFER Suites, AutoCAD. 3D Model Exploitation: Flood Simulation, City 3D land Use Model, Existing and proposed building, Shadow Analysis

GSV 676: Mobile GIS (2 Units)
Basics of mobile application development and deployment process, jQuery and jQuery Mobile architecture, Building of mobile web apps using HTML5, JavaScript, CSS3 and jQuery Mobile, Building of mobile web maps with ArcGIS Online Mobile, Google Maps, and Leaflet. ArcPad Data Collection, ArcPad Customization, other software implementation

GSV 678: GIS Programming (2 units)
General introduction to programming language and other techniques for modeling with GIS-related applications: fundamental data structures and algorithms, geospatial data manipulation and processing, and database management. GIS application development with hands-on experience with appropriate software

GSV 680: Seminar I (2 Units)
First seminar on the student's area of research work which must include a proposal for the Master's research project. The Departmental Postgraduate Committee must approve the topic

GSV 681: Seminar II (2 Units)
Second seminar on the student's area of research work which must include a presentation of results of the Master's research project

GSV 691: Master's Project Report I(4 units)
The Master's project report I serves as the initial research report. This report must be written in good English and should demonstrate the candidate's mastery of his/her field of specialisation and literature review of chosen theme of research.

GSV 692: Master's Project Report II (8 units)
The Master's research project report serves as the final research report. The final report which must be written in good English, should demonstrate the candidate's mastery of his/her chosen research topic, research methodology, analysis, interpretation and presentation of results of research

11.0 PHD PROGRAMME

11.1Doctor of Philosophy (PhD) in Geoinformatics and Surveying

All PhD candidates would be required to take minimum of 30 units of which 12 units are for the thesis, 12 units for the coursework including a 3 unit Course on Research Grant Writing

and Synopsis Writing, 6 units for two seminars, one presented as Research Proposal at the beginning of the student's research programme and the other, at the end of the research work before the final defence. All doctoral coursework should include book and/or journal article reviews. All Doctoral students are expected to pass the Course on Research Grant Writing and Synopsis Writing leading to extension of network of research collaboration and mentorship. This shall include a Workshop to be organized by SPGS which issues a Certificate of Participation (without which the result shall be incomplete).

11.2 PhD PROGRAMME: COURSE STRUCTURE

YEAR 1: 1ST SEMESTER

CODE	TITLE	CREDIT UNITS
PGC 701	Synopsis and Grant Writing	3
	Specialties/Electives	3
	Total	**6**

Select 3 units of Electives from the following Courses for First Semester:

Courses	Units
GSV 721: Environmental Geodesy I	3
GSV 723: Advanced Global Geodetic Observation System	3
GSV 725: Advanced GNSS and Inertial Surveying	3
GSV 727: Local Gravity Field Determination	3
GSV 729: The Motion of the Earth	3
GSV 731: Advanced Remote Sensing and Image Analysis	3
GSV 741: Trends in Hydrographic Surveying	
GSV 751: Cartographic Mapping of the Physical Environment	3
GSV 753: Typography and Lettering the Map	
GSV 771: Advanced Geographic Information System	3

YEAR 1: 2ND SEMESTER

CODE	TITLE	CREDIT UNITS
	Specialties/Electives	6
	Total	**6**

Select 6 units of Electives from the following Courses for Second Semester:

Courses	Units
GSV 722: Environmental Geodesy II	3
GSV 724: Gravimetric Satellite Geodesy	3
GSV 726: Modern Space Geodesy Techniques	3
GSV 728: Advanced Optimization and design of Geodetic Network	3
GSV 732: Digital Terrain Analysis	3
GSV 734: Remote Sensing Applications in Environmental Resources Mapping and Modelling	3
GSV 742: Ocean Dynamics and Sedimentation	
GSV 752: Advanced Thematic Mapping	3
GSV 754: Atlas Cartography	
GSV 772: GIS Modelling and Analysis	3
GSV 774: Advanced GIS Programming	3

YEAR 2: 1ST SEMESTER

CODE	TITLE	CREDIT UNITS
GSV 781	PhD Seminar I	3
	Total	**3**

YEAR 2: 2ND SEMESTER

CODE	TITLE	CREDIT UNITS
GSV 790	PhD Thesis I	4
	Total	**4**

YEAR 3: 1ST SEMESTER

CODE	TITLE	CREDIT UNITS
GSV 783	PhD Seminar II	3
	Total	**3**

YEAR 3: 2ND SEMESTER

CODE	TITLE	CREDIT UNITS
GSV 792	PhD Thesis II	8
	Total	**8**

11.2 PhD PROGRAMME: COURSE DESCRIPTION

PGC 701: SYNOPSIS AND GRANT WRITING (3 units)

Identification of University of Nigeria synopsis structure and requirements, (Introduction, Methodology and Results). Determining the content of each sub-unit of the synopsis. Steps

in writing of synopsis from the Dissertation/Thesis document, Structural and language issues. Common errors in synopsis writing and strategies for avoiding them,. The roles of the student and the supervisor in the production of a synopsis. Writing of mock synopsis.

