



**OBAFEMI AWOLOWO UNIVERSITY
ILE-IFE, NIGERIA**



**DEPARTMENT OF GEOLOGY
FACULTY OF SCIENCE**

Website:
gly.oauife.edu.ng



The Course Unit System and the Computation of Grade Point Average (CGPA)

- Definition of Terms

- (i.) **Student Workload:** This defined in terms of course units. One unit represents one hour of lecture or one hour of Tutorial or 2-4 hours of practical work per week throughout a semester. Thus for example, a course in which there are 2 hours of lectures and 1 hour of Tutorial per week is a 3 unit course.
- (ii.) **Total Number of Units (TNU):** This is the total number of course units carried by a student in a particular semester. It is the summation of the load Units on all courses carried during the semester. For example, a student who is carrying 6 courses of 3 units each has a TLU of 18 for that semester. No student shall be allowed to carry (i.e. register for) or be examined in more than 24 units in any particular semester.
- (iii.) **Cumulative Number of Units (CNU):** This is the summation of total number of units over all the semesters from the beginning to date. A student who is prone to repeating courses will finish (if he does not drop out) with a higher CNU than his non-repeating colleague and will most likely require a longer time to complete requirements for the award of degrees.
- (iv.) **Level of Performance Rating:** This is the rating of grades obtained in terms of credit points per load unit. The rating used is as follows:

Level of Performance	Rating (credit point per unit)
A = 70%-100%	5
B = 60%-69%	4
C = 50%-59%	3
D = 45%-49%	2
E = 40%-44%	1
F = 00%-39%	0

Based on the above, a student who obtained a grade of 'A' in a 4-unit course has scored 20 credit points, and one who obtained a grade of C in that course has scored 12 credit points.

- (v.) **Total Credit Points (TCP):** This is the sum of the products of the course units and rating in each course for the entire semester period. For example, consider a student who took 4 courses of 5 units each. Let's say the grade obtained in the four courses were C, B, F, and D respectively. The TCP of this student is $5 \times 3 + 5 \times 4 + 5 \times 0 + 5 \times 2 = 45$.
- (vi.) **Cumulative Credit Points (CCP):** This is the summation of Total Credit Points over all semesters from beginning to date.
- (vii.) **Grade Point Average (GPA):** This is the total credit points (TCP) divided by the total units (TNU). For example, consider the student's scores referred to above. His TCP is 45 and of course, his TNU is 20 (i.e. 4 courses at 5 units each, for the semester). The highest GPA that can be earned is 5.0 and that is when a student has earned a grade of 'A' in every course during the semester. The lowest GPA obtainable is 0.0 and this would happen if the student has F all round during the semester.
- (viii.) **Cumulative Grade Point Average (CGPA):** This is the summation of TCPs for all semesters, divided by the summation of TNUs for the said semesters. Like the GPA, CGPA obtainable ranges from 0 to 5.





- Sample Computation (example to be relevant to the Department)

Consider a student who has enrolled in a course programme designated as GLY and has just completed 2 full semesters in the University. His course programme and his GPA and CGPA could be as follows:

SEMESTER I

1	2	3	4	5	6	7	8
	L	T	P	Units	Grades	Results Credit Points	GPA/CGPA
Course Code							
BIO 101	3	0	3	3	78% (A)	3X5=15	GPA = 49/17 = 2.88
CHM 101	3	1	3	5	60% (B)	5X4=20	CCP = 49+0 = 49
MTH 101	4	1	0	5	45% (D)	5X2=10	CNU = 17+0 = 17
PHY 101	3	0	0	3	38% (F)	3X0=0	CGPA = 49/17 = 2.88
PHY 107	0	0	4	1	60% (B)	1X4=4	
				17 (TNU)		49 (TCP)	In this case the TCP, TNU, and GPA will be the same for CCP, CNU and CGPA

SEMESTER II

1	2	3	4	5	6	7	8
	L	T	P	Units	Grades	Results Credit Points	GPA/CGPA
Course Code							
CHM 102	3	1	3	5	66% (B)	5X3=15	GPA = 63/18 = 3.50
PHY 102	3	0	0	3	72% (A)	3X5=15	CCP = 63+49 = 112
PHY 108	0	0	4	1	47% (D)	2X1=2	CNU = 18+17 = 35
MTH 102	4	1	0	5	53% (C)	5X3=15	CGPA = 112/35 = 3.20
ZOO 102	3	1	2	4	60% (B)	4X4=16	
				18 (TNU)		63 (TCP)	

L = Lecture; T = Tutorial; P = Practical; U = Unit

First Class	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
Pass	1.00-1.49

- **Requirement for the Award of Degree**

To be eligible for the award of a degree, a candidate must satisfactorily complete a minimum number of **154 units** of course work for both the Geology and Applied Geophysics undergraduate programmes comprising the **University, Faculty and Departmental** requirements.

Students wishing to take the B.Sc. Geology degree could choose their Foundation Programme from either the **Scheme A** or the **Scheme B** options.

Students who are admitted directly into the Part Two of the programmes may be exempted from courses adjudged equivalent to the required foundation courses.





THE B. Sc. GEOLOGY PROGRAMME (COURSES)

(i) Foundation Programme (Faculty Requirements)

<i>Course Code</i>	<i>Course Title</i>	Units
MTH 101	Elementary Mathematics I	5
MTH 102	Elementary Mathematics II	5
MTH 201	Mathematical Methods I	4
MTH 202	Mathematical Methods II	4
PHY 101	General Physics I	3
PHY 102	General Physics II	3
PHY 105	Physics for Biological Sciences I	4
PHY 106	Physics for Biological Sciences II	4
PHY 107	Experimental Physics IA	1
PHY 108	Experimental Physics IB	1
*PHY 205	Introductory Modern Physics	3
PHY 207	Experimental Physics IIA	1
PHY 208	Experimental Physics IIB	1
CHM 101	Introductory Chemistry I	5
CHM 102	Introductory Chemistry II	5
BIO 101	Biology for Physical Sciences	3
BOT 101	Form and Function in Plants	4
ZOO 101	Introductory Zoology I	3
ZOO 102	Introductory Zoology II	3
ZOO 103	Experimental Zoology	1

(ii) Departmental Requirements - Compulsory Courses

<i>Course Code</i>	<i>Course Title</i>	Units
GLY 201	Introductory Geology	4
GLY 202	Invertebrate Paleontology	3
GLY 204	Introductory Map Interpretation and Geological Mapping	2
GLY 206	Mineralogy I	3
GLY 208	Environmental Geology	2
GLY 302	Metamorphic Petrology	3
GLY 303	Structural Geology	3
GLY 304	Advanced Map Interpretation	1
GLY 305	Photogeological Interpretation	1
GLY 306	Fundamentals of Hydrogeology	2
GLY 307	Sedimentary Petrology	3
GLY 308	Stratigraphic Principles and Interpretations	2
GLY 310	Principles of Geochronology and Isotope Geochemistry	1
GLY 312	Fundamentals of Geochemistry	2
GLY 314	Introductory Geostatistics	2
GLY 403	Igneous Petrology	3
GLY 405	Geology of Nigeria	2
GLY 409	Engineering Geology	2
GLY 411	Global Tectonics	2
GLY 413	Advanced Mapping Techniques	1
GLY 414	Independent Mapping Exercise	3
GLY 415	Petroleum Geology	3
GLY 416	Seminar	1
GLY 417	Economic Geology	3
GLY 421/422	Honours Thesis	6
GLY 424	Marine Geology	2
AGP 303	Introductory Exploration geophysics	3
CVE 301	Surveying I	3
CHM 201	Basic Inorganic Chemistry	4
CHM 203	Basic Physical Chemistry	4
CHM 205	Experimental Physical/Inorganic Chemistry	1
CSC 201	Computer Programming	3
CSC 208	Computer Technology	2



**(iii) Departmental Requirements - Restricted Electives**

<i>Course Code</i>	<i>Course Title</i>	<i>Units</i>
GLY 301	Mineralogy II	3
GLY 401	Paleoecology	1
GLY 402	Micropaleontology	3
GLY 404	Quaternary Geology	2
GLY 406	Structural Petrology	2
GLY 407	Techniques of Hydrogeology	2
GLY 408	Sedimentary Basins of Africa	1
GLY 410	Precambrian Geology of Africa	1
GLY 412	Mining Geology	2
GLY 418	Special Topics	1
GLY 419	Applied Geochemistry	2
GLY 423	Historical Geology	1
GLY 424	Marine Geology	2
BOT 102	Introductory Ecology	2
BOT 201	Form and Function in Plants II	3
BOT 202	Biometry	3
BOT 304	Systematics of Non-Flowering Plants	3
CHM 202	Basic Organic Chemistry	4
CHM 206	Experimental Organic Chemistry	1
CHM 301	Instrumentation and Analytical Chemistry I	2
CHM 302	Structural and Main Group Inorganic Chemistry	4
CHM 313	Instrumentation and Analytical Chemistry II	2
PHY 202	Introduction to Environmental Physics	3
MTH 301	Functions of a Complex Variable	2
ZOO 201	Principles of Animal Systematics	3

