MSc IN GEOTECHNICAL ENGINEERING

Handbook – 2021/2022 intake

MSc in Geotechnical Engineering

Department of Civil Engineering,
University of Moratuwa,
Moratuwa,
Sri Lanka 10400

EMAIL: geomscuom@gmail.com

ELIGIBILITY REQUIREMENTS

a) The degree of Bachelor of The Science in Engineering of the University of Moratuwa, Sri Lanka, specialising in Civil Engineering,

or

b) The degree of Bachelor of The Science in Engineering of the University of Sri Lanka, Katubedda Campus, specialising in Civil Engineering,

or

c) Any other engineering degree in a relevant field and equivalent to (a) above where both relevance and the equivalence is judged by the Faculty and approved by the Senate of the University of Moratuwa, Sri Lanka,

or

d) At least the Associate Membership of a recognised professional engineering institution in the relevant field and a minimum of one year of experience after obtaining such membership. The acceptability of the professional qualification of the candidate, the recognition of the institute and the relevancy of the field for this purpose shall be judged by the Faculty and approved by the Senate.

CURRICULUM, CREDIT RATING AND SCHEME OF EVALUATION

Code	Module	Credits	Evaluation	
			Continuous Assessments	Final Exam
CE 5401	Engineering Properties of Soil	4.5	25%	75%
CE 5402	Engineering Geology	4.0	25%	75%
CE 5403	Geotechnical Investigations	3.0	25%	75%
CE 5404	Design of Dewatering Systems	2.0	25%	75%
CE 5405	Earth Retaining Systems	4.0	25%	75%
CE 5406	Ground Improvement Techniques	2.5	25%	75%
CE 5407	Design and Construction of Shallow Foundations	3.0	25%	75%
CE 5408	Structural Design of Foundations	2.5	25%	75%
CE 5409	Design and Construction of Deep Foundations	4.0	25%	75%
CE 5410	Computer Applications in Geotechnical Engineering	3.5	50%	50%
CE 5414	Rock Mechanics	3.0	25%	75%
CE 5415	Slope Engineering	4.0	25%	75%
CE 5411	Design Project	4.0	100%	__
CE 5412	Research Seminar	2.0	100%	__
CE 5490	MSc Research Project	20.0	100%	__

Scheduled Teaching Arrangement

Semester 1 (16 weeks)

CE 5401 Engineering Properties of Soil

CE 5402 Engineering Geology

CE 5403 Geotechnical Investigations

CE 5404 Design of Dewatering Systems and Ground Subsidence

CE 5414 Rock Mechanics

Semester 2 (15 weeks)

CE 5405 Earth Retaining Systems

CE 5406 Ground Improvement Techniques

CE 5407 Design and Construction of Shallow Foundations

CE 5411 Design Project

CE 5412 Research Seminar

CE 5415 Slope Engineering

Semester 3 (15 weeks)

CE 5408 Structural Design of Foundations

CE 5409 Design and Construction of Deep Foundations

CE 5410 Computer Applications in Design of Foundations and Earth Retaining Systems

CE 5411 Design Project

CE 5412 Research Seminar

MSc/PG DIPLOMA IN GEOTECHNICAL ENGINEERING SUBJECT SYLLABI

1. *CE 5401 - Engineering Properties of Soil*

(4.5 credits: 56 hrs lectures + 16 hrs laboratory work)

- Introduction to soil mechanics: mass-volume relationships, structure of clay minerals and adsorbed water, consistency limits, soil classification,
- Effective stress concept: Terzaghi's concept of effective stress, other definitions of effective stress.
- Flow of water through soils: Solution to seepage problems using flow nets, finite difference method, treatment of non-homogeneous, anisotropic soils; introduction to filter design.
- Consolidation of soils: Deformation of soil medium subject to external stress change, immediate elastic settlements, primary consolidation, one-dimensional consolidation under uniform and non-uniform stress distributions, radial drainage with sand drains, secondary consolidation.
- Shear strength of soils: Failure criteria stress path, introduction to critical state soil mechanics, lab and field determination of shear strength parameters.
- Behaviour of tropical soils; behaviour of peaty soils.