Identification of types and nature of grant and grant writing; mining of grants application calls on the internet. Determining appropriate strategy for each grant application. Study of various grant application structures and contents and writing of concept notes, detailed project description, budgeting and budget defense. Study of sample grant writings in various forms and writing of mock research and other grants.

All registered PhD students must attend a solution-based interactive workshop to be organised by the School of Postgraduate Studies for a practical demonstration and application of the knowledge acquired from the course, conducted by selected experts.

GSV 721: Environmental Geodesy I (3 units)
Review of basic geodesy principles: Review of the three distinct pillars of geodesy and emerging new applications; Geodetic reference systems and frames (Terrestrial and Celestial systems); Changes in Earth's shape; Earth's rotation; Observation techniques: Observing point motion and maintaining global geodetic reference frames with VLBI, SLR, LLR, GNSS, DORIS; Observing surface displacements with imaging geodesy using Satellite altimetry, In SAR, LIDAR, GNSS reflectometry; Observing the Earth gravity field from space with CHAMP, GRACE, GOCE; Observing gravity changes on the Earth's surface using absolute and cryogenic gravimeters.

GSV 722: Environmental Geodesy II (3 units)
Surface displacements and their relation to tectonic strain, temporal changes in strain rates, co-seismic, pre-seismic and post-seismic deformations. Surface displacements associated with hydrological, cryospheric, oceanic, and atmospheric loading.
Observation of sea level changes. Geodetic observations and numerical weather forecast, climatology, space weather, Tsunami early warning, atmospheric /ionospheric seismology, earthquakes and LOD, Hydrogeodesy: Monitoring the global water cycle with geodetic observations.

GSV 723: Advanced Global Geodetic Observation System (3 units)
Physics of the solid Earth; the Cryosphere; Ocean processes ; Weather and Climate processes ; Sea level change; the hydrological cycle ; Rotation of the earth and geophysical fluids. Roles of GGOS in : Navigation; Engineering , surveying and mapping ; Timing applications; Early warning and emergency management ; Management of and access to natural resources; management of Natural hazards; Climate change; Energy resources; Monitoring the environment and improving predictability; Terrestrial, coastal and marine ecosystem.

GSV 724: Gravimetric Satellite Geodesy (3units)
Review of Classical Mechanics: Equations of motion; generalized coordinates; Lagrangian equations of motion; Canonic equations of motion. Close Satellite Orbits; Basics of Celestial Mechanics; Gravitational potential of the earth. Perturbations;
Determination of the Earth Gravity Field Characteristics; Evaluation of recent Satellite (Gravity) missions and their products (CHAMP, GRACE, GOCE, ALTIMETRY);

GSV 725: Advanced GNSS and Inertial Surveying (3units)
Review of GNSS basic concepts; trends and applications in GNSS technology: GNSS in surveying and geodesy (e.g., RTK, PPP and CORS networks); GNSS in remote sensing (e.g., meteorology, reflectometry, ionospheric sounding); GNSS in time determination. Basics of Inertial Navigation, Hardware and Software implementation, GNSS/INS Integration, Kalman Filtering

GSV 726: Modern Space Geodesy Techniques (3units)
Review of basic concepts of Space Geodesy;instrumentation and observing methods of Space Geodetic Techniques: VLBI, SLR, LLR, GNSS, DORIS, Satellite Altımetry;Data Extraction; Combination of Space Geodetic Techniques and products; Ground-based infrastructure; Applications in resource management

GSV 727: Local Gravity Field Determination (3units)
Study of various methods of estimating the anomalous potential of the Earth's gravity field or its derivatives. Detailed study of various approximation and interpolation techniques including the use of the higher degree spherical harmonics. The least squares collocation, buried masses, cubic spline functions, Fast Fourier Transform (FFT) and other methods of finite elements. Construction of local covariance functions of anomalous potential and applications to Nigerian data. The treatment of the influence of topography. Correlations between the anomalous potential and anomalous crustal mass distribution.

GSV 728: Advanced Optimization and design of Geodetic Network (3units)
Definition of geodetic datum, terrestrial coordinate systems, datum shift and network orientation; Definition and objectives of network optimisation and design including the criteria, objective (risk) functions, formulation of design problems and their solutions. Design orders: zero, first, second and third order designs. Treatment of various solution strategies including the application of generalised inverses, linear and non-linear programming, sequential least squares and computer simulation. Statistical analysis of a geodetic network. Applications to Deformation Analysis; Global and regional geodetic networks; and other branches of surveying and geodesy.

GSV 729: The Motion of the Earth (3units)
Rigorous derivation of the dynamical theories of the forced motions of the earth around its centre of mass (diurnal rotation, precession and nutation) based on the concepts of the earth as a rigid body, an elastic body, and so forth. Free and other motions of the earth including the problems of the polar motion, secular declination, seasonal, periodic and irregular variations of the earth's rotation. Concepts in geodetic reference systems and their applications to the solution of problems of geodesy and geo-dynamics. A study of the observational systems for the realisation of the motions of the earth.