<i>SUMMARY (Geology Programme)</i>	<i>Scheme A (Units)</i>	<i>Scheme B (Units)</i>
Foundation Requirements	44	41
Departmental Requirements (Compulsory Courses)	80	79
Departmental Requirements (Restricted Electives)	14	18
Special Electives	12	12
Free Electives	4	4
TOTAL	154	154





B. Sc. APPLIED GEOPHYSICS PROGRAMME (COURSES)

(i) Foundation Programme (Faculty Requirements)

<i>Course Code</i>	<i>Course Title</i>	Units
MTH 101	Elementary Mathematics I	5
MTH 102	Elementary Mathematics II	5
MTH 201	Mathematical Methods I	4
MTH 202	Mathematical Methods II	4
PHY 101	General Physics I	3
PHY 102	General Physics II	3
PHY 107	Experimental Physics IA	1
PHY 108	Experimental Physics IB	1
PHY 204	Introductory Modern Physics	3
PHY 207	Experimental Physics IIA	1
PHY 208	Experimental Physics IIB	1
CHM 101	Introductory Chemistry I	5
CHM 102	Introductory Chemistry II	5
BIO 101	Biology for Physical Sciences	3

(ii) Departmental Courses - Compulsory Courses

<i>Course Code</i>	<i>Course Title</i>	Units
GLY 201	Introductory Geology	4
GLY 204	Introductory Map Interpretation and Geological Mapping	2
GLY 206	Mineralogy I	3
GLY 302	Metamorphic Petrology	3
GLY 303	Structural Geology	3
GLY 305	Photogeological Interpretation	1
GLY 306	Fundamentals of Hydrogeology	2
GLY 307	Sedimentary Petrology	3
GLY 312	Fundamentals of Geochemistry	2
GLY 405	Geology of Nigeria	2
GLY 409	Engineering Geology	2
GLY 413	Advanced Mapping Techniques	1
GLY 415	Petroleum Geology	3
GLY 417	Economic Geology	3
CVE 301	Surveying I	3
CSC 201	Computer Programming	3
CSC 208	Computer Technology	2
AGP 301	Physics of the Earth	2
AGP 302	Magnetic Methods in Prospecting	3
AGP 303	Introductory Exploration Geophysics	3
AGP 304	Gravity Methods in Prospecting	3
AGP 306	Electrical Methods in Prospecting	3
AGP 401	Seismic Methods in Prospecting	4
AGP 402	Engineering Geophysics	2
AGP 403	Electromagnetic Methods in Prospecting	3
AGP 404	Groundwater / Environmental Geophysics	2
AGP 405	Geophysical Well Logging	2
AGP 406	Geothermal Exploration	2
AGP 407	Radiometric Methods in Prospecting	1
AGP 408	Geophysical Field Practice	3
AGP 410	Honours Thesis	6
AGP 412	Seminar	1





(iii) Departmental Requirements - Restricted Electives

Course Code	Course Title	Units
GLY 314	Introductory Geostatistics	2
GLY 407	Techniques of Hydrogeology	2
GLY 412	Mining Geology	2
PHY 201	Classical Mechanics	3
PHY 202	Introduction to Environmental Physics	3
PHY 203	Electrical Circuits and Electronics	3
PHY 301	Mathematical Physics I	3
PHY 303	Electromagnetism I	3
PHY 304	Electromagnetism II	3
PHY 305	Thermodynamics and Kinetic Theory	3
PHY 306	Optics	3
MTH 301	Functions of a Complex Variable	2
MTH 302	Differential Equations	3
CSC 311	Techniques in Data Analysis	4

C. Course Contents/Description

**GLY 201 - INTRODUCTORY GEOLOGY
3-0-3 (4 UNITS) HARMATTAN SEMESTER**

The solar system; Fundamentals of plate tectonics; Physics of the Earth; Elementary crystallography, silicate structure; Properties of minerals and rocks; Economic minerals; Surface Processes; downslope movements of surface materials; Geologic work of river, wind and ice and associated landforms. Weathering and sedimentary rocks, igneous activity and igneous rocks, metamorphism and metamorphic rocks; Geologic structures; Principles of historical geology; Fossils, introduction of stratigraphy and dating of rocks; Geologic Time Scale; Groundwater; A one-week field trip to Sedimentary and Basement Complex localities.

**GLY 202 - INVERTEBRATE PALEONTOLOGY
2-0-3 (3 UNITS) RAIN SEMESTER**

Fossils, fossilization, major fossil groups; Invertebrate Paleontology, morphology, classification, geologic history and paleoecology of major invertebrate phyla.

Pre-requisites: GLY 201

**GLY 203 - GEOLOGY FOR ENGINEERS
2-0-3 (3 UNITS) HARMATTAN SEMESTER**

Elements of crystallography and crystal chemistry. Physical properties of minerals. Introduction to rock forming minerals. Identification of common minerals. Igneous processes and igneous rocks. Weathering, erosion, transportation and deposition of sediments by running water and wind. Diagenesis and formation of sedimentary rocks. Sedimentary structure. Metamorphism, Description and Identification of igneous, metamorphic and sedimentary rocks. Introduction to basic principles of stratigraphy and applied physical stratigraphy. Introduction to Structural Geology and simple geologic structures; folds, faults and other fractures. Geologic hazards; landslides, rock falls, earthquakes, volcanic activity. Basic map reading and interpretation of simple geologic maps. A one-week field trip to Sedimentary and Basement Complex localities.

**GLY 204 - INTRODUCTORY MAP INTERPRETATION AND GEOLOGIC MAPPING
0-0-6 (2 UNITS) RAIN SEMESTER**

The Interpretation of simple geological maps involving the thickness of strata and the geometrical forms of outcrops. The interpretation of one-inch geological maps and the drawing of simple geological sections. Field mapping class during week-days, several short excursions during the session.

Pre-requisites: GLY 201





GLY 206 - MINERALOGY I
2-0-3 (3 UNITS) RAIN SEMESTER

Introduction to Mineralogy, Crystals and Crystallographic system crystal symmetry and elements of symmetry, crystal forms and crystal classes. Chemical properties of minerals and principles of crystal chemistry. Ionic sizes - and coordination number. Bonding of atoms, atomic substitution and solid solution in minerals. Isomorphism, polymorphism and pseudomorphism. Classification of minerals and introduction to common rock, forming minerals and their paragenesis. Characteristic properties and propagation of light. Petrographic microscope and optical properties of common rock forming minerals. Uses of minerals. Physical properties of minerals - colour, luster, streak, cleavage, fracture, hardness, density, tenacity, habits and forms of aggregation.

Pre-requisites: GLY 201

GLY 208 - ENVIRONMENTAL GEOLOGY
1-0-3 (2 UNITS) RAIN SEMESTER

Fundamental concepts in environmental geology. Earth material and processes. Hazardous earth processes and their remedies: Flooding land slides, earthquakes, volcanic activities, coastal hazards, solids mineral resources and environmental impacts. Waste disposal systems. Geologic aspects of environmental health. Environmental Geology in the Petroleum and related Industries.

Prerequisite: GLY 201 or GLY 203

GLY 301 - MINERALOGY II
2-0-3 (3 UNITS) HARMATTAN SEMESTER

Mineral separation techniques. Methods of chemical analysis (AAS, XRF, Electron Probe) of minerals and calculation of structural formulae. Stereographic Projection and study of crystal systems. Methods in determinative mineralogy and X-ray diffraction techniques. Study of non-silicate minerals. Mineral paragenesis.

Pre-requisites: GLY 206

GLY 302 - METAMORPHIC PETROLOGY
2-0-3 (3 UNITS) RAIN SEMESTER

Definition: Scope of metamorphism. Classification of metamorphic rocks. Physico-chemical processes in metamorphism. Thermotectonic modeling. Textures of metamorphic rocks. Classical concepts in metamorphism. Contribution from Grubenman-Beck, Eskola Miyashiro, Barrow, etc. Facies and facies series. Metamorphism associated with igneous intrusions and metamorphism associated with different plate tectonic environments. Eclogites, granulites, charnockites, gneisses and migmatites. Metamorphism and crustal evolution. Study of thin sections of metamorphic rocks from the different tectonic environments.

Pre-requisites: GLY 206

GLY 303 - STRUCTURAL GEOLOGY
2-0-3 (3 UNITS) HARMATTAN SEMESTER.

Nature of Structural Geology. Stress and strain in minerals. Determination of Strain in rocks. Recognition, classification and significance of faults. Normal faults, thrusts and reverse faults; Strike-slip faults. Regional example of faults. Relation of faults strain directions. Relation of fault orientation to stress direction; Mohr-Coulomb law of failure. Anderson's theory. Exceptions to the theory. Origin of joints. Description and Geometric analysis of folds, classification of folds. Kinematics and dynamics of folding. Description of cleavage; geometric relationship of cleavage to folding; types of cleavage; significance of cleavage. Origin of cleavage in metamorphic tectonics. Description and classification of foliation; axial plane foliation, transposed foliation and fault zone foliation. Structures in sedimentary rocks: Growth Faults, Salt domes, Diapirs, etc. Description, classification, origin and Geometric analysis of lineation in tectonites. Structures in igneous bodies.





