



ASSAM SCIENCE AND TECHNOLOGY UNIVERSITY

Guwahati

**Course Structure and Syllabus
(From Academic Session 2020-21 onwards)**

M.Tech

**CIVIL ENGINEERING
SPECIALIZATION: GEOTECHNICAL ENGINEERING**

2nd Semester



ASSAM SCIENCE AND TECHNOLOGY UNIVERSITY

Guwahati

Course Structure (From Academic Session 2020-21 onwards)

M. Tech: Civil Engineering Specialization: Geotechnical Engineering 2nd Semester: Course Structure

Theory/ Practical	Sl. No.	Sub Code	Subject	Hours Per week			Credit C	Marks	
				L	T	P		CE	ESE
Core									
Theory	1	CEG202201	Advanced Foundation Engineering	3	0	0	3	30	70
	2	CEG202202	Geotechnical In-situ Testing and Instrumentation	3	0	0	3	30	70
	3	CEG202203	Earth and Rockfill Dams	3	0	0	3	30	70
Practical	1	CEG202214	Software Lab	0	0	4	2	30	70
Program Elective-2									
Theory	1	CEG202PE2*	Program Elective-2	3	0	0	3	30	70
Program Elective-3									
Theory	1	CEG202PE3*	Program Elective-3	3	0	0	3	30	70
Audit Course-2									
Theory	1	MAC20222*	Audit Course-2	2	0	0	0	-	100
Total				17	0	4	17	180	520
Total contact hours per week: 21									
Total Credit: 17									

Program Elective-2

Sl No	Code	Subject
1	CEG202PE21	Finite Element Analysis
2	CEG202PE22	Ground Improvements Techniques
3	CEG202PE2*	Any other subject offered from time to time with the approval of the University

Program Elective-3

Sl No	Code	Subject
1	CEG202PE31	Environmental Geotechnics
2	CEG202PE32	CAD of Foundations
3	CEG202PE3*	Any other subject offered from time to time with the approval of the University

Audit Course-2

Sl No	Code	Subject
1	MAC202221	Constitution of India
2	MAC202222	Pedagogy Studies
3	MAC202223	Stress Management by Yoga
4	MAC202224	Personality Development through Life Enlightenment Skills
5	MAC20222*	Any other subject offered from time to time with the approval of the University

Detailed Syllabus:

Course Code	Course Title	Hours per week L-T-P	Credit C
CEG202201	Advanced Foundation Engineering	3-0-0	3

Shallow foundation: Types - their stability, bearing capacity determination- consideration of eccentric, inclined, uplift, overturning, seismic loading. Footings on slopes and layered soils, I.S. code methods, determination of bearing capacity from standard penetration test values, static cone penetration test, settlement of shallow foundations- Various corrections. Settlement of granular soils by plate load test, standard penetration test, static cone penetration test, I.S code methods, determination of allowable bearing pressure, proportioning of foundation.

Introduction to soil structure interaction, analysis of footings and mats by beams on elastic foundation using tables for determination of contact pressure, shear force and bending moments, subgrade reaction method, finite difference method.

Shallow foundation on rock, bearing pressure on rock.

Load capacity of ordinary pile and under reamed piles. Pile group capacity, settlement of piles. Piles in multilayered deposit, uplift resistance, negative skin friction and its influence on pile design. Methods of reducing negative skin friction, analysis of laterally loaded piles by Reese and Matlock method. Ultimate lateral resistance of piles, I.S. code method. Pile groups under inclined load, Hrennikoff's method, influence of vertical and batter piles.

Bridge sub-structure, forces on bridge foundation (IRC and IRS Specification), Well foundation, stability analysis (IRC method), Tilt and shift of well and their rectification.