2. *CE 5402 - Engineering Geology*

(4.0 credits: 48 hrs lectures + 02 days field visit)

- Geological history and structure of the earth.
- Rock forming minerals, geological cycle, rock weathering.
- Igneous, sedimentary and metamorphic rock: rock formations and type.
- Geological structures, discontinuities in rock-mass, exploration in rock, rock-mass classification, engineering description of rock-mass.
- Sedimentary deposit types: aeolin/desert, alluvial, lacustrine, glacial, piedmont, and marine; Residual soils, hydrogeology.

3. *CE 5403 - Geotechnical Investigations*

(3.0 credits: 40 hrs lectures + 01 day Field work)

- Objectives of Site Investigation
- Stages of Site Investigation and planning
- Methods of site Exploration
- Sampling Techniques; box samples, thin walled samples, piston samples
- In situ tests in boreholes; Standard Penetration Test
- Borehole logging and preparation of site investigation report
- Cone penetration test; types of tests and interpretation
- Vane shear test
- Field Permeability test

- Pressuremeter test
- Specifications for Site Investigations, Writing Site investigation reports

4. *CE 5404 - Design of Dewatering Systems*
(2.0 credits: 28 hrs lectures)

- Introduction to Hydraulic modification: Traditional dewatering methods (open sumps and ditches, gravity flow wells, well-point systems, vacuum dewatering wells).
- Fundamental soil-water relationships, pore pressures, Darcy's law.
- Hydraulics of slots and wells: aquifer types, Dupuit-Thiem approximation, free discharge height, influence range, multi-well installations, imperfect wells and other cases, development of drawdown with time, interpretation of time-drawdown measurements; formulae for drainage slots, single-wells and multiple-wells.
- Design of dewatering systems: Ground and well determinants (ground permeability; filter criteria and design of well screens; individual well capacity; well diameter, depth and spacing); Dewatering of excavations (design approaches, pipelines and pumping plant, settlement of adjacent structures, performance evaluation).

5. *CE 5414 - Rock Mechanics*
(3.0 credits: 40 hrs lectures + 4hrs Laboratory work)

- Rock as an engineering material: Exploration in rock, rock mass classification, stereographic projections, engineering description, groundwater flow.
- Stability of rock slopes and exposed surfaces: Plane failure mode, wedge failure mode, toppling failure mode, factor of safety against failure, remedial measures for rock slope instability, rock bolting.
- Physical and mechanical properties of rock: Properties determined by laboratory tests, properties determined in-situ, correlations between properties.
- Stress, strain and deformation in rock: Natural and induced stresses in rock, stress determination methods, constitutive relations for rock, rock failure theories.
- Foundations on rock: Performance and failure modes of different foundations on rock; influence of ground water; design of spread footings, rock-socketed piles/piers, gravity and embankment dams, tension foundations.

6. *CE 5405 - Earth Retaining Systems*
(4.0 credits: 56 hrs lectures)

- Introduction to different forms of earth retaining structures
- Methods for Earth Pressure Computation
- Compaction Effects
- Codes for design of Earth Retaining Structures
- Design of Gravity Retaining Structures and Optimum shapes
- Design of Embedded Earth Retaining Structures

- Design of Shoring- Soldier pile walls
- Design of Reinforced Concrete Earth Retaining Structures
- Design of Reinforced Earth Retaining Structure
- Design of Anchored Earth Retaining Structures
- Design of Soil Nailing
- Use of Finite Element method in Design and Analysis of Earth Retaining Structures
- Maintenance and Monitoring of Earth Retaining Structures

7. CE 5406 - Ground Improvement Techniques
(2.5 credits: 32 hrs lectures)

- Improvement of soft clay and peat by: preloading, preloading with vertical drains, vacuum consolidation, deep mixing and electro osmosis.
- Use of sand compaction piles and stone columns in soft clays and soft peaty clays.
- Use of Geosynthetics in ground improvement.
- Ground improvement by dynamic compaction.
- Improvement of granular soils by vibroflotation
- Recent innovations in ground improvement techniques