Classification of igneous bodies. Mechanism of emplacement of igneous intrusions. Gravity-controlled structures; gravity sliding in nappes. Mantle gneiss domes.

Prerequisite: GLY 204

**GLY 304 - ADVANCED MAP INTERPRETATION
0-0-3 (1 UNIT) RAIN SEMESTER**

Interpretation of geological maps of sedimentary basins and grabens, monotectonic sedimentary areas, polytectonic and polymetamorphosed sedimentary covers and basements. Drawing of cross-sections and structural maps. Writing reports on map interpretation and geological history, structural control of mineral deposits and groundwater.

Pre-requisites: GLY 204

**GLY 305 - PHOTOGEOLOGICAL INTERPRETATION
0-0-3 (1 UNIT) HARMATTAN SEMESTER**

Aerial Photography - types, stereoscopy, measuring and plotting instruments in photogeology and their procedures. The principles of interpretation - types of photogeologic studies (geomorphological, geological, etc) the factors that affect results; their identifications and interpretation. Typical examples and case histories - geomorphological and geological illustrations. The uses of photogeology in reconnaissance mapping, economic mineral prospecting and water resources.

**GLY 306 - FUNDAMENTALS OF HYDROGEOLOGY
1-0-3 (2 UNITS) RAIN SEMESTER**

History and scope of hydrogeology. Hydrologic cycle and origin of groundwater. Occurrence of groundwater under different geologic conditions. Hydrologic processes, variable and water budget. Analysis of hydrographs. Basic physical and chemical properties of water and porous media affecting groundwater flow. Elementary theory of groundwater flow; Darcy's law, hydraulic conductivity, transmissivity of aquifers, continuity, continuity equations of groundwater flow for confined, unconfined and leaky aquifer systems. Well hydraulics and estimation of aquifer parameters. Groundwater maps and flow nets. Methods of groundwater exploration and development in different geologic terrains. Water-well drilling techniques. Quality of water, radiochemistry and microbiological quality of groundwater. Presentation and interpretation of result of chemical analyses. Groundwater quality standards, pollution and groundwater quality protection strategies. Groundwater in Nigeria.

Pre-requisites: GLY 204

**GLY 307 - SEDIMENTARY PETROLOGY
2-0-3 (3 UNITS) HARMATTAN SEMESTER**

Weathering, transportation and deposition of particles: Entertainment and settling. Textures or clastic sediments, concepts of size, grade scales, methods of size analysis. Grain distribution and interpretation. Shape roundness fabric and surface texture of classics grains. Porosity and permeability. Non - clastics materials; transport and deposition. Composition and classification of sedimentary rocks, minerals in sedimentary rocks primary rocks (primary, secondary, detrital and authigenic). Microscope studies of heavy minerals fractions. Sedimentary structures; study of diagnostic processes; common sedimentary rocks.

Pre-requisites: GLY 206

**GLY 308 - STRATIGRAPHIC PRINCIPLES AND INTERPRETATION
2-0-0 (2 UNITS) RAIN SEMESTER**

Principles of stratigraphy. Review of development of modern stratigraphy, stratigraphic classification, definition and scope of sedimentary environments; basic tools of environmental analysis, classification of depositional environments, facies concepts and models, facies association,





discussion on continental, transitional and marine environments using examples. Sequence Stratigraphy.

Pre-requisite: GLY 307

**GLY 310 - PRINCIPLES OF GEOCHRONOLOGY AND ISOTOPE GEOCHEMISTRY
1-0-0 (1 UNIT) RAIN SEMESTER**

Principles of Geochronology. Methods of radiometric dating. Stable Isotopes. Data Interpretations.

Pre-requisites: GLY 201, CHM 101, CHM 102

**GLY 312 - FUNDAMENTAL OF GEOCHEMISTRY
2-0-0 (2 UNITS) RAIN SEMESTER**

Definition and scope of geochemistry. Historical development of geochemistry. Elemental abundance and distribution in sun, meteorite and the earth. Structural (isomorphous, solid solutions, ionic radii/change, etc.) and thermodynamic (entropy, free energy, phase rule, etc) controls and elements during magmatic and metamorphic processes. Geochemistry of aqueous systems (chemical equilibria, chemical weathering, redox processes, minerals/rocks stability, etc), Eh-pH diagrams and their utilities. Elements distribution during sedimentary processes. The geochemical environment, dispersion, migration and the mobility of elements. The geochemical cycle.

Pre-requisites: GLY 201, CHM 101, CHM 102

**GLY 314 - INTRODUCTORY GEOSTATISTICS
1-0-3 (2 UNITS) RAIN SEMESTER**

Introduction to data analysis in geology. Elementary statistics, elementary matrix algebra, least squares, etc. Geological population, population distribution, sampling distribution and statistical influence. Geological sampling, probability theory and application of probability in model building. Digital computing and geology statistical techniques of data analysis (vis: mean, chi-square, linear model, ANOVA, etc) and application in Geology.

Pre-requisites: GLY 201

**GLY 401 - PALEOECOLOGY
1-0-0 (1 UNIT) HARMATTAN SEMESTER.**

Ecology and paleoecology defined: Classification of sedimentary environments. Petroleum-bearing rocks and their paleoecology. Mode of life of organisms and organic influence on sediments. Chemical and biological factors of the environment. Association of organisms (Paleosynecology). Origin and study of fossiliferous horizons. Case study of some modern and ancient sedimentary environments.

Pre-requisite: GLY 202, GLY 308.

**GLY 402 - MICROPALAEONTOLOGY
2-0-3 (3 UNITS) RAIN SEMESTER.**

Definition of Micropaleontology and microfossils. Collection, preparation and preservation of animal and plants microfossils. Morphological classification, paleontology, paleoecology and geological history of major microfossils groups - foraminifera, ostracodes, radiolarians, silicoflagellates, diatoms, pteropods, onodonts, etc. Application of Micropaleontology in the Oil Industry. Importance of Palynology (and palynomorphs) in Applied Geology. Elementary treatment of spores, pollen grains and organic-walled microplankton (dinoflagellate cysts, acritarchs, etc.). Relationship of palynomorphs to sedimentation.

Pre-requisites: GLY 202, GLY 308.





**GLY 403 - IGNEOUS PETROLOGY
2-0-3 (3 UNITS) HARMATTAN SEMESTER**

Magma and nature of igneous rocks (textures, cooling behaviour, physical and chemical properties, mode, norm, occurrence, mineralogy). Classification and variety of igneous minerals. Sources of magma (basalts, granites, etc), plate tectonics and environments of magma generation. Rock association; layered complexes, ultramafic and ultrabasic rocks: basalts (quartz-tholeiite, dolerite association and alkali olivine basalts). Potassic rocks and Nephelinite syenites: rocks of extreme composition - nephelinites, carbonatite). Orogenic association (basalt - andesite - rhyolite association, etc and their plutonic equivalents. Older and younger granite of Nigeria.

Pre-requisites: GLY 206, GLY 312

**GLY 404 - QUATERNARY GEOLOGY
2-0-0 (2 UNITS) RAIN SEMESTER.**

World-wide geological events in Quaternary times - Classical and interglacial periods, marine transgressions and regressions. Shifting climatic belts in the tropics. Mineral deposits in Quaternary environments. Origin of man and the earliest use of rocks and minerals. Quaternary geology of West Africa with special emphasis on Nigeria.

Pre-requisites: GLY 202, GLY 308.

**GLY 405 - GEOLOGY OF NIGERIA
2-0-0 (2 UNITS) RAIN SEMESTER.**

Study of the evolution, structure and stratigraphy of the Nigerian sedimentary basins. The pre-Cambrian of Nigeria especially in the context of West Africa. Mineral deposits. A two-week excursion to the main geological units and mineral deposits of the country. The report/examination on the excursion for 40% of the final grade.

Pre-requisites: GLY 302 and GLY 307 for Geology Students and GLY 307 and GLY 310 for Geophysics Students.

**GLY 406 - STRUCTURAL PETROLOGY
1-0-3 (2 UNITS) RAIN SEMESTER**

Microtextures and microstructure of magmatic and metamorphic rocks: relationships between deformation and crystallization. Stereo - projection of mineral axes and interpretation.

Pre - requisites: GLY 302, GLY 303.

