Guru Nanak dev Engineering College, Ludhiana
(An Autonomous College under UGC Act)
Civil Engineering Department

Course Scheme: M. Tech (Geotechnical Engineering)—Full Time

Schedule of Teaching and study scheme

<table>
<thead>
<tr>
<th>Semester</th>
<th>Subjects</th>
<th>Credits</th>
<th>Contact Hours/week</th>
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List of Core Subjects

<table>
<thead>
<tr>
<th>S. No.</th>
<th>Subjects</th>
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<tbody>
<tr>
<td>1</td>
<td>Soil Dynamics</td>
<td>MTGT-501</td>
</tr>
<tr>
<td>2</td>
<td>Advanced Foundation Engineering</td>
<td>MTGT-502</td>
</tr>
<tr>
<td>3</td>
<td>Applied Soil Mechanics</td>
<td>MTGT-503</td>
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<tr>
<td>4</td>
<td>Research Methodology</td>
<td>MTGT-504</td>
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<td>5</td>
<td>Analysis of Settlement of Soils &amp; Foundations</td>
<td>MTGT-505</td>
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<tr>
<td>6</td>
<td>Site Investigations</td>
<td>MTGT-506</td>
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### List of Laboratory/Practical work

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<thead>
<tr>
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<tr>
<td>1</td>
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### List of Program Electives

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<tr>
<td>1</td>
<td>Soil-Structure Interaction</td>
<td>MTGT-601</td>
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<td>2</td>
<td>Rock Mechanics</td>
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<td>Geosynthetic Engineering</td>
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<td>Structural Design of Foundations</td>
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<td>Clay Mineralogy</td>
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<td>Retaining Structures</td>
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<td>7</td>
<td>Slope Stability Analysis</td>
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<td>8</td>
<td>Case Histories in Geotechnical Engineering</td>
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<td>9</td>
<td>Earth Anchors</td>
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<td>Design of Highway and Airport Pavements</td>
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<td>Strength of Materials</td>
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<td>12</td>
<td>Burried Structures</td>
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<td>13</td>
<td>Environmental Impact assessment &amp; Management</td>
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<td>Disaster Reduction and management</td>
<td>MTGT-615</td>
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<td>16</td>
<td>Environmental Geotechnology</td>
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<td>17</td>
<td>Ground Improvement</td>
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<td>Earthen Embankment</td>
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<td>19</td>
<td>Geomechanics</td>
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<td>20</td>
<td>Highway Materials &amp; Construction</td>
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### List of subjects to be offered as ‘Open Electives’

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<tr>
<td>1</td>
<td>Experimental Methods in Engineering</td>
<td>MTCE-621</td>
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<td>2</td>
<td>Numerical Methods in Engineering</td>
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<td>3</td>
<td>Instrumentation and model simulation</td>
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<td>Advanced Engineering Mathematics</td>
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<td>Probabilistic Methods in Engineering</td>
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<td>Limit Analysis</td>
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MTGT-501: Soil Dynamics

Course Credits --4

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Course Content


2. Dynamic Bearing Capacity: General, Failure Zones & Ultimate Bearing capacity criteria for satisfactory action of footing. Introduction to bearing capacity and settlement analysis under earthquake loading- Seismic design considerations, Codal provisions,


References

4. Lkuo Towhata, Geotechnical Earthquake Engineering, Springer, NY. 1995
5. Bharat Bhushan Prasad Fundamental of Soil Dynamics and Earthquake Engineering, PHI, 2005

Note: All relevant Indian Standards are allowed in the Examination.
Shallow Foundation: Terzaghi's bearing capacity equation, General bearing capacity equation, Balla's & Meyerhof's theory, Effect of water table, special footing problems, I.S. Code, Footing pressure for settlement on sand, Soil pressure at a depth, Boussinesq's & westergaard methods, Computation of settlements (Immediate & Consolidation) Permissible settlements, Proportioning of footing, Inclined & Eccentric loads.

Pile Foundation: Timber, concrete, Steel piles, estimating pile capacity by dynamic formula, By wave equation & By static methods, Point Bearing piles, Pile loads tests, Negative skin friction, Modulns of subgrade reaction for laterally loaded piles, Lateral resistance.

