



CENTRE FOR GEOTECHNICAL & COASTAL ENGINEERING RESEARCH (CGCER)

UNIVERSITY OF PORT HARCOURT



**Masters of Science (MSc) Degree Programme in Geotechnical and Coastal Engineering
(Revised Programme)**

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1. Introduction

The Center for Geotechnical and Coastal Engineering Research, domiciled under the Department of Civil and Environmental Engineering, University of Port Harcourt proposes to revise the existing programme for Master of Science (MSc) in Geotechnical and Coastal Engineering at Post Graduate Levels as part of its mandate on human capital development through research in the Geotechnical & Coastal Environment.

2. Philosophy

The Philosophy of the MSc Programme is anchored on the drive of initiating, encouraging, promoting and sustaining advanced applied research and development in the various aspects of Geotechnical Engineering, Coastal Engineering.

3. Vision

To turn in internationally recognized Graduates whose professionalism would be of immense benefit in tackling the problems associated with the Geotechnical and Coastal Environments. In addition, the MSc Programme also has the vision of preparing interested Graduates for further studies.

4. Mission

To create, preserve and apply knowledge obtained through applied research to the service of humanity through comprehensive research and development in the Geotechnical and Coastal Engineering fronts.

5. Justification / Rationale

Flood, Erosion and Ocean encroachment around Coastlines have made infrastructural development in such environment highly challenging, hence man is forced to thinker ways of living with the Sea environment. Exploring challenging Soils, Marine and Coastal environment therefore becomes inevitable, both for Geotechnical research and Infrastructural development. Besides, the harsh Onshore Oil and Gas exploration, exploitation and processing activities deriving from Security threats and militancy in the host Onshore communities has forced International Oil and Gas companies (IOCs) to extend the frontiers of their activities Offshore, into the deep waters region. This further necessitates advanced research activities into the Coastal environment.

6. Aim & Objectives

Aim

The aim of the MSc programme in Geotechnical and Coastal Engineering is to prepare students for professional work in the respective research areas or for further studies leading to the Doctor of Philosophy (Ph.D) in the relevant areas.

Objectives

To achieve the aim of the Post Graduate Diploma Programme in Geotechnical & Coastal Engineering, the following under listed objectives will be pursued:

1. Sourcing of highly qualified resource persons from both the academic and industrial worlds to deliver knowledge filled and experienced based lectures.
2. Organization of conferences, seminars and workshops in the relevant areas of interest.
3. Providing Internship opportunities for interested students in recognized industries.

7. Course Delivery

All lectures for every Programme shall be administered / delivered on modular basis from 08.00am to 04.00pm (with One Hour (12.00-01.00) break) from Mondays to Fridays. That is, 40 hours lecture per week per Course which is approximately equal to 14 weeks Semester of Academic work for a 3 Credit Units (2-Hours lecture plus one Hour Practical or Tutorial per week) Course. Examination for a Course is taken after the Lectures on Saturdays, while the Continuous Assessment is done within the lecture periods as Practical reports, Test, Group Discussions, Field Trips reports and Assignments.

8. Examination Regulations & Scoring / Grading System

To qualify for sitting for a final Examination in a Course student is expected to have 75% lectures attendance of ALL lectures in that Course. The overall Examination score in a Course shall be 100% which shall comprise of:

Examination	-	70%
Continuous Assessment	-	30%

Every student is expected to score a minimum of 50% in the overall evaluation for a Course in order to PASS; otherwise he or she shall be deemed to have failed the Course. In which case, the student is allowed a second final chance to retake a Supplementary Examination in the Course which cannot be scored above a C-Grade. The Examination Grading shall be:

Score(%)	Grade	Grade Points
70 – 100	A	5.00
60 – 69	B	4.00
50 - 59	C	3.00
0 - 49	F	0.00

9. Programme Structure

1. The full-time option is for a minimum of 12 calendar months and a maximum of 24 calendar months
2. The part-time option is for a minimum of 24 calendar months and maximum of 48 calendar months.

10. Career Opportunities

The main aim of the programmes of the Center is to produce a hands-on, Industry-ready Geotechnical Engineers and Coastal Engineers with a wide-range of Job Opportunities in Marine & Coastal Environment, Shore Protection, Artificial Intelligence, Dams, Port & Harbour, Geotechnical Services, Ocean Survey, Construction, Consultancy, Coastal Infrastructure Research & Development.