**GLY 407 - TECHNIQUES OF HYDROGEOLOGY
1-0-3 (2 UNITS) HARMATTAN SEMESTER**

Hydrogeological processes affecting ground water recharge: base-flow analysis. Aquifer models: porous and fractured media. Hydraulic principles and groundwater flow. Flow models in different aquifer systems: confined, unconfined and leaky. Well hydraulics. Pumping tests and determination of chemical transport. Chemical significance of properties and constituents in water analysis: Buffer capacity, pH, specific electrical conductance, alkalinity, and acidity, major, minor and trace constituents of water (silica, aluminium, iron, chloride, fluoride, etc.). Water criteria. Exploration techniques. Exploration techniques. Management methods.

Pre-requisites: GLY306, CHM204 / 205, MTH 201 or consent of instructor.





GLY 408 - SEDIMENTARY BASINS OF AFRICA
1-0-0 (1 UNIT) RAIN SEMESTER

Regional Phanerozoic stratigraphy of Africa with special reference to coastal and other sedimentary basins.

Pre-requisites: GLY 308

GLY 409 - ENGINEERING GEOLOGY
2-0-0 (2 UNITS) HARMATTAN SEMESTER

Soil classification, permeability of soils, permeability tests, compressibility of soils. The consolidation test. Unconfined test, shearing resistance, of resistance of soils. Triaxial compression test. Unconfined compression test. Rock as an engineering material. Stress and strain - basic principles. Stress / strain behaviour of rocks indicating deviations from ideal behaviour. Anisotropy, fluids and temperature effects, strength and failure in rocks, measurement of stress and strain in the laboratory and in the field. Geology in the solution of problems usually encountered during the design and / or construction of highways, dams foundation slopes and embankments. Excavations in the soils and rocks. Quarries and construction materials. Erosion problems.

Pre-requisites: GLY 307

GLY 410 - PRECAMBRIAN GEOLOGY OF AFRICA.
1-0-0 (1UNIT) RAIN SEMESTER

Principles of Precambrian Stratigraphy and application to major shield areas of the world. Precambrian of Nigeria in the context of West Africa. Precambrian of Africa.

Pre-requisites: GLY 302, GLY 310, GLY 403.

GLY 411 - GLOBAL TECTONICS
2-0-0 (2 UNITS) HARMATTAN SEMESTER

The solar system: Description, Characteristics, Origin and Evolution. The earth: earthquakes - effects, measurements and wave characteristics, distribution, location, magnitude and intensity. Causes, mechanisms and control of earthquakes. The earth's gravity. Gravity anomalies. The earth's density and moments of Inertia; Isostasy.

The structure of the earth based on seismology and gravity studies. Bulk composition of the earth - The chondrite earth model and its validity. Meteorites: chemical fraction processes in the formation of meteorites. Heterogeneous and homogeneous accretion models. The origin and composition of the earth's core. The earth's magnetic field, Geomagnetism, paleomagnetism. The earth's heat, sources of the earth's heat. Oceanic, continental and global heat flow, mantle convection and evolution of the mantle. Oceanic crust, upper mantle and ophiolitic sequences. Continental crusts - composition, layering and evolution, absolute and relative plate motion. Consequences and constraints of plate boundaries. Plate tectonics and mantle convection. Causes of plate motion. Classical concepts of orogeny. Plate tectonics and orogeny.

Pre-requisites: GLY 303, GLY 312.

GLY 412 - MINING GEOLOGY
2-0-0 (2 UNITS) RAIN SEMESTER

Approaches to mining; role of geological factors in mining and mine development; Mining methods. Underground geological mapping and mine surveying; pre grade control. World mineral supply and demand; metal prices and mineral marketing; mapping legislation, mineral rights royalties, Oil Industry Mining. Environmental impact of mining.

Pre-requisite: GLY 417





**GLY 413 - ADVANCED MAPPING TECHNIQUES
(1 UNIT) END OF HARMATTAN SEMESTER**

Field mapping class at the end of the Harmattan semester. A report is to be submitted and graded along with the rain semester Examinations.

Pre-requisites: GLY 204, GLY 302, GLY 303 AND GLY 307.

**GLY 414 - INDEPENDENT MAPPING EXERCISE
2-0-3 (3 UNITS) END OF RAIN SEMESTER**

A student - independent mapping exercise lasting at least four weeks at the end of the rain semester. A report on the exercise must be written and submitted at the beginning of the following Rain Semester.

Pre-requisites: GLY 413

**GLY 415 - PETROLEUM GEOLOGY
2-0-3 (3 UNITS) HARMATTAN SEMESTER**

The origin and occurrence of petroleum. Organic matter and distribution in nature. Oil field waters; chemical and physical properties of oil and natural gas. Organic matter diagenesis and petroleum generation, Migration of Petroleum (primary and secondary). Reservoir rocks (clastics and carbonates) and porosity types. Traps-structural, stratigraphic, combination, hydrodynamics. Formation evaluation (logs and well - log analysis). Exploration methods, drilling and completion operations. The Niger Delta petroleum province.

Pre-requisites: GLY 303, GLY 307, GLY 308.

**GLY 416 - SEMINAR
(1 UNIT) 2-SEMESTER (SESSIONAL)**

One hour per week (compulsory for all geology students). Topics of importance in Geology and allied fields are discussed weekly by staff and students. Each one would be expected to prepare and deliver at least one seminar during the session. Guest speaker within and outside the University will be invited from time to time.

**GLY 417 - ECONOMIC GEOLOGY
2-0-3 (3 UNITS) HARMATTAN SEMESTER**

Principles and processes in the formation of mineral deposit. Ground preparation and ore localization. Wall-rock alteration, paragenesis and zoning in mineral deposits. Ore textures: classification and distribution of mineral deposits. Metallic mineral deposit: ferrous, ferroalloy, non-ferrous and precious metals. Non-metallic mineral deposit and their classification: Ceramic materials, structural and building materials, industrial, manufacturing, chemical and refractory minerals. Metallogenic belts and epochs. Mineral deposits of Nigeria.

Pre-requisites: GLY 206, GLY 303, GLY 312.

**GLY 418 - SPECIAL TOPICS
(1 UNIT) - 2 SEMESTERS (SESSIONAL)**

This course is designed for students who have scored a minimum of B⁺ grade in a certain course and are desirous of more in-depth knowledge in that field.

Pre-requisites: Consent of the Head of Department





**GLY 419 - APPLIED GEOCHEMISTRY
2-0-0 (2 UNITS) HARMATTAN SEMESTER**

Instrumental analysis, Principles of analytical techniques; AAS, XRD, XRF, Colorimetry, etc. Data treatment and reduction. Introduction to exploration Geochemistry. Geochemical anomalies and statistical assessment of background and threshold. Litho-geochemical, pedo-geochemical, biogeochemical, geobotanical, gaseous and stream sediments, survey techniques of mineral exploration. Introduction to Environmental Geochemistry. Processes and product of water-air and sediment-water interfaces. Organic substances in natural water. Metal-organic-sediment interactions. Some concepts in water pollution.

Pre-requisites: GLY 312

**GLY 421 / 422 HONOURS THESIS
6 UNITS - 2 - SEMESTERS (SESSIONS): 009 3 UNITS -HARMATTAN
009 3 UNITS - RAIN**

An independent research project, selected on the basis of student's interest and supervised by staff, is designed during the final year of study. The project may take the form of original research, a review, or compilation of data in any area of geology. Students are required to submit a one - page short description of the project during the first week of the semester in which the thesis is to be submitted and three copies of the thesis are due latest on the last day of lectures of the semester in which the thesis is to be examined. Assessment based on the dissertation and on performance in an oral examination.

Pre-requisites: GLY 413 and relevant courses in proposed field of study.

**GLY 423 - HISTORICAL GEOLOGY
(1 UNIT) HARMATTAN SEMESTER**

The Geological Time Scale. The Palaeozoic; Mesozoic and Cenozoic Era. Brief, treatment of the different systems; African and Nigerian examples to be cited where applicable. Emphasis will be on paleo-geography, tectonics, organic life and economic products. Pleistocene epoch as it relates to plants, animals, water bodies and the development of Man.

Pre - requisite: GLY 202

**GLY 424 - MARINE GEOLOGY
2-0-0 (2 UNITS) RAIN SEMESTER.**

The scope of Oceanography: Physical, chemical and biological aspects. Shorelines and shoreline processes. The study of the ocean floors: Continental margins, Oceanic ridges and rises, etc., major ocean basins. The origin, classification and distribution of marine sediments. Ocean resources.

Pre - requisites: GLY 307, GLY 308

**GLY 424 - MARINE GEOLOGY
2 - 0 - 0 (2 UNITS) RAIN SEMESTER.**

The scope of Oceanography: Physical, chemical and biological aspects. Shorelines and shoreline processes. The study of the ocean floors: Continental margins, Oceanic ridges and rises, etc. major ocean basins. The origin, classification and distribution of marine sediments. Petroleum and other Ocean resources.

Pre-requisites: GLY 307, GLY 308.

**AGP 301 - PHYSICS OF THE EARTH
2-0-0 (2 Units) HARMATTAN SEMESTER**

The earth in space. Geochronology and the age of the earth. Gravity and the figure of the earth. Earth's magnetic field - its morphology, temporal variations (micropulsations to reversals), history





and origin. Earthquakes - their distribution, focal mechanism, and prediction. Seismology and the planetary interior. Geothermics and Planetary.