Single Pile v/s Pile Groups, Pile group consideration, Efficiency, Stresses on underlying strata, Settlement of pile group, Pile caps, Batter piles, Approximate and exact analysis of pile groups, I.S code.

Well foundation: Types (open end & closed or box, pneumatic, drilled) shapes, Bearing capacity and settlements, Determination of grip length by dimensional analysis, Design of well foundation construction, Tilts & shifts.

Machine Foundations: Types, Analysis and design by Barkens methods, Determination of coeff. of uniform elastic compression, Pauw's analogy and design of a Block type M/C foundation, I.S.I method of design, Co- vibrating soil mass.


References
1. Barken, D.D. " Dynamic of Bases and Foundation "
2. Peek Hansen " Foundation Engineering and Thornolour"
3. Leaconards " Foundation Engineering "
4. Bowles " Foundation Design"
5. Rechartetal "Vibration of Soils - Foundations."
MTGT-503: Applied Soil Mechanics

Course Credits: 4

Internal Marks: 50
External Marks: 100
Total Marks: 150

1. Introduction to stability of slopes, Stability number, Friction circle, Bishop's method of slices—simple and rigorous; Wedge method, Factor of safety w.r.t height and strength.

2. Earth work construction, Embankments, Earth dams, Field compaction, Seepage and piping in embankments and dams construction problems.


4. Arching in Soil & underground culvert and conduits.

5. Swell and shrinkage, Soils characteristics, swelling pressure of soils, Mechanics of Swelling, Crack.

6. Design of open cuts.

References:
1. "Soil Mechanics", Lambe & Whitman, Wiley Publisher
2. "Soil Mechanics and Foundation Engineering", Dr. K R Arora, Standard Publisher Distributors, New Delhi
OVERVIEW OF RESEARCH
Nature and Objectives of research; historical, descriptive and experimental. Study and formulation of research problem. Scope of research and formulation of hypotheses; Feasibility, preparation and presentation of research proposal

METHODS OF DATA COLLECTION
Primary data and Secondary Data, methods of primary data collection, classification of secondary data,

SAMPLING METHODS
Probability sampling: simple random sampling, systematic sampling, stratified sampling, cluster sampling and multistage sampling. Non-probability sampling: convenience sampling, judgement sampling, quota sampling. Sampling distributions.

PROCESSING AND ANALYSIS OF DATA
Statistical measures and their significance: Central tendencies, variation, skewness, Kurtosis, time series analysis, correlation and regression, Testing of Hypotheses :Parametric (t, z and F) Chi Square, ANOVA. Measures of central tendency and dispersion: mean, median, mode, range, mean deviation and standard deviation. Regression and correlation analysis.

DESIGN OF EXPERIMENTS:
Basic principles, study of completely randomized and randomized block designs. Edition and tabulation of results, presentation of results using figures, tables and text, quoting of references and preparing bibliography.

Note: Application and use of various software for case studies should essential be covered in the lectures.

References:
Kothari C.R., Research Methodology Methods and techniques by, New Age International Publishers, 2nd edition
MTGT 505: Analysis of Settlement of Soils & Foundations

Course Credits -- 4

Internal Marks: 50
External Marks: 100
Total Marks: 150

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Stress Strain Relation; Evaluation of parameters, types of settlements - elastic and inelastic, Method for estimation; Consolidation theories - one and three dimensional.
Settlement of footings - isolated footings, strip footing, Rafts, Piles and piles groups, Analysis of foundation Soil system.

References
1. Leonards - "Foundation Engineering"
2. Das Braja M - "Advanced Soil Mechanics"
3. Lambe & Whitman - "Soil Mechanics"
MTGT-506: Site Investigations

