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Geotechnical Engineering — Complete Syllabus

BTEUP Diploma in Civil Engineering • 5th Semester • Session 2026-27

Subject 5.3 (Theory) + 5.8 (Lab) • Total 200 Marks • 4 Credits

About this document: Geotechnical Engineering appears twice in the 5th semester — as a theory paper (5.3) and as a lab (5.8). Both are covered here, completely, in the official order.

Examination Scheme

Code	Paper	Type	L - P	Credits	Internal	External	Total
5.3	Geotechnical Engineering	Theory	2 - 0	2	Theory 40	Theory 60 (3 hrs)	100
5.8	Geotechnical Engineering Lab.	Practical	0 - 4	2	Practical 60	Practical 40 (3 hrs)	100
Geotechnical Engineering Total				4	100	100	200

What This Subject Aims To Do

To understand and determine physical and index properties and classification of soil, estimate permeability and shear strength of soil, know the load bearing capacity of soil, and learn various soil stabilisation and compaction methods.

Unit-Wise Complete Topic List

Unit	Topic	Periods	Marks Share
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1	Overview of Geology and Geotechnical Engineering	3	10%
2	Physical and Index Properties of Soil	7	25%
3	Permeability and Shear Strength of Soil	7	25%
4	Compaction and Consolidation	5	20%
5	Bearing Capacity of Soil and Stabilization of Soil	6	20%

Unit 1 — Overview of Geology and Geotechnical Engineering (3 Periods, 10%)

Topics: Introduction of geology, branches of geology, importance of geology for civil engineering structure and composition of earth; definition of a rock: classification based on their genesis (mode of origin), formation; classification and engineering uses of igneous, sedimentary and metamorphic rocks; importance of soil as construction material in civil engineering structures and as foundation bed for structures.

Unit 2 — Physical and Index Properties of Soil (7 Periods, 25%)

Topics: Soil as a three-phase system, water content, determination of water content by oven drying method as per BIS code, void ratio, porosity and degree of saturation, density index; unit weight of soil mass — bulk unit weight, dry unit weight, unit weight of solids, saturated unit weight, submerged unit weight; determination of bulk unit weight and dry unit weight by core cutter and sand replacement method, determination of specific gravity by pycnometer; consistency of soil, Atterberg limits of consistency: liquid limit, plastic limit and shrinkage limit, plasticity index; particle size distribution test and plotting of curve, determination of effective diameter of soil, well graded and uniformly graded soils, BIS classification of soil; effective stress (concept only), stresses in subsoil, definition and meaning of total stress, effective stress and neutral stress, principle of effective stress, importance of effective stress in engineering problems.

Unit 3 — Permeability and Shear Strength of Soil (7 Periods, 25%)

Topics: Definition of permeability, Darcy's law of permeability, coefficient of permeability, factors affecting permeability, determination of coefficient of permeability by constant head and falling head tests, simple problems to determine coefficient of permeability; seepage through earthen structures, seepage velocity, seepage pressure, phreatic line, flow lines, application of flow net (no numerical problems); shear failure of soil, concept of shear strength of soil; components of shearing resistance of soil — cohesion, internal friction; Mohr-Coulomb failure theory, strength envelope, strength equation for purely cohesive and cohesion less soils; direct shear and vane shear test — laboratory methods.

Unit 4 — Compaction and Consolidation (5 Periods, 20%)

Topics: Concept of compaction and consolidation, standard and modified Proctor test as per IS code, plotting of compaction curve for determining: optimum moisture content (OMC), maximum dry density (MDD), zero air voids line; factors affecting compaction, field methods of compaction — rolling, ramming and vibration; suitability of various compaction equipments — smooth wheel roller, sheep foot roller, pneumatic tyred roller, rammer and vibrator; difference between compaction and consolidation; definition of earth pressure, active and passive earth pressure for no surcharge condition, coefficient of earth pressure, Rankine's theory and assumptions made for non-cohesive soils.

Unit 5 — Bearing Capacity of Soil and Stabilization of Soil (6 Periods, 20%)

Topics: Bearing capacity and theory of earth pressure; concept of bearing capacity, ultimate bearing capacity, safe bearing capacity and allowable bearing pressure; introduction to Terzaghi's analysis and assumptions, effect of water table on bearing capacity; field methods for determination of bearing capacity — plate load and standard penetration test; test procedures as per IS:1888 and IS:2131; concept of soil stabilisation, necessity of soil stabilisation, different methods of soil stabilisation; California bearing ratio (CBR) test — meaning and utilisation in pavement construction; necessity of site investigation and soil exploration: types of exploration, criteria for deciding the location and number of test pits and bores; field identification of soil — dry strength test, dilatancy test and toughness test.

Practical Work

- Identification of rocks from the given specimen.
- Determine water content of given soil sample by oven drying method as per IS: 2720 (Part- II).
- Determine specific gravity of soil by pycnometer method as per IS 2720 (Part- III).
- Determine dry unit weight of soil in field by core cutter method as per IS 2720 (Part- XXIX).
- Determine dry unit weight of soil in field by sand replacement method as per IS 2720 (Part- XXVIII).
- Determine plastic and liquid limit along with plasticity index of given soil sample as per IS 2720 (Part- V).
- Determine shrinkage limit of given soil sample as per IS 2720 (Part- V).
- Determine grain size distribution of given soil sample by mechanical sieve analysis as per IS 2720 (Part- IV).
- Use different types of soil to identify and classify soil by conducting field tests — through visual inspection, dry strength test, dilatancy test and toughness test.

- Determine coefficient of permeability by constant head test as per IS 2720 (Part- XVII).
- Determine coefficient of permeability by falling head test as per IS 2720 (Part- XVII).
- Determine shear strength of soil by direct shear test as per IS 2720 (Part- XIII).
- Determine shear strength of soil by vane shear test as per IS 2720 (Part- XXX).
- Determine MDD and OMC by standard Proctor test of given soil sample as per IS 2720 (Part- VII).
- Determination of CBR value on the field as per IS 2720 (Part- XVI).

Reference Books (as listed in the syllabus)

- Punmia, B.C., Soil Mechanics and Foundation Engineering, Laxmi Publication, Delhi.
- Murthy, V.N.S., A text book of soil mechanics and foundation Engineering, CBS Publishers & Distributors Pvt. Ltd., New Delhi.
- Ramamurthy, T.N. & Sitharam, T.G., Geotechnical Engineering (Soil Mechanics), S Chand and Company Ltd., New Delhi.
- Raj, P. Purushothama, Soil Mechanics and Foundation Engineering, Pearson India, New Delhi.
- Kasamalkar, B. J., Geotechnical Engineering, Pune Vidyarthi Griha Prakashan, Pune.
- Arora K R, Soil Mechanics and Foundation Engineering, Standard Publisher.
- S.K.Sharma, Soil Mechanics & Foundation Engineering, Asian Publishers, Muzaffarnagar, ISBN No. 978-93-91541-60-6.

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Source: BTEUP 3rd Year curriculum (folder2627), approved in C.D.C. meeting held on 16.07.2026. Topic lists follow the official syllabus; short explanations are the author's own plain-English summaries, not syllabus text. Please confirm with your own polytechnic for any local changes.