GSV 731: Advanced Remote Sensing and Image Analysis (3units)
The course will introduce advanced methods of remote sensing and image analysis for geosciences with special emphasis to the research themes of current Remote Sensing Research Group. Themes to be considered may include: advanced computer analysis of digital satellite and airborne data (optical, infrared and radar), advanced image classification methods, texture analysis, change detection, automatic linear feature

extraction, structural pattern recognition and Remote Sensing applications. Remote sensing software (Erdas Imagine, ILWIS, ArcGIS, QGIS) will be used.

GSV 732: Digital Terrain Analysis (3units)
Theory and methods of the generation, compilation, analysis, and applications of digital elevation data; GIS terrain data models; photogrammetry and LiDAR DEM processing; terrain surface modeling; digital terrain analysis; terrain visualization, and watershed delineation. Computer exercises in thegeneration and processing of DEM using GIS and image processing software packages including ArcMap, ArcGIS 3D Analyst, ArcScene, Erdas Imagine and ILWIS.

GSV 734: Remote Sensing Applications in Environmental Resources Mapping and Modeling (3units)
Overview of remote sensing in environmental studies/modelling; Sturdy of varios cases: Urban Mapping Applications; Hydrological Applications; Soil water and drought monitoring for early-warning applications; applications in early warning for food security; mineral exploration applications; agricultural farms monitoring; vegetation mapping and monitoring; mapping of suitable sites for renewable energy exploration

GSV 741: Trends in Hydrographic Surveying (3 units).
Mean Sea level: classification and computation, Satellite altimetry. Multibeam Echo sounders, Ellipsoidal referenced bathymetry, bathymetry from air and space borne sensors, Airborne Laser Swath Sounder (LIDAR) and application in coastal zone mapping. Side Scan Sonar; Under water sensors.

GSV 742:Ocean Dynamics and Sedimentation (3units)
Ocean Waves-surface and internal waves. Mordern wave measurement techniques. Renewable energy from waves. Currents: tidal currents, wind driven and density driven currents.. Sediment transport: measurement and analysis.

GSV 751: Cartographic Mapping of the Physical Environment (3units)
Mapping of the physical environment: classification of maps of the physical environment; climatic mapping; geological mapping; geomorphological mapping; hydrological mapping/wetlands; pedological mapping; vegetation mapping, etc

GSV 752: Advanced Thematic Mapping (3units)
Basic principles of thematic mapping; advanced thematic mapping: base maps for thematic maps; qualitative mapping of point, linear and area data; quantitative mapping of point, linear and area data

GSV 753: Typography and Lettering the map (3units)
History of map lettering, functions of lettering, nature of typography; elements of typographic design; lettering the map; geographic names; naming conventions;
etc.

GSV 754: Atlas Cartography (3 units)
Atlas cartography: World, International, National, etc.

GSV 771: Advanced Geographic Information System (3units)
Review of the conceptual and technical issues underlying Geographic Information Systems (GIS), including GIS data modeling, geodatabase models and structures, analytical procedures associated with spatial statistics, spatial modeling concepts and methods, and some latest developments in GIS. Students have the opportunities of designing, implementing and presenting a GIS project that takes full advantage of the advanced GIS theories and techniques to solve spatial problems chosen by students with special emphasis to the research themes of current Geospatial Research Group of the Department

GSV 772: GIS Modelling and Analysis (3units)
Basics of GIS Modelling; Finding suitable locations, Rating suitable location; Modelling paths, modelling flow; modelling interactions; Spatial Models (Cartographic models, Spatio-temporal models, Network models)

GSV 774: Advanced GIS Programming (3units)
Overview of Programming languages for GIS; Methods of creating new applications and improving productivity in GIS through computer programming, culminating in a programming project; accessing maps and data layers, querying and selecting features, updating databases, and accessing raster.

GSV 781: PhD Seminar I (3units)
First seminar on the student's area of research work which must include a proposal for the PhD Thesis

GSV 783: PhD Seminar II (3units)
Second seminar on the student's area of research work which must presented at the end of the student's research work before the final defence and must include presentation of results

GSV 790: PhD Thesis I (4units)
The PhD Thesis I consists of a detailed report of research on the candidates PhD Thesis under a supervisor. It must deal with a research problem chosen from the candidate's area of specialisation and must show familiarity with existing literature in the area of research and mastery of research methodology.

GSV 792: PhD Thesis II (8units)
In-depth analysis and thoroughly researched and original presentation of the result of the research. The thesis must make an original contribution to knowledge and be publishable. It must deal with a research problem chosen from the candidate's area of specialisation. It must show familiarity with existing literature in the area of research and mastery of research methodology and presentation of result.

GSV 0690: Project (4 units)
The student is expected to work on a well-thought-out individual project topic which requires not only application of intellectual and practical skills, but also the exercise of judgement in investigating, analysing/reviewing underpinning principles in the field of Geoinformatics and Surveying. The project should exhibit adequate understanding of design of studies, data collection, processing, analysis and presentation embodied in a project report which must be typewritten and well bound.