Text/Reference Books:

1. Bowles, Joseph E., "Foundation Analysis and Design", Mc-Graw Hill. 1996
2. Das, Braja M., "Principles of Foundation Engineering", PWS Publishing. 1998
3. Som, N, N. and Das S. C., "Theory and Practice of Foundation Design", Prentice Hall. 2003
4. Poulos, H. G. and Davis, F. H., "Pile Foundation Analysis and Design", Wiley and Sons. 1980
5. Saran, S., "Analysis and Design of Substructures", Oxford and IBH. 2006

Course Code	Course Title	Hours per week L-T-P	Credit C
CEG202202	Geotechnical In-situ Testing and Instrumentation	3-0-0	3

Introduction:

Necessity and importance of soil and rock exploration, methods of sub-surface exploration, open excavation, boring, stabilization of bore holes, factors affecting the selection of suitable method of boring, extent of boring, factors controlling spacing and depth of bore holes. Spacing and depth for various Civil Engineering structures, Indirect method of exploration- Seismic refraction method, electrical resistivity, resistivity sounding and profiling. Qualitative and quantitative interpretation of test results, comparison of resistivity and seismic surveys limitations and shortcomings

Sampling-

Sources of disturbances and their influence. Types of samplers, Principle of design of samplers, Preservation and shipment of samples

Boring and sampling records, Preparation of bore-log

Penetration test: Standard penetration tests, Dynamic cone penetration test with and without bentonite slurry, Static cone penetration tests. Various corrections in the test results. Interpretation of test results for design and determination of modulus of deformation. Correlation among various test results, Pressuremeter test and interpretation of test results.

Plate load tests under constant load, cyclic load, repetitive load. Determination of deformation modulus, sub-grade modulus, coefficient of elastic uniform compression. Limitations of plate load tests.

Pile load test – Methods by constant load, cyclic load, pull-out test, lateral pile load test

In-situ dynamic tests- Shear modulus test, vertical and horizontal block vibration test. Determination of different dynamic soil constants

In-situ test for deformability, shear strength and for internal stresses of rock, Case histories

Observational procedure:

Its uses and suitability for different problems in geotechnical engineering. Limitations and pitfalls of observations, Introduction to instrumentation in Geotechnical Engineering, measurement of pore water pressure. Measurement of earth pressure, displacement, different instruments used for field measurement.

Text/Reference Books:

1. Geotechnical and Geographical Site Characterization, An-Bin Huang, Paul W Mayne, CRC Press, 2008.
2. Head, K. H., Manual of Soil Laboratory Testing, Vols. 1 to 3, 1981.
3. Compendium of Indian Standards on Soil Engineering Parts I and II (1987-1988)

Course Code	Course Title	Hours per week L-T-P	Credit C
CEG202203	Earth and Rockfill Dams	3-0-0	3

MODULE 1: Design Consideration

Design consideration, Factors influencing design, Types of earth and rockfill dams, Design details, Provisions to control pore pressure.

MODULE 2: Failure and Damages

Failure and damages, Nature and importance of failures in embankment and foundation piping, Differential settlement, Foundation slides, Earthquake damage creep and anisotropic effects, Reservoir wave action, Dispersive piping

MODULE 3: Seepage Analysis

Seepage analysis, Flownets, Stability conditions during construction, Full reservoir and drawdown.

MODULE 4: Stability of Slopes

Introduction, Stability of infinite and finite slopes, Limit Equilibrium method, Wedge analysis, Method of Slices, Bishop's method, Janbu's method etc. Special aspects of slope analysis, stability charts.

MODULE 5: Special Design Problem

Special design problems, Slope protection, Filter design, Foundation treatment, Earth dams on pervious soil foundation, Treatment of rock foundation, Construction Techniques, Quality control and performance measurement, Applications of Geosynthetics in earth and rockfill dams.

Text/Reference Books:

1. Rowe, R.K., Geotechnical and Geo-environmental Engineering Handbook, Kulwer Academic Publishers, 2001.
2. Anderson, M.G., and Richards, K.S., Slope Stability, John Wiley, 1987.
3. Sherard, J.L., Woodward, R.J., Gizienski, R.J. and Clevenger, W.A., Earth and Earth rock dam, John Wiley, 1963.
4. Chowdhury, D.F., Slope analysis, Prentice Hall, 1988.
5. McCarthy, R.N., Essentials of Soil Mechanics and Foundations: Basic Geotechnics Sixth Edition), Prentice Hall, 2002.
6. Bramhead, E.N., The Stability of Slopes, Blacky Academic and Professionals Publications, Glassow 1986. Chandhar, R.J., Engineering Developments and Applications, Thomas Terlod, 1991.