11. Programme Requirements & Criteria for the Award of the MSc Degree

To achieve the above objectives and qualify for the award of the MSc degree, the student must complete and pass all the prescribed courses in the chosen area of interest, participate in and present seminars and produced a well supervised dissertation on an approved research topic relevant to the interest of the Center.

12. Entry / Admission Requirements

To be admitted into any of the research areas in the MSc Degree programmes of the Center, a candidate must be in one of the following categories;

- a. Candidate with a first degree in Civil Engineering and Coastal Engineering from any recognized University having a minimum of Second Class lower division for admission into MSc Geotechnical and Coastal Engineering Programme;
- b. Candidate with a first degree in Engineering and other relevant Science Disciplines from any recognized University having a minimum of Second Class lower division for admission into MSc Coastal Technology Management Programme;
- c. Candidate with a Post Graduate Diploma (PGD) in Engineering and other relevant Science Disciplines obtained from any recognized University (CGPA of 3.00 on a 5.00 point scale or its equivalent) for MSc Coastal Technology Management Programme.
- d) Candidate with a Post Graduate Diploma (PGD) in Civil, Geotechnical and Coastal Engineering (CGPA of 3.00 on a 5.00 point scale or its equivalent) obtained from any recognized University) for MSc Geotechnical and Coastal Engineering Programme.

13. Course Listings

The course listings consist of compulsory courses and electives.

13.1 Course Listings for MSc in Geotechnical and Coastal Engineering Programme

S/No	Course Code	Course Title	Credit Unit
1	GCE 801	Finite Element Method and Mathematical Modeling	3
2	GCE 802	Engineering Behavior and Properties of Soils	3
3	GCE 803	Earth Structures & Slopes	3
4	GCE 804	Embankments, Dam Engineering & Seepage	3
5	GCE 805	Rocks and Tropical Soil Engineering	3
6	GCE 806	Soil Dynamics & Earthquakes Engineering	3
7	GCE 807	Probabilistic & Reliability Methods in Geotechnical Engineering	3
8	GCE 808	Geotechnical Investigation & Monitoring	3
9	GCE 809	Introduction to Coastal Engineering	3
10	GCE 810	Coastal Infrastructure	3
11	GCE 811	Dynamics of Coastal Structures	3
12	GCE 812	Applied Modeling of Nearshore Processes & Transport	3
13	GCE 813	Coastal Engineering Measurements and Data Analysis	3
14	SGS 801	ICT & Research Methodology	2
15	SGS 802	Management & Entrepreneurship	2
16	GCE 8XX	Elective	3
17	GCE 814	Internship Seminar	3
18	GCE 800	Dissertation	6
		TOTAL	55
TECHNICAL ELECTIVES (CHOOSE ONE)			
19	GCE 815	Tunnel (Underground) Engineering	3
20	GCE 816	Special Topics in Geotechnical Engineering	3
21	GCE 817	Groundwater Hydrology & Exploration	3

22	GCE 818	Numerical Solutions of Differential Equations	3
23	GCE 819	Hydrodynamics for Coastal Engineers	3
24	GCE 820	Computer Programme for Oceanographers	3

13.2 M.Sc Geotechnical and Coastal Engineering Course Details

GCE 801-Finite Element Method & Mathematical Modelling (3 Credits)

Finite Element Methods; discretization of domains; Elements numbering techniques; Element Assembly and Solution of banded matrices, tridiagonal, pentadiagonal, etc 1-D, 2-D, and 3-D elements, Galerkin's weighted Residual Method (GWRM), collocation method, etc. Local and Global coordinates. Modeling, calibration, verification/validation and prediction.

Computer/software applications to field and idealized problems, input data, output data interpretation with respect to. Geotechnical and Coastal Engineering problems for instance, flood prediction, solute transport wave prediction, stress and strains in structures.