Course Credits --4

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2. Indirect method of exploration, Seismic method, Electrical resistivity, Resistivity sounding and profiling, Qualitative and quantitative interpretation of test results, Comparison of resistivity and seismic surveys, Shortcomings.
3. Stabilization of bore holes, Different method of stabilisation of the bore holes, their relative merits and demerits.
5. Sampling: Source of disturbance and their influence, Type of sampler, Principle of design of sampler, Representative and undisturbed sampling in various types of soils, Surface sampling, Amount of sampling, Boring and sampling record, Preservation and shipment of sample preparation of bore log.
6. In situ Permeability. Pumping in test in a cased hole with open end, Falling head packer test constant head packer test, Pump in out tests in a single test wall and open pit or unlined hole. Piezometer methods.
7. Water content at site: Speedy moisture tester, Their relative merits and demerits.
8. Fields Tests: Standard penetration test, Dynamic cone penetration tests with and without bentonite mud slurry. Static cone penetration test, Surface sampling, Cyclic plate load test, Large shear box test, Vane shear test, Pile load, , Block resonance test, wave propagation test. Small size penetrometers, Pressuremeter test and Diltometer test. Various corrections in the test results and interpretation of test results for design of foundations. Correlation among various test results. Precautions to be exercised during the execution of these tests. Preparation of bore hole log.

References
2. Simon and Cayton " Site investigation"
MTGT-507: Laboratory-1

Course Credits --2

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1) Algorithm/flow chart for various geotechnical engineering problems using spreadsheet, C++ etc.
2) Stability analysis using various softwares such as GEO5, PLAXIS etc.
3) Bearing Capacity of shallow and deep foundations using software such as GEO5, PLAXIS etc.
4) Settlement analysis of shallow and deep foundations using software such as GEO5, PLAXIS etc.
5) Analysis of soil-structure interaction problems such as piled-raft, laterally loaded piles, sheet piles etc.
6) Analysis of ground improvement problems such as soil nailing, use of geogrids/geosynthesis etc.
MTGT-508 Laboratory-2

Course Credits --2

Internal Marks: 50
External Marks: 50
Total Marks: 100

1. Relative Density of sand Test
2. Proctor Compaction Test
3. CBR Test
5. Free Swell, Swell Potential, Swell Pressure Test
6. Standard Penetration Test
7. Dynamic Cone Penetrometer Test
8. Bearing capacity of footing in Soil box- isolated footings, pile and piled-raft footings
9. Analysis of cuts and slopes
MTGT-604: Structural Design of Foundations

Course Credits --3

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**Shallow Foundation**

Design of footing e.g. isolated footing in B.B.C. and steel grillage, combined footings of rectangular, Trapezoid cantilever types. Mat or raft foundation for dry and saturated soil, floating foundations

**Deep Foundation**

Design of Piles, Pile caps and pile foundations buildings, Design of retaining structures

**Earth Retaining Structures**

Design of retaining walls for dry and saturated back fills with surcharge loads. Retaining walls resting on piles, Design of bridge abutments, Design of sheet piles used for coffer dams, Design of sheeting bracing in excavation trenches

**Special Structures**

Design of foundation for transmission Design of basement walls, Bridges structures Analysis and Design: Design of walls foundation and caissons of different types, Design of bridge piers resting on piles.

**References:**

1. “Advanced RCC Design” Pillai & Mennon, Tata MacGraw Hill
2. “Advanced Design of Structures”, N. Krishna Raju
4. “Limit state Design of Reinforced Concrete”; Varghese P C; Prentice-Hall of India Pvt. Ltd”.
5. "Reinforced Concrete and masonry Structures", Hool and kinne
MTGT– 616 Environmental Geotechnology

Internal Marks: 50
External Marks: 100
Total Marks: 150

Course Credits --3
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Contamination in soils: Subsurface contamination, Mass transport mechanisms, Mass transfer mechanisms, Governing equation for mass transport, Soil as a geotechnical trap, effects of subsurface contamination its detection and monitoring.

Mechanisms of soil-water interaction: Diffuse double layer and simple DDL models; Force of attraction and repulsion; Soil-water-contaminant interaction; Effect of contaminants on engineering properties of soil.

Site investigation: Introduction, Site investigation approach, phase investigations, Geophysical techniques, Hydro-geological investigations, Hydro-geochemical investigations, Geochemical data collection and analysis.

Concepts of waste containment facilities: Desirable properties of soil; contaminant transport and retention; containment of solid waste in landfills, environmental impact of slurry waste and containment of slurry wastes, contaminated site remediation.

Case histories: Case histories on geoenvironmental problems pertaining to use of readily available local soils, bioremediation of spills etc.