Prerequisites: *GLY 201, MTH 201, MTH 202, PHY 204, PHY 207, PHY 208.*

AGP 302 - MAGNETIC METHOD IN PROSPECTING
2-0-3 (3 Units) RAIN SEMESTER

Basic concepts, definitions and units. Elements of Geomagnetism. Temporal variations. The magnetic properties of minerals and rocks. Magnetic prospecting instruments and magnetic survey procedures, including the correction of magnetic data, magnetic anomalies of some idealized sources and their geologic equivalents, magnetic interpretation by characteristic points, half slopes, nomograms, and polynomials. Regional, residual, derivatives and continuation. Airborne, ground and marine magnetic surveys and their applications.

Prerequisites: *GLY 201, MTH 201, MTH 202, PHY 204, PHY 207, PHY 208.*

AGP 303 - INTRODUCTORY EXPLORATION GEOPHYSICS
2-0-3 (3 Units) HARMATTAN SEMESTER

The nature and scope of geophysics and the role of geophysics in geological prospecting and exploration, principles, methods and techniques and principal applications of the gravity, magnetic, resistivity, electrochemical, electromagnetic, refraction and reflection seismic and radiometric surveys. Resolving different geological mapping mineral and hydrocarbon exploration, groundwater surveys and engineering problems using the geophysical methods.

Prerequisites: *GLY 201, MTH 201, MTH 202, PHY 204, PHY 207, PHY 208.*
Geology students require only GLY 201 as Prerequisite.

AGP 304 - GRAVITY METHODS IN PROSPECTING
2-0-3 (3 Units) RAIN SEMESTER

Basic definitions and units. Variations of earth's gravity field with latitude and elevation. Mineral and rock densities. Gravity prospecting instruments, fluids operations and reductions. Gravity anomalies of some idealized sources and their geologic equivalents. Simplified methods of rapid gravity interpretation. Regional, residual derivatives and continuation. Ground, marine and airborne gravity surveys and some case histories of gravity surveys.

Prerequisites: *GLY 201, MTH 201, MTH 202, PHY 204, PHY 207, PHY 208.*

AGP 306 - ELECTRICAL METHODS IN PROSPECTING
2-0-3 (3 Units) RAIN SEMESTER

Electric conduction and the electrical properties of earth materials. Electrical resistivity prospecting - electrode arrays; and apparent resistivity formulae: profiling and sounding, interpretation of resistivity data; geological problems amenable to resistivity investigation; some case histories. The self potential (SP) method - origin, measurement interpretation and examples. The induced polarization (IP) method - phenomenon of IP in ore bearing rocks and sediment; time and frequency domain measurements; pseudo-sections; geological applications and some case histories.

Prerequisites: *GLY 201, MTH 201, MTH 202, PHY 204, PHY 207, PHY 208.*

AGP 401 - SEISMIC METHODS IN PROSPECTING
3-0-3 (4 Units) HARMATTAN SEMESTER

Seismic wave propagation in an elastic medium. Elastic properties of rocks. Principles of refraction and reflection seismic in horizontal and inclined single and multiple interfaces. Seismic prospecting instrumentation and field procedures. Simple methods of interval velocity determination. Variable velocities, wave fronts and ray paths. Elements of seismic data processing - migration, deconvolution etc. introduction to vertical seismic profiling and seismic stratigraphy. Some direct seismic signals in





hydrocarbon search (e.g. velocity sag, Vp/Vs ratio, bright and flat spots). Use of seismic methods in geological prospecting and exploration and in solving simple engineering problems.

Prerequisites: GLY 201, MTH 201, MTH 202, PHY 204, PHY 207, PHY 208.

AGP 402 - ENGINEERING GEOPHYSICS
2-0-0 (2 Units) RAIN SEMESTER

Geophysical methods in engineering site investigations: foundation studies, highway routes, oil pipeline route, dam sites investigation etc. determination of soil/Bedrock engineering characteristics - nature of soil/bedrock, soil corrosivity, depth to bedrock (or overburden thickness), formation parameters (porosity, permeability, etc.), dynamic elastic constants, rock quality designation (RQD) and fracture frequency (FF), bedrock structural disposition. Location of construction materials, mineral resource (metallic, non - metallic, quarry) evaluating (disposition and quantification) and strategy for mode of mining. Location of disused mine shafts, buried cables, land mines, capsized submarines/ships, etc. case Histories

Prerequisites: GLY 201, MTH 201, MTH 202, PHY 204, PHY 207, PHY 208.

AGP 403 - ELECTROMAGNETIC METHODS IN PROSPECTING
2-0-3 (3 Units) HARMATTAN SEMESTER

Elementary theory - description of electromagnetic fields, combination of E>M fields, amplitude and phase relations. Ground electromagnetic methods (principles, field practice and data interpretation). Tilt angle, turam, horizontal loop systems, and VLF, AFMAG, Telluric and magnetotelluric methods. Airborne electromagnetic methods, their principles and practices - Rotary - m fields, AFMAG, VLF, transient (INPUT) methods Quadrature, long wire systems. Applications of electromagnetic methods in mineral prospecting, geological mapping and groundwater investigation. Case histories.

Prerequisites: GLY 201, MTH 201, MTH 202, PHY 204, PHY 207, PHY 208.

AGP 404 - GROUNDWATER / ENVIRONMENTAL GEOPHYSICS
2-0-0 (2 Units) RAIN SEMESTER

Application of geophysical methods in groundwater and environmental pollution studies. Direct and indirect investigation techniques. Aquifer identification and delineation in typical basement complex and sedimentary areas. Mapping of geological structures favorable to groundwater accumulation, determination of aquifer parameters, porosity and its mapping. Groundwater quality determination, mapping of saline water zones and chemical pollution plumes. Case histories.

Prerequisites: GLY 201, MTH 201, MTH 202, PHY 204, PHY 207, PHY 208.

AGP 405 - GEOPHYSICAL WELL LOGGING
1-0-3 (2 UNITS) HARMATTAN SEMESTER

Types of geophysical well logs and information obtainable from them. Archie's Law. A general survey of the electrical Logs (S.P, resistivity - conventional and focused), induction, radiation, density and sonic methods of borehole geophysics - their applicability, advantages and limitations.

Prerequisites: GLY 201, MTH 201, MTH 202, PHY 204, PHY 207, PHY 208.

AGP 406 - GEOTHERMAL EXPLORATION
2-0-0 (2 Units) RAIN SEMESTER

Origin and nature of heat flow from the earth. Geothermal systems and their characteristics. Geophysical investigation of geothermal systems, identification and delineation of geothermal reservoirs. Geothermal resources and their uses. Description of known geothermal energy fields.

Prerequisites: GLY 201, MTH 201, MTH 202, PHY 204, PHY 207, PHY 208.





**AGP 407 - RADIOMETRIC METHODS IN PROSPECTING
1-0-0 (1 Unit) HARMATTAN SEMESTER**

Radiometric methods of geophysical prospecting, Fundamental Principles and Techniques. Interpretation and application in mineral and groundwater investigation.

**AGP 408 - GEOPHYSICAL FIELD PRACTICE
0-0-9 (VACATION COURSE) (3 UNITS)**

Independent geophysical field exercise of 4 - 6 weeks duration to be carried out during the long vacation at the end of the part three school year and to be evaluated based on the report to be submitted before the end of the first semester of the final year of study.

Pre-requisites: GLY 413

**AGP 410 - HONOURS THESIS
0-0-18 (6 Units) 2 SEMESTERS (SESSIONAL)**

An independent research project, selected on the basis of the students interest and the availability of facilities and supervised by staff. The project initiated at the beginning of the final year, takes the form of original research or a compilation and analysis of data in any branch of geophysics or in any application of geophysics in an exploration problem. Students are required to submit a one page short description of the project during the first week of the semester in which the thesis is to be submitted and three copies of the thesis is to be submitted and the three copies are due latest on the last day of lectures of the semester in which the thesis is to be examine. Assessment is based on the discretion and performance in an oral examination

Pre-requisites: AGP 408

**AGP 412 - SEMINAR
0-0-3 (1 Unit) 2 SEMESTERS (SESSIONAL)**

A seminar talk, to be given by the student during the final year on any assigned topic of geophysical interest and relevance.

THE POSTGRADUATE PROGRAMMES AND CONTENTS

1. Hydrogeology and Engineering Geology Option

GLY 600 - Geological Photo-interpretation and Photogrammetry.
GLY 601 - Soil and Rock Mechanics
GLY 602 - Advanced Engineering Geology
GLY 603 - Advanced Structural Geology
GLY 604 - Applied Hydrology
GLY 605 - Hydrogeology
GLY 606 - Applied Geophysics in Site Investigation
GLY 620 - Seminar and
GLY 621 - Special Projects.