8. CE 5407 - Design and Construction of Shallow Foundations
(3.0 credits: 44 hrs lectures)

- Introduction: purpose and types of shallow foundations; selection of type of foundation.
- Shear failure: failure mechanisms; estimation of ultimate bearing capacity for vertically, inclined and eccentrically loaded footings, and footings on slope; ultimate bearing capacity for footings on layered ground.
- Stress distribution through isotropic and anisotropic soil due to a shallow foundation.
- Settlements: estimation of allowable total and differential settlement of structure, estimation of immediate total and differential settlement of shallow foundations on different soil types, methods of avoiding or accommodating excessive differential settlements.
- Factors of safety: allowable bearing capacity, selection of factor of safety for shallow foundations.
- Plate bearing test and interpretation of plate load test results.
- Estimation of modulus of subgrade reaction.
- Design of combined footings using soil-structure interaction; design of strap footings; design of raft foundations.
- Design of shallow foundations on unsaturated soils.
- Construction of shallow foundations: Construction processes, equipment and plant.

9. CE 5408 - Structural Design of Foundations
(2.5 credits: 36 hrs lectures)

- Structural design of shallow foundations: strip footings; pad footings; combined footings (beams on elastic foundations, strap footing, trapezoidal footing); raft foundations (semi-flexible rafts-crust raft, beam and slab rafts, cellular rafts).
- Structural design of deep foundations: driven files (design for working stresses, driving stresses and handling stresses); cast-in-situ piles (drilled shaft, bored piles); piles subject to lateral loads; pile-caps.

10. CE 5409 - Design and Construction of Deep Foundations
(4.0 credits: 60 hrs lectures)

Introduction:

- Use of deep foundations; types of deep foundations; selection of type of deep foundation.

Design of single piles:

- Development of the resistive force and the load transfer curves.
- Effects of pile driving.
- Estimation of carrying capacity of pile foundations using driving formulae; advantages and disadvantages of the method.
- Estimation of carrying capacity of pile foundations using wave propagation through piles: wave equation analysis; pile driving analyzer; advantages and disadvantages of the method.
- Estimation of carrying capacity of piles using soil strength parameters and using results of insitu tests.
- Estimation of carrying capacity of piles in the bed rock.
- Estimation of carrying capacity of piles using pile load test and statinamic test.
- Estimation of settlement of single pile using elastic methods.
- Negative skin friction; development of negative skin friction; estimation of maximum drag down force and the resulting settlement; minimizing negative skin friction.
- Uplift resistance of a single pile.
- Behaviour of a pile subjected to lateral loads: p-y curve; estimation of lateral carrying capacity of piles.

Design of pile groups:

- Introduction, estimation of group efficiency factor.
- Failure modes and estimation of carrying capacity of free-standing pile groups and piled foundations.
- Interaction between piles in a group; distribution of load among piles in the group with rigid pile caps; settlement of piles in a group with a flexible pile cap.
- Pile groups subjected to lateral loads; interaction between piles; lateral load carrying capacity of a pile group.
- Pile groups subjected to negative skin friction.

- Problems associated with Sri Lankan soils.

Construction:

- Construction planning and processes for deep foundations; piling equipment and methods.

11. CE 5410 – Computer Applications in Design of Foundations and Earth Retaining Systems

(3.5 credits: 32 hrs lectures + 32 hrs of Computer Lab)

- Boundary value problems and Indicial notation.
- The finite element method under small displacement and infinitesimal strain theory.
- Stress and strain analysis in a continuum.
- Constitutive relations for geo-materials.
- Seepage in soils by finite element software.
- Analysis of earth retaining walls by finite element software.
- Analysis of slope stability by finite element.
- Foundation-soil interaction by finite element software.

12. CE 5415 – Slope Engineering

(4.0 credits: 52 hrs. of Lectures and a field visit)

- Modes of Slope instability; Concept of safety factor, Rain induced slope failures.
- Different Deterministic Methods of Stability Analysis.
- Slope Stability Analysis by limit equilibrium methods taking the failure mass as one unit - Chart solutions
- Circular and Non-Circular Methods of Slices
- Slope stability Analysis by Wedge Methods
- Time Dependence of Slope Stability
- Slope Stability Analysis by Probabilistic Methods
- Landslide Hazard Zonation
- Slope Stability Analysis by Limit Analysis Methods
- Slope Stability Evaluation by Finite Element Techniques
- Influence of Vegetation on Slope Stability
- Techniques for Enhancing the Safety Margins of Slopes
- Site Specific Monitoring of Slopes
- Global Monitoring of Slopes

13. CE 5411 – Design Project

(4.0 credits: 112 hrs of Design Office)

An approved comprehensive design project done with a group of maximum of four candidates under the supervision of a staff member.