Books:-

4. Hsai_Yang Fang and Daniels, J.L. Introductory Geotechnical Engineering an Environmental Perspective, Taylor & Francis, Oxon., 2006
MTGT – 617 Ground Improvement

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Internal Marks: 50  
External Marks: 100  
Total Marks: 150

1. Introduction, Economic considerations, Consolidation by preloading and sand drains, Strengthening by granular columns and lime columns, Compaction by vibro-flotation, Blasting, Dynamic consolidation, Grouting techniques and principles grounds anchors, Reinforced earth construction Geo-textiles Problems.


References:

1. M.P. Moasley “Ground Improvement”  
2. P. Purushothama Raj “Ground Improvement”  
3. Das Braja M. “Principles of foundation Engineering”
MTGT-619 Geomechanics

Course Credits -- 3

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1. Superficial deposits, weathering and erosion processes, Mechanism involved, Detailed description of the resulting geomorphologic feat covering weather effects, river actions, Sea action, Wind action and ice action, Their origin, Mechanism involved and engineering significance.

2. Detailed geologic and physiographic account of extra peninsular India and Indo gangetic Plains.

3. Study of important Rock: forming minerals, Quartz group, Mica, Feldspar group, Pyroxene group, Amphibole group and miscellaneous mine of common occurrence. Structures and texture of the main rock group geological and engineering characteristics of the important rock by: Microscopic study of important rock and minerals including preparation of thin sections.

4. Geotectonics: North movement, Diastrophism, Oscstasy and central drafts, formation of major structural feature in rock folds. Faults, Joints and unconformities, their effects on cut crops mechanism involved, Their engineering significance.


6. Earthquakes: Mechanism involved; Geological consideration for construction; Reservoir related earthquakes.

7. Groundwater: Ground water investigation in Civil engineering, Ground water provinces in India.


References:

1. Leggey "Engg. Geology"
2. Slyth "Engg Geology"
3. D.S. Arora "Geology for Engineers"
MTGT 620 Highway Materials and Construction

Course Credits --3

Internal Marks: 50  L  T  P  3 0 0
External Marks: 100
Total Marks: 150

Subgrade Soil:- significance, characteristics of soil, desirable properties, Index Properties, Soil classification based on grain size, IS soil classification, GI of soil, Subgrade strength, Evaluation of soil strength- Direct Shear Test, Triaxial Comp. test, UCS test, plate bearing test, Modulus of subgrade reaction, CBR Test.
Stone Aggregates:- Introduction, desirable properties, crushing test, impact test, soundness test, shape test, specifics gravity & water absorption, bitumen adhesion test.
Bituminous Materials:- Introduction, types of bitumen materials, desirable properties, penetration test, ductility test, viscosity test, float test, specific gravity test, softening point test, flash & fire point test, solubility test, spot test, loss on heating test, water content test, Cutback bitumen, bitumen emulsion, tar.
Bituminous Paving Mixes:- Requirements of bituminous mixes, design of bituminous mix, Marshall Method of bituminous mix design, modified Hubbard field method of bituminous mix design, Hveem method of bituminous mix design.
Bituminous Pavement Construction:- Introduction, types of pavement construction, excavation equipments, embankment construction, preparation of subgrade, compaction equipments, field control for compaction, construction of earth roads, construction of gravel roads, construction of WBM roads, construction of bituminous pavements, Bituminous construction procedures.
Cement Concrete Pavement Construction:- Introduction, Mix design, concrete strength, size of aggregates & gradation, workability, construction of cement concrete pavement slab, construction of joints, joints filler & sealer, pre-stressed concrete pavements.

References:
3. Relevant IRC and IS Codes of Practices (Separate List will be given).
5 Relevant IRC and IS codes
MTCE-622: Numerical Methods in Engineering

Course Credits --3

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2. Finite Difference Technique: Partial differential equation: Laplace, Poisson and wave equation – Explicit and implicit methods. Initial and Boundary value problems of ordinary and partial differential equations, Solution of Various types of plates and other civil engineering related problems

3. Statistical Methods: Method of correlation and Regression analysis for fitting a polynomial equation by least square

4. Initial Value problem: Galerkin’s method of least square, Initial Value problem by collocation points, Runge kutta Method

References:
3. J.B Dixit : Numerical Methods, USP (Laxmi publication),