2. Mineral Exploration Option

GLY 600 - Geological Photo-interpretation and Photogrammetry.
GLY 607 - Economic Geology / Mine Evaluation and Mineral Economics.
GLY 608 - Geophysical Methods of Mineral Prospecting
GLY 609 - Geochemical Methods of Mineral Prospecting
GLY 610 - Fundamentals of Geochemistry
GLY 612 - Advanced Mineralogy
GLY 613 - Advanced Petrology.
GLY 620 - Seminar and
GLY 621 - Special Projects.





3. Sedimentary and Petroleum Geology Option

- GLY 614 - Advanced Micropaleontology
- GLY 615 - Advanced Stratigraphy (including Sequence Stratigraphy)
- GLY 616 - Advanced Sedimentology and Sedimentary Petrology.
- GLY 617 - Subsurface Geology
- GLY 618 - Reservoir Geology and Petroleum Engineering
- GLY 619 - Petroleum Economics
- GLY 620 - Seminar and
- GLY 621 - Special Projects
- GLY 622 - Palynology
- GLY 623 - Seismic Interpretation (including Seismic Stratigraphy).

4. Hydrogeology Option

- GLY 604 - Applied Hydrology
- GLY 620 - Seminar and
- GLY 621 - Special Projects.
- GLY 625 - Well Hydraulic and Pumping Test Analysis
- GLY 626 - Water Quality
- GLY 636 - Applied Geophysics in Hydrogeological Investigations

Elective Courses

Six units of electives courses must be taken from the following elective courses:

- GLY 600 Geological photo-interpretation and Photogrammetry
- GLY 601 Soil and Rock Mechanics
- GLY 602 Advanced Engineering Geology
- GLY 603 Advanced Structural Geology
- GLY 615 Advanced Stratigraphy (including Sequence Stratigraphy)
- GLY 617 Subsurface Geology
- GLY 627 Groundwater Modeling and Case Studies
- GLY 628 Isotopic techniques in Groundwater Studies
- GLY 629 Planning and Management of Water Resource Projects
- GLY 636 Applied Geophysics in Hydrogeology Investigations

5. Applied Geophysics Option

Course Code	Description	Course units
AGP 601	Gravity and Magnetic Methods	(2+0+3) 3
AGP 602	Static and Time Varying Field Theory	(2+0+0) 2
AGP 603	Seismic Methods	(2+0+3) 3
AGP 604	Digital Computer Techniques for Geophysical Applications	(2+0+0) 2
AGP 605	Electrical and Electromagnetic Methods	(3+0+3) 4
AGP 606	Borehole Geophysics	(1+0+0) 1
AGP 607	Geophysical Field Work	1
AGP 608	Thesis	6
AGP 610	Radioactivity Methods	(2+0+0) 2
AGP 611	Physical Properties of Rocks and Minerals (Laboratory Studies)	(0+0+6) 2
AGP 612	Paleomagnetism	(2+0+0) 2
AGP 613	Modelling in Geophysical Prospecting	(1+0+3) 2
AGP 614	Advanced Data Processing	(1+0+3) 2
AGP 615	Solid Earth Geophysics	(2+0+0) 2
AGP 616	Instrumentation	(0+0+6) 2

Elective Courses (Compulsory Courses)

Course Code	Description	Course units
*AGP 430	Mathematics for Geologists	(4+0+0) 4
*AGP 431	Geology for non-geologist	(4+0+0) 3
*AGP 433	Electronic Techniques for Geophysicists	(0+0+3) 1
*AGP 432	Introduction to Geophysical Prospecting	(3+0+3) 4





* Remedial Course

Courses are to be selected according to various backgrounds in Geophysics, Geology, Physics, Mathematics, Electronic and Electrical Engineering including other Technologists.

DETAILS OF COURSES

GLY 600 - Geological Photo Interpretation and Photogrammetry Harmattan Semester 1+0+3 (2 Units)

Characteristics of air photographs and mosaics. Interpretation of geology by various techniques such as drainage pattern analysis, tonal, vegetation and geomorphological studies. Use of air photographs in applied geological studies. Map reading and topography. Binocular vision, parallaxes. Floating marks. Principles of stereophotogrammetry. Inner relative and absolute orientation. Determination of height and dips. Map making with stereoscope and parallax bar. Photogrammetry instruments. Preparation of thematic maps from aerial photographs.

GLY 601 - Soil and Rock Mechanics, Harmattan Semester 2+0+3 (3 Units) Field Trips.

Engineering classification of rock and soils. Weathering and weathering factors. Weatherability of minerals. Soil types, structures and textures in rocks and soils. Clay mineral types, structures, identification and influence on soil properties. Stress and strain in two and three dimensions. Representation of stress and strain. Theories of elasticity and plasticity. Stress fields and their measurements. Criteria of failure and yield. Classification of soils. Flow of water in soil - steady state transient conditions. Shear strength and its measurement. Limiting conditions in a semi-infinite space. Soil properties and their measurement. Earth pressures. Bearing capacity.

GLY 602 - Advanced Engineering Geology, Rain Semester 2+0+3 (3 Units) Field Trips.

Exploration of building subsoils. Open cuts and retaining walls. Foundations slopes and their stability. Engineering geological maps and their evaluation. Mining and tunneling (Theory and methods). Dams - types, design and construction. Elements of a road pavement. Site investigation in engineering practice. Rock as a construction material. Laterite soils and black cotton soils - distribution and nature, physical characteristics, chemistry and mineralogy. Structure and engineering properties. Interaction with engineering.

GLY 603 - Advanced Structural Geology, Harmattan Semester 1+0+3 (2 Units).

Stress in 2-dimensions, trajectories, Mohr diagram. Strain in 2- and 3-dimensions, progressive deformations, deformations, fabric resulting from strain. Rheology, stress-strain relations of elastic, viscous and visco-elastic materials. Geometric techniques of structural analysis. Projection techniques. Fracture analysis. Mapping techniques. Geotectonics, crustal morphology, world patterns theories of orogenesis.

GLY 604 - Applied Hydrology, Harmattan Semester 2+0+0 (2 Units)

Introduction to open channel flow - Chezy's and Manning formulae. Tubular and laminar flow. Hydrological cycle - precipitation, evapotranspiration, infiltration, runoff measurement of flow. Hydrograph analysis. Hydrological forecasting. Choice of dam sites and safety consideration of slopes. Drainage characteristics of Nigerian Rivers. Erosion problems in Nigeria.

GLY 605 - Hydrogeology, Rain Semester 2+0+3 (3 Units) Field Trips

Occurrence of groundwater, groundwater recharge as part of hydrological cycle, groundwater and well hydraulics. Exploration for groundwater - remote sensing, geological and geophysical methods. Groundwater extraction - perforation methods. Well completion, well development, pumping test. Water quality and purification. Artificial recharge of groundwater. Salt water intrusion in coastal aquifers. Problems of water resources planning and management in Nigeria.

GLY 606 - Applied Geophysics in Site Investigation, Harmattan Semester 2+0+3 (3 Units) Field Trips

Geophysical methods of investigation foundation problems. Resistivity and seismic techniques. Application of geophysics to water supply engineering, location of sewer pipes, etc.

GLY 607 - Economic Geology/Mine Evaluation and Mineral Economics, Rain Semester 4+0+0 (4 Units) Field Trips





Distribution of the ore minerals and their geochemistry. Metallogenic epochs and provinces. Mechanics of transport and accumulation of ore minerals during processes of igneous activity, metamorphism, sedimentation, weathering and erosion. Estimation of reserves. Discussion of selected examples from the main groups of mineral deposits. Historical aspects of mining and relationship to industrialization. Laws, taxation and investment. Financing a mineral investment. Mineral management and policy. Small operators and large companies. Marketing and technological problems. Price fluctuations and factors affecting them. Trend in utilization of mineral products. Conservation and the environment.

GLY 608 - Geophysical Methods in Mineral Prospecting, Rain Semester 2+0+3 (3 Units) Field Trips

The principles and practice of prospecting for mineral deposits by electrical, magnetic, electromagnetic, gravity and seismic methods. Interpretation and applications. Case histories, field demonstrations.

GLY 609 - Geochemical Methods in Mineral Prospecting, Harmattan 2+0+3 (3 Units) Field Trips

Surveying, mapping, sampling (including drilling methods), radiometric methods, semi quantitative field methods, UV-spectrum. Laboratory techniques of geochemistry. Interpretation of results, discussion of selected examples. Field demonstrations.

GLY 610 - Fundamentals of Geochemistry, Harmattan Semester 2+0+0 (2 Units)

Classification of elements. Distribution of elements in cosmic systems, meteorites lithosphere, hydrosphere, atmosphere. Geochemistry of different rock types; igneous, sedimentary, metamorphic, Weathering and soil formation.