GCE 802 – Engineering Behavior and Properties of Soils (3 Credits)

Continuum mechanics: principles, parameters and representation of soil properties; spaces, Framework of Critical state soil Mechanics; Behavior of simple soils; Critical state models; Quantitative models of pore pressure; Strength behavior of Dilative Soils; Residual strength; failure theories, strength behavior of simple contractive soils; stress-strain relationships of soils; Constitutive models; Effective stress design methods, SHANSEP Soil physics, Chemistry and Mineralogy; Conduction Phenomena: coupled and uncoupled consolidation, compression, creep, time effects, sensitive soils; sampling and disturbances; Transient and Dynamic loading response; Effective of cycle loading; Graduate soil laboratory.

GCE 803 - Earth Structures & Slopes (3 Credits)

Equilibrium of Retained soil:- Limiting equilibrium analysis; Earth pressure theories; Lateral earth; Rigid retaining walls; sheet pile walls; anchored bulkhead. Deep excavations in soil; pressure distribution, base instability, bracing and other support methods; Earth anchored excavation; concrete diaphragm walls; Reinforced earth walls; cellular cofferdams; soft ground tunneling; Ground movement accompanying excavations and tunneling operations; Slope stability:- Design and analysis of slopes and embankments, circular and non-circular failure surfaces, concept of safety; Probabilistic slope stability analysis; stress strain and time-

dependent behavior; Identification and control of slope stability problems; Graduate soil Laboratory.

GCE 804 - Embankments, Dam Engineering & Seepage (3 Credits)

Types of Dams, Design consideration; design details; site explorations; behavior of rockfills; stress-strain modeling, Finite element modeling, stresses, load transfer; Cracking; pore pressure; observations / monitoring; inspection and maintenance; foundation and abutment treatment, cut-off; causes of failure; Trailings dam, Permeability, flow equations; flow nets. Numerical analyses, Seepage analogies; unknown boundaries; Transfer conditions; Anisotropic seepage; layered systems; piping filters.

GCE 805 - Rock & Tropical Soil Engineering (3 Credits)

Introduction: Rock as an Engineering material; Geological classification; Engineering classification of intact Rocks; structural features in Rock masses; Engineering classification of in-situ Rock masses; in-situ state of stress; stress - strain - strength behavior. Analyses of stress and strain, Elastic relationships (isotropic, anisotropic); Deformability of discontinuities; failure criteria (intact, anisotropic, jointed); Property evaluation and Measurement:- Laboratory, field; Tropical soils: Chemical, physical, textural and engineering properties; Remote sensing and air photo applications to Tropical soils engineering properties; geophysical techniques in tropical site characterization; Prediction of Engineering performance of tropical soils. Case histories.

GCE 806 - Soil Dynamics & Earthquakes Engineering (3 Credits)

Introduction: Dynamic response characteristics, wave propagation; Dynamic soil properties; Foundation response to vibrations, Blasting vibrations, Seismic slope stability analyses, Seismic design of retaining walls; Liquefaction; Seismic response of clays; Risks analyses and stability; Offshore dynamics. Engineering earthquakes from engineering point of view; Earthquake mechanism; Basic characteristics of strong ground motion; Response of simple systems to earthquakes; structural design for earthquakes, Seismic codes; Earthquake resistant designs; site effects; soil amplifications; Seismic risks & design decisions; Soil-structure interactions; nuclear reactor containment structures; Earth- - Dam Design (Seismic); fluids in tanks & reservoirs, blast loading.

GCE 807 - Probabilistic & Reliability Methods in Geotechnical Engineering (3 Credits)

Basic probability theory & applications; Common probability distributions and Geotechnical applications, Joint distributions; Moment approximations; Reliability of soil structures; system reliability and applications; Geotechnical applications of entropy and test biased distribution, the hazard function; Applications of diffusion theory to subsidence, consolidation and stress distribution (Probability consolidation, Probabilistic stress distribution); Markov Process and progressive slope failure; Time series analyses and groundwater fluctuation; Uncertainty and soil parameters; Decision making under uncertainty, site characterization.

GCE 808 - Geotechnical Investigation and Monitoring (3 Credits)

Site Planning and design density of boreholes, sampling technology and disturbance, in-situ and laboratory testing, geophysical methods. Various aspects of ground instrumentation - monitoring of ground movements, drawdown, excess pore pressures, strut forces, wall deflection and observational methods.