Course Code	Course Title	Hours per week L-T-P	Credit C
CEG202214	Software Lab	0-0-4	2

Students have to learn the application of the following softwares:

1. MIKE 21C
2. HEC RAS
3. QGIS/ArcGIS
4. SWAT/ GeoHEC HMS

Course Code	Course Title	Hours per week L-T-P	Credit C
CEG202PE21	Finite Element Analysis	3-0-0	3

Matrix Methods in Skeletal Structural Analysis: Force and Displacement Methods.

Finite Element Technique, Various Steps of Analysis, Basic Theory, Shape Function Theory. Use of Parametric and Local Coordinates, Numerical Integration.

Element Properties, Two-Dimensional Elements, Plate Bending Elements Introduction to Three Dimensional Elements and special Elements.

Application to Plane-Stress and Plane-strain Problem, Axi-symmetric Problem, Temperature and Seepage Problem, Non-Linear Problem.

Introduction to Incremental and Iterative Processes for Non-Linear Problem. Example on the Finite Element Analysis, Finite Element Programming Organisation, Efficient Solver, Input/Output and Software Package for Finite Element Analysis.

Text/Reference Books:

1. Concepts and Applications of Finite Element Analysis by R. D. Cook.
2. Finite Element Analysis- Theory and Programming by C.S. Krishnamurthy.
3. Finite Element Method by O. C. Zienkiewicz.
4. Finite Element Procedures by K. J. Bathe.
5. Introduction to Finite Element Method by C. S. Desai and J. F. Abel.

Course Code	Course Title	Hours per week L-T-P	Credit C
CEG202PE22	Ground Improvements Techniques	3-0-0	3

OBJECTIVES: At the end of the course student is expected to identify the problematic soil and suitably suggest remedial measures to improve their behaviour

MODULE 1: Surface Compaction (4 Lectures)
Introduction, Review of compaction theory, Field procedures of compaction, Equipments for Surface Compaction, Quality Control.

MODULE 2: In-situ Deep Compaction in Granular Soils (4 Lectures)
Introduction, In-situ densification methods in granular soils, Terra-Probe, Vibroflotation techniques, Ground Suitability for Vibroflotation, Advantages, Mueller Resonance Compaction, Dynamic Compaction, Depth of Improvement.

MODULE 3: Dewatering Methods (6 Lectures)
Methods of Dewatering Systems, Design Steps for Dewatering Systems, Distance of Well Points from Sources of Seepage, Effective Well Radius, Discharge Computations, Design of Filters, Selection of Pumps and Accessories, Well pointing in Deep Excavations.

MODULE 4: Precompression and Vertical Drains (6 Lectures)
Review of Compressibility of Soils and Consolidation, Principle of Precompression, Methods of Preloading, Monitoring of Compression, General Principle of Vertical Drains, Design of Vertical Drains, Types and Construction of Vertical Drains, Dynamic Consolidation, Consolidation by Electro-osmosis.

MODULE 5: Stone Columns (4 Lectures)
Stone Columns, Improvement in Soil Bearing Capacity due to Stone Columns

MODULE 6: Grouting and Injection (4 Lectures)
Introduction, Groutability, suspension grout, solution grout, grouting equipment and methods, Applications.

MODULE 7: Cementing and Chemical Stabilization (4 Lectures)
Cement Stabilization, Bituminous Stabilization, Chemical Stabilization

MODULE 8: Reinforcement of Soil (8 Lectures)
Concept of soil reinforcement – Types of reinforcement material – Reinforced earth wall – Mechanism – simple design – applications of reinforced earth. Role of Geotextiles in filtration, drainage, separation, road works and containment.