GLY 612 - Advanced Mineralogy, Harmattan Semester 1+0+3 (2 Units)

Crystal symmetry and stability relation of rock-forming minerals. Effects of paragenesis on the chemistry of minerals. Phase relations of the major rock-forming minerals. Techniques in mineral analysis. Silicate analysis by atomic absorption spectrophotometry and/or X-ray fluorescence spectrometry. Evaluation and interpretation of chemical analytical data of minerals. Physical methods in determinative mineralogy. Universal stage methods, X-ray powder diffraction methods, density determination.

GLY 613 - Advanced Petrology, Rain Semester 2+0+0 (2 Units)

Advanced study of the evolution of igneous and metamorphic rocks with emphasis on phase equilibria. Study of selected igneous provinces. Origin and evolution of magma. Metamorphic facies and facies series. Petrochemistry and petrochemical calculations. Trace elements and their application to petrogenetic problems. Review of developments in experimental petrology. Principles of rock analysis. Application of statistical methods of petrology.

GLY 614 - Advanced Micropaleontology, 1+0+3 (2 Units) Harmattan Semester

Definition and practical value of Micropaleontology. Historical Review of Micropaleontology. Development of Commercial Micropaleontology. Physical, Chemical, and Biological factors of marine and non-marine microenvironments and their effects on microscopic organisms. Environmental distribution of microorganisms. Evolutionary and phylogenetic relationships within microorganism groups (e.g., Foraminifera, Ostracoda, Calcareous Nannofossils - particularly Coccoliths and Discoasters, Radiolarians, Diatoms, Silicoflagellates, Conodonts and Pteropoda). Ecological and Paleocological relationships of living and fossil microorganisms. Taxonomy and morphological (particularly diagnostic features) biostratigraphically and paleoecologically important taxa of Foraminifera, Ostracoda, Calcareous Nannofossils (particularly Coccoliths and Discoasters, Radiolarians, Diatoms, Silicoflagellates, Conodonts and Pteropods). Applications of Micropaleontology to high-resolution Biostratigraphy. Pale bathymetry, Paleofacies analyses, Paleocology, etc. in Oil Exploration and Production. Micropaleontological characteristics of systems tracts, condensed sections etc. Applications of Micropaleontology to other fields (e.g., Engineering Geology and Mineral Exploration).

GLY 615 - Advanced Stratigraphy (including Sequence Stratigraphy) 2+0+0 (2 Units) Harmattan Semester

Principles of Stratigraphy. Type areas and boundary problems. Correlation. Stratigraphic Nomenclature. Biostratigraphy and biostratigraphic refinements with emphases on African (including Nigerian) examples. Sequence Stratigraphy: Definitions of sequences, systems tracts, parasequences,





parasequence sets etc. and various surfaces. Integrating seismic, well log, and high-resolution biostratigraphic and paleoenvironmental data in Sequence Stratigraphy. Applications of Sequence Stratigraphy in Petroleum Exploration and Production. The Niger Delta.

GLY 616 - Advanced Sedimentology and Sedimentary Petrology 2+0+3 (3 Units) Rain Semester

Origin of Sediments. Mode of transportation and deposition of Sediments. Texture of clastic sediments - surface textures, size, shape, porosity, permeability etc. Lithification and Diagenesis. Composition of sedimentary rocks. Sedimentary Structures. Heavy mineral analysis and provenance studies. Preparation of thin sections, grain mounts, and staining techniques. Identification, classification, and origin of sedimentary rocks. Carbonate rocks: petrology, microfacies, cathodoluminescence, etc. Carbonate reservoir rocks. Petrophysical characteristics of sedimentary rocks. Sedimentology and sedimentary petrology of petroleum reservoir rocks. Sedimentology in Sequence Stratigraphy: Sedimentological characteristics of Lowstand, Transgressive, and Highstand Systems Tracts and Condensed Sections.

GLY 617 - Subsurface Geology 2+0+3 (3 Units) Rain Semester

Subsurface maps: Choice of datum horizon, contour interval, construction, interpretation and uses. Electrical Log cross-sections and qualitative interpretation of Electrical Log diagrams. Criteria for identifying subsurface faulting. Basin analysis: Basins in their plate tectonic environment. The lithosphere's physical state. Basins due to lithospheric stretching and to flexure. Effects of mantle dynamics. Basins associated with strike-slip deformation. Sediment routing systems. Basin stratigraphy. Subsidence and thermal history. The petroleum play.

GLY 618 - Reservoir Geology and Petroleum Engineering 2+0+3 (3 Units) Rain Semester

Clastic reservoir rocks and porosity types. Oil Field waters and subsurface pressures. Operations related to drilling and completing a well - coring and sidewall sampling, casing, drilling time and drill stem tests. Geological Factors affecting choice of techniques and completion operations. Fundamentals of fluid-permeated rocks. Porosity and permeability. Darcy's Equation. Pressure - Volume - Temperature relationship and use. Condensate reservoir. Mechanisms controlling oil production. Calculation of Oil and Gas in place (including material balance techniques).

GLY 619 - Petroleum Economics 2+0+2 (2 Units) Rain Semester

The Global distribution of petroleum. World oil and energy crisis. Current world situation of the Oil Industry. The Giant Petroleum Companies. Capital budgeting decision. Objectives of the Firm. Characteristics of Natural Resources. Need for Economic Analysis. Economic evaluation - Nomenclature, Utilization, Equity. Economic evaluation techniques: Time value of money and interest calculations, discounted cash flow method, Rate of return and present value, taxes inflation, Profitability criteria. Application to Oil and Gas Exploration and Production. Net value of produced oil and gas. Acceleration projects. Tax shelters. Introducing probability and statistics to the oil industry: Events and random variables, Expected values etc. Decision trees and executed monetary value. Utility theory and its applications: Subjective value of money, Relationship of Utility and monetary value. Expected utility value.

GLY 620 - Seminar Rain and Harmattan Semesters

Important topics in applied geology will be discussed by staff and students in weekly seminars. Each student will be required to prepare and deliver at least one seminar during the year. Seminars may also take the form of group discussion of a common subject or be related to special projects. Assessment will be based on comprehension of subject matter, coherence and depth of presentation as well as participation in the group discussion.

GLY 621 - Special Projects

An independent research project selected on the basis of student interest, supervised by staff will be assigned toward the end of the rain semester. Generally, such project will require several weeks of independent field and/or laboratory work and analysis of data collected. The project will thus take the form of an original research. Reviews or extensive compilation of data may also be accepted depending on the content. The completed dissertation must be submitted in conformity with the regulation of the Graduate Studies Committee.

GLY 622 - Palynology, 1+0+3 (3 Units) Harmattan Semester

Definition of Palynology and some palynological terms. General survey of palynological representatives of the plant and animal kingdoms. Morphological (sculptural and structural)





considerations of pollen and spores. Systematics and nomenclature in palynology. Relationship of deposition and preservation of palynomorphs to sedimentary processes. Sample reliability in relation to palynological analyses. Dinoflagellate cysts, acritarchs, tasmanitids and other organisms commonly found in palynological preparations. Paleocological significance of palynomorphs. General considerations of palynomorphs from different geological periods with special emphasis on Cretaceous, Tertiary and Quaternary assemblages. Palynology in Sequence Stratigraphy: Palynological characteristics of Lowstand, Transgressive, and Highstand Systems Tracts, Condensed Sections and Maximum Flooding Surfaces. Palynofacies analysis. Palynology and thermal maturation studies.

GLY 623 - Seismic Interpretation (including Seismic Stratigraphy) 0-0-3 (1 Unit) Rain Semester
Refraction techniques for exploration. Advanced reflection technique (data collection) for exploration. Seismic signal analyses. The propagation of elastic waves through solids. The effect of boundaries between different media. Direct detection of hydrocarbon deposits. Techniques of marine seismic investigation. Specialized interpretation techniques of reflection seismic data (both land and sea). Velocity spectra, velocity determination, static and dynamic correction, normal move out correction. Synthetic seismogram and migration. Seismic Stratigraphy: Seismic sequence analysis, Seismic facies analysis, Analysis of relative sea level change.

GLY 625 - Well Hydraulics and Pumping Test Analysis, Harmattan Semester 2+0+0 (2 Units)
Flow to wells in aquifers. Design and interpretation of pumping test data from confined, unconfined and leaky aquifers. Hydrogeology of fractured rock aquifers.

GLY 626 - Water Quality, Rain Semester 2+0+3 (3 Units)
Classification and distribution of elements. Chemical reactions affecting solute transport and composition of naturally occurring waters. Microbiological indices of water quality. Geochemistry of natural groundwater in different environment. Surveying and sampling methods. Laboratory techniques of water analyses. Pollution and quality protection strategies. Water treatment methods.

GLY 627 - Groundwater Modelling and Case Studies, Rain Semester 2+0+0 (2 Units)
Finite difference and finite element methods for subsurface fluid flow and mass or energy transport. Development and use of numerical models in groundwater investigations. Case studies.