GCE 809 - Introduction to Coastal Engineering (3 Credits)

Characteristics & Physical behavior of the Coastal Environment; Two dimensional wave equations & wave characteristics; Wave refraction, diffraction & reflection; Coastal sediment transport including nearshore currents, longshore onshore-offshore transport, and shoreline configuration; equilibrium beach profile concept with application to shore protection; shoreline modeling; tidal inlet hydrodynamics and inlet stabilization; design criteria for soft structures; Coastal zone processes & field Investigations - Wind wave measurements, Wave investigation facilities.

GCE 810 - Coastal Infrastructure (3 Credits)

Planning and design criteria of coastal infrastructure, including breakwaters, jetties, sea walls, groins, piers, submerged pipelines, harbor design, and tsunami defense. Use of laboratory models, numerical simulations, and field observations for design.

GCE 811 - Applied Modeling of Nearshore Processes & Transport (3 Credits)

Numerical modeling of the nearshore ocean, Numerical models for wave propagation, nearshore circulation, platform shoreline evolution and bathymetric profile evolution. Application to coastal phenomena, and the interpretation of model results;

Coastal features - Nearshore morphology, Crenulate bays, Sand waves, Beach cusps, Offshore sandbars; Equilibrium beach profiles; Sediment Characteristics & Transport; Long-Term

Processes, Analyses, Modeling and Predictions of beaches & Shorelines; Shoreline Modification & Analyses.

GCE 812 - Dynamics of Coastal Structures (3 Credits)

Different types of Coastal structures and Compliant towers; New generation Offshore & Coastal structures; Environmental forces & Currents; Characteristics of single degree-of-freedom (DOF) models; Free, Forced, Underdamped & Damped single DOF systems; Two DOF systems; Eigenvalues & Eigenvectors & Orthogonality of modes; Multi-DOF systems - Natural frequencies & Mode shapes; Stadia, Raleigh-Ritz & Influence Coefficient methods; Continuous systems; Fluid - Offshore structures interactions (Jackets, Platforms, etc); Dynamic analyses of Articulated towers; Iterative frequency domains; Experimental & Analytical studies of Multi-legged articulated towers (MLAT); Tension legged Platforms (TLP) - Geometrical optimization and Dynamic analyses; TLPs under seismic excitation & Direct integration method; Stochastic Dynamics of Coastal structures - Response spectrum & Narrow band process; Return periods & Fatigue prediction; Modal response method, Modal mass contribution & Missing mass correction; Duhamel's integrals.

GCE 813 - Coastal Engineering Measurements & Data Analysis (3 Credits)

Coastal Engineering Measurements: Hands-on experience in the conduct of field & laboratory observations, including waves, currents, wind, tides, tsunamis, sediments, bathymetry, shore profiles, wave forces on structures, and structural response. Online data archival & retrieval systems.

Data Analysis: Fourier transform applications to the processing of Coastal engineering related types of signals. Introduction to probability and statistics. Digital processing techniques. Laboratory work involving analysis of Coastal engineering-related signals using modern data acquisition systems.

SGS 801 - ICT & Research Methodology (2 Credits)

Essentials of Spreadsheets, Internet Technology, Statistical Packages, Precision & Accuracy of Estimates, Principles of Scientific Research, Concepts of Hypothesis, Formulation & Testing, Organisation of Research & report Writing.

SGS 802 - Management & Entrepreneurship (2 Credits)

Business Environment, General Management, Financial Management, Entrepreneurship Development, Feasibility Studies, Marketing & Managerial Problem Solving,

GCE 815 - Tunnel (Underground) Engineering (3 Credits)

Tunnel characteristics, clearances and ; Tunnel survey and preliminary investigation; soft ground tunneling; shield tunneling; Rock tunnels; mixed face tunneling, Tunnel-boring machines; Material handling and construction plant; shotcrete; cut and cover construction; safety provisions; drainage systems; tunnel operation and maintenance.

GCE 816 - Special Topics in Geotechnical Engineering (3 Credits)

Review of site appraisal & Engineering behavior of soils, foundation for structures - shallow foundations, deep foundations: piles, piers (caissons), bridge supports, Foundations in difficult ground conditions; Deep basements; Geotechnical Structures, Offshore Geotechnical Engineering; Offshore structures, Soil and Ground improvements; land reclamation; Earthworks & Soil stabilization, Geotextiles and Geosynthetics; Environmental Geotechnical Engineering - ground movements (subsidence); Effects of pollution on the properties & engineering behavior of soils, Advanced Soil Mechanics, laboratory principles & procedures.