OUTCOMES: Student will be in a position to identify and evaluate the deficiencies, if any, in the deposits of a project area and capable of providing alternate methods to improve its character suitable to the project so that the performance of the structures built is satisfactory

Text/Reference Books:

1. Ground Improvement Techniques by Dr. P Purushothama Raj
2. Koerner, R.M. “Construction and Geotechnical Methods in Foundation Engineering”, McGraw Hill, 1994.
3. Mittal.S, “An Introduction to Ground Improvement Engineering”, Medtech Publisher, 2013.
4. Bergado et. al. – Soft Ground Improvement
5. Gopal Ranjan and A. S. R. Rao – Basic and Applied Soil Mechanics

Recommended IS Codes:

1. IS9759 : 1981 “Guidelines for Dewatering During Construction”, Bureau of Indian Standards, New Delhi, Reaffirmed 1999
2. IS15284(Part 1) : 2003 “Design and Construction for Ground Improvement – Guidelines” (Stone Column), Bureau of Indian Standards, New Delhi, 2003

Course Code	Course Title	Hours per week L-T-P	Credit C
CEG202PE31	Environmental Geotechnics	3-0-0	3

Environmental Geotechnics - Introduction, Contaminated Land; Source, Production and Classification of Wastes, Environmental Effects on Geotechnical Problems, Soil Pollutant Interactions; Waste Disposal Facilities- Site Selection and Design, Liners, Basic concepts, design and construction liner stability, compatibility, performance, stabilization/ solidification, geotechnical use of Industrial Wastes such as fly ash, Waste Containment Devices.

Text Books:

1. Daniel, D.E. (1993): Geotechnical Practice for Waste Disposal, Chapman and Hall, London.
2. Dutta, S. (2002): Environmental Treatment Technologies for Hazardous and Medical Wastes, Remedial Scope and Efficiency, Tat McGraw Hill.
3. Raju, V. S. Datta, M., Seshadri, V., Agarwal, V.K. and Kumar, V. (1996): Ash Ponds and Ash Disposal Systems, Norosa Publishing House.

References:

1. R.K. Rowe, Geotechnical and Geoenvironmental Engineering Handbook, Kluwer Academic Publications, London.
2. L.N. Reddi and H.I. Inyang, Geoenvironmental Engineering, Principles and Applications, Marcel Dekker Inc. New York.
3. R.N. Yong, Geoenvironmental Engineering, Contaminated Soils, Pollutant Fate, and Mitigation, CRC Press, New York.
4. D.G. Fredlund and H. Rahardjo, Soil Mechanics for Unsaturated Soils, Wiley- Interscience, USA.
5. J.K. Mitchell, Fundamentals of Soil Behavior, Wiley.
6. D. Hillel, Introduction to Environmental Soil Physics, Academic Press, New York

Course Code	Course Title	Hours per week L-T-P	Credit C
CEG202PE32	CAD of Foundations	3-0-0	3

MODULE 1: Introduction

Estimation & use of Engineering Properties of Soil for Foundation Design. Shallow and Deep Foundations. Earth Retaining Structures- their Geotechnical and Structural Design. Advantages of Computer Aided Design vs. Conventional Design Methods.

MODULE 2: Design of Shallow Foundations

Proportioning of Shallow Foundation from bearing capacity and settlement considerations. Modulus of subgrade reaction and beam on elastic foundation approaches to shallow foundation design. Structural design of isolated footings and rafts. Use of CAD software.

MODULE 3: Design of Deep Foundations

Estimation of axial and lateral load carrying capacities of deep foundations. Load- settlement analysis of axially loaded pile foundations. Analysis of pile foundations under lateral loads. Structural design of piles and pile cap. Use of CAD software.

MODULE 4: Design of Earth Retaining Structures

Estimation of earth pressures on retaining walls. Stability check for gravity and counter fort retaining walls. Use of Cad software.

Text/Reference Books:

1. J. E. Bowles, “Foundation Analysis and Design”, McGraw Hill Companies, 1997
2. M. D., Desai, “Ground Property Characterization from In-Situ Testing”, Published by IGS- Surat Chapter, 2005
3. M. J., Hvorslev, “Sub-Surface Exploration and Sampling of Soils for Civil Engineering Purposes”, US Waterways Experiment Station, Vicksburg, 1949

Course Code	Course Title	Hours per week L-T-P	Credit C
MAC202221	Constitution of India	2-0-0	0

Course Objectives:

Students will be able to:

1. Understand the premises informing the twin themes of liberty and freedom from a civil rights perspective.
2. To address the growth of Indian opinion regarding modern Indian intellectuals' constitutional role and entitlement to civil and economic rights as well as the emergence of nationhood in the early years of Indian nationalism.
3. To address the role of socialism in India after the commencement of the Bolshevik Revolution in 1917 and its impact on the initial drafting of the Indian Constitution.