14. CE 5412 – Research Seminar
(2.0 credits)

- Research Proposals
- Literature Review
- Research Methodology
- Research Papers
- Active participation in specially arranged research seminars.

15. CE 5490 – MSc Research project
(20.0 credits)

An approved individual research project, done under the supervision of a staff member, and to be evaluated by a dissertation and an oral examination.

Performance Criteria - P.G. Diploma in Geotechnical Engineering

1. Title of award

Post-Graduate Diploma

2. Participation in the Academic Programme

2.1 At least 80% attendance is normally required in lectures and tutorials to be eligible to sit for examination.

2.2 Participation is compulsory in seminars, and assignments, such as; laboratory work, design work, field trips, field camps, as envisaged in the course curriculum.

2.3 Undertaking a specified design project.

3. Pass in the Post Graduate Diploma

3.1 A candidate is deemed to have passed the postgraduate Diploma if he/she has:

(a). Obtained a minimum of 40 credits offered according to the course curriculum approved by the Faculty and Senate, by successfully completing the continuous assessment components and the written examinations.

(b). Obtained 6 credits by successfully completing all assignments including seminars and projects.

(c). If the candidate is unsuccessful in any of the parts (a) and (b) he/she may be re-examined. Normally, only one re-examination will be allowed, and this will be at the next holding of the examination(s)/assessments(s). No postponement will be allowed without prior approval of the Senate.

Note: Where the overall mark for a module consists of a written examination mark as well as marks for continuous assessments of that module, the candidate shall obtain at least 40% of marks assigned for each component.

3.2 Credit Rating

One credit corresponds to approximately 14 hours of lectures or 28 hours of assignments.

4. Award of Grades for Subject Modules

Grades of performance for the modules shall be awarded as follows:

Guideline Percentage	Grade	Grade Point	Description
85 and above	A+	4.2	
75 to 84	A	4.0	Excellent
70 to 74	A–	3.7	
65 to 69	B+	3.3	
60 to 64	B	3.0	Good
55 to 59	B–	2.7	
50 to 54	C+	2.3	Pass
	I	0.0	Incomplete
	F	0.0	Fail
	N	0.0	Academic Concession

* The examiner and the moderator may change the grade boundaries within reasonable limits if they feel that justifiable grounds exist for such changes.

4.1 Grade C+ or above is required to pass a module and earn credits for the module.

4.2 A student who has not obtained a grade C+ in a module but has obtained minimum marks for at least one component, receives an incomplete grade I.

4.3 A candidate receiving an F grade must repeat all components.

4.4 The I grade or F grade can be improved to a C+ grade by repeating one or more components to satisfy the requirements for a pass in the module. The maximum grade awarded for a module after repeating one or more components will be a C+ and will be used for calculating the Grade Point Average.

4.5 Grade N signifies Academic Concession granted with the approval of the Faculty, in the event a student is unable to sit for the end-of-semester examination due to illness or other compelling reasons. In such instances the student must notify the Registrar within 48 hours of the cause. Further, the student should make an appeal with supporting documents to the Dean for an Academic Concession within one week from the date of the end of the examination. The continuous assessment component can be carried forward to the next examination as the first attempt.

4.6 Calculation of the grade point average:
The grade point average (GPA) is calculated from the grade points received by the student (grade point) and the credit assigned for each of the modules (credits) by the formulae.

$$\text{GPA} = \frac{\sum(\text{Grade Point} \times \text{Credits})}{\sum \text{Credits}}$$

4.7 Release of Results:

Subject to confirmation by the Senate, results of a candidate may be released after the board of examiners meeting, unless the board of examiners meeting recommends withholding of the results for specific reasons.

4.8 The effective date of the PG Diploma shall be the first day of the following month after successful completion of all of the following:

a) written examinations
b) seminars
c) assignments
d) examination of the design project and oral presentations

4.9 Duration of the Course:

PG Diploma - 1 Year Part Time
All lectures, assignments, seminars, field trips etc. will be conducted normally on Fridays and Saturdays.