GCE 817 - Groundwater Hydrology & Exploration (3 Credits)

Groundwater as a renewable resource; occurrence, disposal and historic background; types of aquifers; measurement of soil moisture; unsteady flows and measurement of hydraulic conductivity, transivity, and specific yield/storage coefficients; well hydraulics with considerations to Theis Jacob, Chow and Hantush methods; leaky aquifer, recovery methods, and Bolton's flow around fully and partially penetrating wells and well losses; well construction and drilling methods. Groundwater quality analyses, artificial recharge; surface and subsurface investigations and sea water intrusions.

GCE 818 - Numerical Solutions of Differential Equations (3 Credits)

Introduction, Gaussian elimination, LU factorization & Cholesky factorization; Mathematical preliminaries on linear space, QR factorization by Gram-Schmidt & Householder transformation; Least squares fitting, condition number and stability; Iterative methods for linear systems, conjugate gradient method; Eigenvalue & eigenvector problem; Initial value problem of Ordinary Differential Equations. Euler's method, Explicit Runge-Kutta methods,

convergence rate analysis, stiff equations & absolute stability; Quadrature integration & Implicit Runge-Kutta and multistep methods; Two point boundary value problems, finite difference & shooting methods. Partial Differential Equation -1: Poisson equations; Partial Differential Equation 2: Diffusion equations, consistency, order & stability. Lax Equivalence Theorem; Partial Differential Equation - 3: Stability analysis: eigenvalue approach & Fourier transform approach, advection equations.

GCE 819 - Hydrodynamics for Coastal Engineers (3 Credits)

Periodic wave pattern: the approach of differential calculus, the control volume approach. Wave effects on coasts. Wind generated waves: basic concepts. Analysis of the sea states: the time domain. The wave climate. Design waves and risk analysis. Analysis of the sea states in the space-time. The theory of Quasi- Determinism theory. Analysis of the wave forces on offshore structures. Stability analysis of coastal structures.

Introduction to wave mechanics, a review of hydrodynamics and vector analysis, small amplitude water wave theory, formulation and solution, engineering wave properties, long waves, wave statistics and spectra, wave forces, waves over real sea beds, nonlinear properties derivable from small amplitude waves, nonlinear waves, a series of experiments for a laboratory course component in water waves.

GCE 820 – Computer Programme for Oceanographers (3 Credits)

Introduction to MATLAB desktop environment, Basic programming and data analysis skills, Matrix algebra & Vectorization of functions, Writing optimized routines to analyze data sets, Basic graphics & visualization, Two- dimensional & three-dimensional Graphing, Contouring & Movies; Scalar & Vector Space - Time Series at fixed locations & Moving locations (Shipboard surveys), Oceanographic characteristics varying in both three-dimensions & Time; Matlab-based Processing, Analyses & Visualization of large Oceanographic data-sets;

14. Graduation Requirements

To be awarded the MSc degree in Geotechnical and Coastal Engineering students must have passed all prescribed courses.