Unit 1: History of Making of the Indian Constitution (4Lectures)

History, Drafting Committee, (Composition & Working)

Unit 2: Philosophy of the Indian Constitution (4 Lectures)

Preamble, Salient Features

Unit 3: Contours of Constitutional Rights & Duties (4 Lectures)

- Fundamental Rights
- Right to Equality
- Right to Freedom
- Right against Exploitation
- Right to Freedom of Religion
- Cultural and Educational Rights
- Right to Constitutional Remedies □ Directive Principles of State Policy
- Fundamental Duties

Unit 4: Organs of Governance (4 Lectures)

- Parliament
- Composition
- Qualifications and Disqualifications
- Powers and Functions
- Executive
- President
- Governor
- Council of Ministers
- Judiciary, Appointment and Transfer of Judges, Qualifications
- Powers and Functions

Unit 5: Local Administration**(4 Lectures)**

- District's Administration head: Role and Importance,
- Municipalities: Introduction, Mayor and role of Elected Representative CEO of Municipal Corporation.
- Pachayati raj: Introduction, PRI: ZilaPachayat.
- Elected officials and their roles, CEO ZilaPachayat: Position and role.
- Block level: Organizational Hierarchy (Different departments),
- Village level: Role of Elected and Appointed officials
- Importance of grass root democracy

Unit 6: Election Commission**(4 Lectures)**

- Election Commission: Role and Functioning.
- Chief Election Commissioner and Election Commissioners.
- State Election Commission: Role and Functioning.
- Institute and Bodies for the welfare of SC/ST/OBC and women

Suggested reading

1. The Constitution of India, 1950 (Bare Act), Government Publication.
2. Dr. S. N. Busi, Dr. B. R. Ambedkar framing of Indian Constitution, 1st Edition, 2015.
3. M. P. Jain, Indian Constitution Law, 7th Edn., Lexis Nexis, 2014.
4. D.D. Basu, Introduction to the Constitution of India, Lexis Nexis, 2015.

Course Outcomes:**Students will be able to:**

1. Discuss the growth of the demand for civil rights in India for the bulk of Indians before the arrival of Gandhi in Indian politics.
2. Discuss the intellectual origins of the framework of argument that informed the conceptualization of social reforms leading to revolution in India.
3. Discuss the circumstances surrounding the foundation of the Congress Socialist Party [CSP] under the leadership of Jawaharlal Nehru and the eventual failure of the proposal of direct elections through adult suffrage in the Indian Constitution.
4. Discuss the passage of the Hindu Code Bill of 1956.

Course Code	Course Title	Hours per week L-T-P	Credit C
MAC202222	Pedagogy Studies	2-0-0	0

Course Objectives:

Students will be able to:

1. Review existing evidence on the review topic to inform programme design and policy making undertaken by the DfID, other agencies and researchers.
2. Identify critical evidence gaps to guide the development.

Unit 1: Introduction and Methodology (4 Lectures)

- Aims and rationale, Policy background, Conceptual framework and terminology □ Theories of learning, Curriculum, Teacher education.
- Conceptual framework, Research questions.
- Overview of methodology and Searching

Unit 2: (2 Lectures)

- Thematic overview: Pedagogical practices are being used by teachers in formal and informal classrooms in developing countries.
- Curriculum, Teacher education.

Unit 3: (4 Lectures)

- Evidence on the effectiveness of pedagogical practices
- Methodology for the in depth stage: quality assessment of included studies.
- How can teacher education (curriculum and practicum) and the school curriculum and guidance materials best support effective pedagogy?
- Theory of change.
- Strength and nature of the body of evidence for effective pedagogical practices.
- Pedagogic theory and pedagogical approaches.
- Teachers' attitudes and beliefs and Pedagogic strategies.