GLY 628 - Isotopic Techniques in Groundwater Studies, Harmattan Semester 1+0+3 (2 Units)

GLY 629 - Planning and Management of Water Resources Projects, Rain Semester 2+0+0 (2 Units)
Resource characteristics of water. Economic evaluation of water projects. Planning precepts. Institutional and policy consideration in water project management. Applications of quantitative methods to water resource management. Benefit cost analysis. Management models and case studies in water management.

GLY 636 - Applied Geophysics in Hydrogeological Investigations, Harmattan Semester 3+0+3 (4 Units)

Application of geophysical methods to hydrogeological investigation. Principles, field procedures and interpretation of surface techniques (electrical resistivity, seismic refraction, induced polarization, gravity and electromagnetic methods and fluid conductivity). Case histories.

AGP 601: Gravity and Magnetic Methods: Rain Semester 2+0+3 (3 Units)

Gravity and Magnetic fields. Ambiguity in interpretation and conditions for uniqueness. Resolution of anomalies. Limiting formulae. Gravity and magnetic effects of some simple models, anomaly characteristics, depth rules, geometric constructions and use of integral transformations, Computation of gravity and magnetic anomalies for irregular bodies. Regional, residual and vertical derivatives. Upward and downward continuation and their uses. Poisson's relation between gravity and magnetic potential. Magnetic reduction to pole. Remanent magnetization in magnetic interpretation. Frequency domains analysis. Field examples.

AGP 602: Static and Time Varying Fields: Rain Semester 2+0+0 (2 Units)

Maxwell's electromagnetic field equations and their physical meanings. Wave, induction and Laplace equations. Static boundary conditions and boundary value problems. Resistivity theory of layered media. Theorems on potential. Long wavelength approximation for slowly varying electromagnetic





potentials and boundary value problems. Conducting loop and sphere in uniform oscillating magnetic similitude and modelling.

AGP 603: Seismic Methods: Rain Semester 2+0+3 (3 Units)

The propagation of elastic waves through solids. The effect of boundaries between different media. The Raypath method. Detection of ground motion and the theories of mechanical and electrical seismographs. Advanced refraction techniques for exploration. Data acquisition in modern practice. Sources: Explosives and implosive, airgun, sparker and others. Recording System: Sources and detector arrays. Vibroseis. Marine seismic methods, seismic signal analysis. Refraction seismic interpretation. Specialized interpretation techniques of refraction, seismic data (land and sea). Velocity spectra, velocity determination, static migration. Synthetic seismogram technique. Modern Seismic interpretation techniques (3D, 4D & 4C), Sequence Stratigraphy.

AGP 604: Digital Computer Techniques for Geophysical Applications: Harmattan Semester 2+0+0 (2 Units)

Signal theory. Theory of discrete-Time Linear Systems, Convolution and Correlation. Special Analysis: Transforms, Power Spectral Analysis, Filtering techniques and statistical methods. Applications to geophysical data processing. Practical examples and class work. Applied numerical methods. Linear and non linear optimization techniques. Linear programming. Numerical models of dynamic systems Automatic interpretation algorithms. Geophysical numerical modelling.

AGP 605: Electrical and Electromagnetic Methods: Rain Semester 3+0+3 (4 Units)

Advanced electrical resistivity (E.R.), Self-Potential (S.P), and induced polarization techniques of geophysical prospecting. Data collection, correlation and consideration of specialized interpretation techniques. Application of the electrical methods in geological mapping mineral investigation, engineering site investigation, groundwater and geothermal energy investigation. Detailed treatment of case histories seminars and classwork. Electromagnetic theory: Description of EM fields, combination of fields. Amplitude and phase relations, mutual inductance, ground Electromagnetic prospecting methods: Tilt (or Dip) Angle methods, Turam and Slingram arrangements. VLF and AFMG. Field Techniques and interpretation. Type curves and phasor (Argand) diagrams airborne EM methods: quadrature methods, long wire system, rotary field. AFMAG VLF and INPUT methods. Field and data interpretation procedures.

AGP 606: Borehole Geophysics Rain Semester 1+0+0 [1 Unit]

Theories and methods of borehole geophysics. Logging Techniques. Log Interpretation. Borehole drilling and completion techniques. Borehole drilling fluids and their effects on geophysical logs. Formation characteristics, lithology, porosity, permeability and geometry. Various types of geophysical logging tools; lithologic, resistivity, porosity and dipmeter. Instrumentation / interpretation and petrophysical parameters derivable from them. Logging whilst drilling and modern concepts of geophysical well log Interpretation.

AGP 607: Geophysical Field Work: Rain Semester (1 Unit)

- a. At least 10 Weekend field trips during the semester.
- b. Each student will work on a given problem using combined geophysical techniques for a period not lasting more than 10 days. At the end of the programme, each student will be required to submit a report.

AGP 608: Thesis Harmattan and Rain Semester (6 Units)

Each student will be assigned an individual project, which is to be undertaken under the guidance of supervisor(s). The project could be of two types:

- a. Critical review of certain solved geophysical problems, or
- b. Field work and interpretation to resolve a geophysical problem

The dissertation is subject to an oral examination where the student is required to defend his work.

AGP 610: Radioactivity Methods Harmattan Semester 2+0+0 (2 Units)

Principles of radioactivity. Radioactivity of rocks and minerals. Ionization chamber. Geiger-Muller counter, scintillation meter. Miscellaneous instruments and Calibration Field techniques. Spectrometric surveys. Aero-spectrometric methods. Interpretation procedure.





AGP 611: Physical Properties of Rocks and Minerals (Laboratory studies): Harmattan Semester 1+0+6 (2 Units)

Rock physics. Determination of density, magnetic susceptibility, permeability, elastic constants, porosity. Techniques of measurement. Micro-statistics of thin sections of rocks. Prediction of in-situ characteristics of rocks.

AGP 612: Paleomagnetism Harmattan Semester 2+0+0 (2 Units)

Detrital Magnetization, Thermo-remanent magnetization, Collection and treatment of Data, Magnetic cleaning, Measurement of natural remanent magnetization. Instrumentation. Investigation of other magnetic properties of rocks. Temperature effects, Stereographic projection. Application of results of paleomagnetism. Polar wandering.

AGP 613: Modelling in Geophysical Prospecting; Harmattan Semester 1+0+3 (2 Units)

Basic Equation of Geophysical Phenomena. Modelling Conditions. Modeling parameters. The resistively model tank. Magnetic response modeling. Electromagnetic Scale modeling. Applications of modeling to geophysical interpretation.

AGP 614: Advanced Data Processing, Harmattan Semester 1+0+3 (2 Units)

Applied Numerical Methods, Linear and Non-linear Optimization techniques. Linear programming. Numerical models of dynamic system. Automatic interpretation algorithms. Geophysical numerical modeling.

AGP 615: Solid Earth Geophysics, Harmattan Semester 2+0+0 (2 Units)

Physical and chemical characteristics of the Earth. Figure of the Earth. Mass, Moment of Inertia and Rotation. The internal structure of the Earth, Seismology, Techniques and results of Crystal seismology. The magnetic Earth; main field, secular variation. Age and Thermal State of the Earth. Geochronology, Geodynamics.

AGP 616: Instrumentation, Harmattan Semester 0+0+6 (2 Units)

The development and modification of geophysical Instruments.

AGP 430: Mathematics for geologists: Harmattan Semester 4+0+0 (4 Units)

Limits, continuity and differentiability, mean value theorem, maxima and minima, error analysis and least square Techniques. Vector analysis, differentiation of a vector. Sequences and series, Fourier series, Tailors series. Elementary numerical analysis line. Surface and volume integrals. The Fourier and Laplace Transforms. Solution of Laplace equations. Spherical Harmonic Analysis. Polynomial surface and their computation.

AGP 431: Geology for Non Geologists: Harmattan semester 4+0+0 (4 Units)

Introduction to and scope of Geology, identification of various rock types and their composition. Introduction to petrology: igneous, metamorphic and sedimentary. Simple geological structures, interpretation of folds, faults. Basic map reading, photo geology and interpretation. Introduction to Structural geology and interpretation for potential mineral resources. Economic geology; mineral deposits, their geology and uses. Industrial minerals and their uses. Introduction to basic principles of stratigraphy. Applied physical Stratigraphy. Geology of petroleum. Oil accumulation and nature, origin of oil, migration and accumulation of oil. Discussions of various traps and salts Domes. Basic concepts of Hydro/Engineering geology and Marine geology.

AGP 432: Geophysical Prospecting, Harmattan Semester 3+0+3 (4 Units)

Gravity and Magnetic methods. Electrical methods. Seismic methods. Electromagnetic methods. Radiometric methods.

AGP 433: Electronic Techniques for Geophysicists: Harmattan Semester 0+0+3 (1 Units)

Basic understanding of the Electronic design of geophysical items of equipment. Troubleshooting. Physical principles of Electronic devices Analysis and design of electronic circuits, filters, Amplifiers, Oscillators, Pulse and Switching circuits, Amplitude frequency Pulse modulation, Power Supplies, microprocessor and their applications in Geophysical instruments.