15. List of Participating Lecturers/Instructors

S/Nos	Names	Qualifications	Specialization	Rank
1	Ejezie, S.U.	Ph.D, MSc., BSc., R.Engr (COREN).	Geotechnical Engineering	Professor
2	Nwaogazie, I.L.	Ph.D, MSc., BSc., R.Engr (COREN).	Engineering Modeling	Professor
3	Teme, S.C.	Ph.D, MSc., BSc., (FNMGS).	Geology & Geotechnical Engg	Professor
4	Jimoh, Y.	Ph.D, MSc., BSc., R.Engr (COREN).	Geotechnical Engg	Professor
5	Oguara, T.M.	Ph.D, MSc., BSc., R.Engr (COREN).	Highway Engineering	Professor
6	Johnary, T.	Ph.D, MSc., BSc., R.Engr (COREN).	Engineering Structures	Professor
7	Igwe, E.A.	Ph.D. MTech., BTech., R.Engr (COREN)	Highway Engineering	Professor
8	Ossia, O.V.	Ph.D, MTech.,BTech., R.Engr (COREN).	Applied Mechanics	Professor
9	Nwofor, T. C.	Ph.D, M.Tech.,B.Tech. R.Engr (COREN).	Engineering Structures	Reader
10	Big-Alabo, A.	Ph.D, MSc., B.Eng., R.Engr (COREN).	Applied Mechanics	Senior Lecturer
11	Douglas, I.E.	Ph.D, MTech., R.Engr (COREN)	Marine Engineering & Turbines	Senior Lecturer
12	Orji, C.U.	Ph.D, MSc., BTech., R.Engr (COREN)	Marine Engineering	Senior Lecturer
13	Tamunodukobipi, D.	Ph.D, MTech.,BTech., R.Engr (COREN).	Applied Rotodynamics	Senior Lecturer
14	Akandu, E.	Ph.D, MTech., BTech	Marine & Offshore Structures	Senior Lecturer
15	Eme, D.B.	Ph.D, M.Te.ch.,B.Tech., R.Engr (COREN). •	Highway Engineering	Senior Lecturer
16	Nwaobakata, E.	Ph.D, M.Tech.,B.Tech., R.Engr (COREN).	Highway Engineering	Senior Lecturer

17	Sule, S.	Ph.D, M.Tech., B.Eng., R.Engr (COREN).	Engineering Structures	Senior Lecturer
18	Awodigi, C. T.	Ph.D, M.Eng., B.Eng., R.Engr (COREN).	Engineering Structures	Senior Lecturer
19	Ugwoha, E.	Ph.D, MSc, BTech., R.Engr (COREN)	Environmental Engineering	Senior Lecturer
20	Kamalu, U.A.	Ph.D, MEng., BEng., R.Engr (COREN)	Electronics Engineering	Senior Lecturer
21	Ukpong, E.U.	Ph.D, MSc, BSc., R.Engr (COREN)	Geotechnical Engineering	Senior Lecturer
22	Nwaigwe, C.	Ph.D, MSc., BSc.	Computation Fluid Dynamics	Lecturer-1
23	Ibekwe, A.U.	Ph.D, M.Tech.,B.Tech., R.Engr (COREN).	Marine Engineering Platforms	industry
24	Tam-Jones, Atuboyedia	Ph.D, M.Tech., B.Tech., R.Engr (COREN)	Highway Engineering	Industry
25	Henshaw, T.	Ph.D., MEng., BEng., R.Eng (COREN)	Water Resources	Industry
26	Ikebude, C.	Ph.D., MEng., BEng., R.Eng (COREN)	Water Resources	Lecturer 1
27	Okoni, B.	Ph.D, MSc, BSc	Computer Science	Lecturer 1

16 Facilities

16.1 Personnel

Being multi-disciplinary in nature, academic Faculty is drawn different academia from relevant Disciplines at the University of Port Harcourt, Other Sister Universities and Industry. The current list of proposed teaching faculty is shown above. However, more Teachers, Instructors and Researchers of high professional repute shall be co-opted as collaborators to build a center of Excellence in Geotechnical and Coastal Engineering. Besides, there are two Professorial Chairs domiciled in the Center, namely: Enoch George Professorial Chair in Geotechnical Engineering and the Gesi Assamawei Professorial Chair in Coastal Engineering Research.

16.2 Offices & Classrooms Space

Besides, the Director's Office, there are two other Offices at ETF Gas Engineering Building for the Center of Geotechnical Engineering and Coastal Engineering, which can house the Administrative staff of the Center. The Center also has another four (4) Classrooms domiciled at the Civil & Environmental Engineering Building at UniPark (Abuja) Campus of the University of Port Harcourt.

16.3 Library / Laboratory Facilities

Currently, the Faculty of Engineering eLibrary, Donald Ekong (Uniport) Library and the World Bank Center of Excellence in Oilfield Chemicals (ACE-CEFOR) have full Access to Research Libraries. (Online and Offline). The Center currently collaborates with the Center of Excellence in Marine & Offshore Engineering, Rivers State University to share Laboratory Facilities built and equipped by Shell Petroleum Development Company (SPDC) to enhance research in this area.