PERFORMANCE CRITERIA – MSC IN GEOTECHNICAL ENGINEERING (BY COURSE)

1. Title of award

Master of Engineering

2. Participation in the Academic Programme

2.1 A candidate must satisfy the requirements for the award of the PG Diploma in Geotechnical Engineering.

2.2 A candidate must undertake an individual research project as assigned by the Department on a specific area.

3. Evaluation of the Research Project

3.1 This consists of examination of dissertation, evaluation of the seminar and oral examination of the candidate by a panel of examiners.

3.2 The grading for the research project will be A+, A, A-, B+, B, B-, C+, I, F.

3.3 All pass grades carry 20 credits for the research project.

4. Award of MSc. Degree:

A candidate is eligible for the award of the MSc. Degree if he/she,

a. has obtained 46 credits from the PG Diploma
b. has successfully completed the research project and obtained 20 credits for the project

5. Date of Award

Date of award of the M.Sc. Degree will be the first day of the month after the successful completion and evaluation of the research project.

RESOURCE PERSONNEL

University of Moratuwa

Department of Civil Engineering:

Prof U.G.A. Puswewala
B.Sc. Eng. Hons (Moratuwa), M Eng. (AIT), Ph.D. (Manitoba), C.Eng., FIE(SL)

Prof. S.A.S. Kulathilaka
B.Sc. Eng. Hons (Moratuwa), Ph.D. (Monash), C.Eng., MIE(SL)

Dr. U.P. Nawagamuwa
B.Sc. Eng. Hons (Moratuwa), M.Eng. (AIT), Dr.Eng. (YNU), C.Eng., FIE(SL)

Dr L.I.N. De Silva
B.Sc. Eng. Hons (Moratuwa), M.Eng (Tokyo), Ph.D. (Tokyo), C.Eng., MIE(SL)

Prof. M.T.R. Jayasingha
B.Sc. Eng. (Hons) (Moratuwa), Ph.D. (Cambridge), C.Eng., MIE(SL), MSSE (SL)

Dr (Mrs) M. A. Pallewatta
B.Sc. Eng. Hons (Moratuwa), Ph.D. (Wollongo), C.Eng., MIE(SL)

Dr (Mrs) A.S. Ranathunga
B.Sc. Eng. Hons (Ruhuna), Ph.D. (Monash), AMIE(SL)

Department of Earth Resources Engineering:

Dr A.M.K.B. Abeysinghe
B.Sc. Eng. Hons (Peradeniya), M.Eng. (AIT), Ph.D. (Saga)

Visiting Staff

Prof B.L. Tennekoon - Emeritus Professor, University of Moratuwa
B.Sc. Eng. (Cey), Ph.D. (Cambridge), C.Eng., FIE (SL)

Prof M. Gunaratne, - Professor, University of South Florida, USA
B.Sc. Eng. (Peradeniya), M.Sc. (British Columbia), Ph.D. (Purdue)

Prof H. S. Thilakasiri - Dean, Faculty of Engineering, SLIIT
BSc. Eng. (Hons) Moratuwa, DIC & MSc. (UK), PhD. (USA), CEng, FIE(SL), IntPE(SL)

Dr W. A. Karunawardena - Director General, NBRO
B.Sc. Eng. (Moratuwa), M.Eng. (Moratuwa), PhD (Kyoto), C.Eng., MIE (SL)

Eng. Shiromal Fernando - Managing Director – CSEC
BSc. (Moratuwa), MPhil (Moratuwa), C.Eng., MIE (SL)

Dr J. S. M. Fowze - Specialist Engineer, Geotechnics and Foundations, CECB
B.Sc. Eng. (Peradeniya), M.Phil. (Peradeniya), PhD (AIT)

Dr N. H. Priyankara - Snr Lecturer, Faculty of Engineering, University of Ruhuna
B.Sc. Eng. (Moratuwa), M.Sc. (AIT), PhD (Tohoku), C.En.g, MIE (SL),

Eng. Mahinda Ratnasiri - General Manager, ELS
B.Sc. Eng. (Moratuwa), M.Sc. (Moratuwa), C.Eng., MIE (SL)

For further details, contact:

Course coordinators:

Dr (Mrs.) A.S. Ranathunga/Dr L.I.N. De Silva

Email: cc-msc-ge@uom.lk

Course Assistant:

Mrs. S.D.P.K. Peiris

Email: geomscuom@gmail.com