Unit 4: (4 Lectures)

- Professional development: alignment with classroom practices and follow-up support
- Peer support
- Support from the head teacher and the community.
- Curriculum and assessment
- Barriers to learning: limited resources and large class sizes

Unit 5: Research gaps and future directions (2 Lectures)

- Research design
- Contexts
- Pedagogy
- Teacher education
- Curriculum and assessment
- Dissemination and research impact

Suggested reading

1. Ackers J, Hardman F (2001) Classroom interaction in Kenyan primary schools, *Compare*, 31 (2): 245-261.
2. Agrawal M (2004) Curricular reform in schools: The importance of evaluation, *Journal of Curriculum Studies*, 36 (3): 361-379.
3. Akyeampong K (2003) Teacher training in Ghana - does it count? Multi-site teacher education research project (MUSTER) country report 1. London: DFID.
4. Akyeampong K, Lussier K, Pryor J, Westbrook J (2013) Improving teaching and learning of basic maths and reading in Africa: Does teacher preparation count? *International Journal Educational Development*, 33 (3): 272–282.
5. Alexander RJ (2001) *Culture and pedagogy: International comparisons in primary education*. Oxford and Boston: Blackwell.
6. Chavan M (2003) *Read India: A mass scale, rapid, ‘learning to read’ campaign*.
7. www.pratham.org/images/resource%20working%20paper%202.pdf.

Course Outcomes:

Students will be able to understand:

1. What pedagogical practices are being used by teachers in formal and informal classrooms in developing countries?
2. What is the evidence on the effectiveness of these pedagogical practices, in what conditions, and with what population of learners?
3. How can teacher education (curriculum and practicum) and the school curriculum and guidance materials best support effective pedagogy

Course Code	Course Title	Hours per week L-T-P	Credit C
MAC202223	Stress Management by Yoga	2-0-0	0

Course Objectives

1. To achieve overall health of body and mind
2. To overcome stress

Unit 1: Definitions of Eight parts of yog. (Ashtanga) (8 Lectures)

Unit 2: Yam and Niyam (2 Lectures)

Do's and Don't's in life.

- i) Ahinsa, satya, astheya, bramhacharya and aparigraha
- ii) Shaucha, santosh, tapa, swadhyay, ishwarpranidhan

Unit 3: Asan and Pranayam (2 Lectures)

- i) Various yog poses and their benefits for mind & body
- ii) Regularization of breathing techniques and its effects-Types of pranayam

Course Code	Course Title	Hours per week L-T-P	Credit C
MAC202224	Personality Development through Life Enlightenment Skills	2-0-0	0

Course Objectives:

1. To learn to achieve the highest goal happily
2. To become a person with stable mind, pleasing personality and determination
3. To awaken wisdom in students

Unit 1: Neetisatakam-Holistic development of personality (8 Lectures)

- Verses- 19,20,21,22 (wisdom)
- Verses- 29,31,32 (pride & heroism)
- Verses- 26,28,63,65 (virtue)
- Verses- 52,53,59 (don't's)
- Verses- 71,73,75,78 (do's)

Unit: 2 (8 Lectures)

- Approach to day to day work and duties.
- Shrimad Bhagwad Geeta : Chapter 2-Verses 41, 47,48,
- Chapter 3-Verses 13, 21, 27, 35, Chapter 6-Verses 5,13,17, 23, 35,
- Chapter 18-Verses 45, 46, 48.

Unit 3: (8 Lectures)

- Statements of basic knowledge.
- Shrimad Bhagwad Geeta: Chapter2-Verses 56, 62, 68
- Chapter 12 -Verses 13, 14, 15, 16,17, 18
- Personality of Role model. Shrimad Bhagwad Geeta: Chapter2-Verses 17, Chapter 3-Verses 36,37,42,
- Chapter 4-Verses 18, 38,39
- Chapter18 – Verses 37,38,63

SUGGESTED READING:

1. "Srimad Bhagavad Gita" by Swami Swarupananda Advaita Ashram (Publication Department), Kolkata
2. Bhartrihari's Three Satakam (Niti-sringar-vairagya) by P.Gopinath, Rashtriya Sanskrit Sansthanam, New Delhi

Course Outcome:

Students will be able to

1. Study of Shrimad-Bhagwad-Geeta will help the student in developing his personality and achieve the highest goal in life
2. The person who has studied Geeta will lead the nation and mankind to peace and prosperity
3. Study of Neetishatakam will help in developing versatile personality of students.
