

GUJARAT TECHNOLOGICAL UNIVERSITY

DIPLOMA IN TRANSPORTATION ENGINEERING

Semester: 4

Subject Name SOIL ENGINEERING

Sr. No.	Course content
1.	INTRODUCTION <p>1.1 History</p> <p>1.2 List structures where soil is used as construction material</p> <p>1.3 Soil-formation in Geological cycle</p> <p>1.3.1 Name the types of failure due to soil in civil engineering structure</p> <p>1.4 Foundation as branch of civil engineering</p> <p>1.4.1 Selection of foundation width</p>
2.	INDEX PROPERTIES AND RELATIONS <p>2.1 Three phase diagram</p> <p>2.1.1 State three constituents of soil</p> <p>2.1.2 Draw a sketch showing three phases of soil</p> <p>2.1.3 State assumptions in drawing a phase diagram</p> <p>2.2 Functional relationship</p> <p>2.3 Properties of soil</p> <p>2.3.1 Define the following terms</p> <p>2.3.1.1 Density</p> <p>2.3.1.2 Field density</p> <p>2.3.1.3 Dry density</p> <p>2.3.1.4 Saturated density</p> <p>2.3.1.5 Void ratio</p> <p>2.3.1.6 Porosity</p> <p>2.3.1.7 Specific gravity</p> <p>2.3.1.8 Degree of saturation</p> <p>2.3.1.9 Moisture content</p> <p>2.4 Derive the following relations for a soil sample from fundamentals</p> $e = \frac{\eta}{(1-\eta)}, S = \frac{\omega G}{e}, \gamma_d = \frac{\gamma_b}{(1+\omega)}, \gamma_b = \gamma_w \frac{(G + eS)}{(1+e)} \text{ and other}$
3.	CLASSIFICATION OF SOIL <p>3.1 Classification of soil (Grain size) as per Indian Standard</p> <p>3.1.1 State the basis of classification of soils</p> <p>3.1.2 List three main categories of soils</p> <p>3.1.3 Draw a scale for classifying soils on the basis of grain size</p> <p>3.2 Mechanical Analysis of soils</p> <p>3.2.1 Distinguish between course grained and fine grained on the basis of (a) range of grain size and (b) engineering properties</p> <p>3.2.2 State how the sieves are designated as per I.S. code and list the I.S. sieves required for analysis</p>

	<p>3.2.3 Explain the terms</p> <ul style="list-style-type: none"> (a) mechanical analysis (b) Sieve analysis (course and fine) (c) sedimentation analysis <p>3.3 Grading Curves and different coefficients i.e. CU and CC</p> <p>3.4 Difference between clay, silt, sand and gravel</p> <p>3.5 Define the following limits</p> <ul style="list-style-type: none"> 3.5.1 Liquid limit 3.5.2 Plastic limit 3.5.3 Shrinkage limit 3.5.4 Plasticity Index <p>3.6 Define the consistency limits</p> <ul style="list-style-type: none"> 3.6.1 Co-relate the four states of soils i.e. liquid, plastic, semisolid and solid with the consistency limits
4.	<p>PERMEABILITY</p> <p>4.1 Permeable and Impermeable soils</p> <ul style="list-style-type: none"> 4.1.1 Define: Permeability and Impermeability 4.1.2 Distinguish between flow of water through pipe and through soils <p>4.2 Factors affecting the permeability</p> <ul style="list-style-type: none"> 4.2.1 List the factors which affect the permeability of soil 4.2.2 Explain how are these factors used to control the permeability of soil to desired extent in various civil engineering structures <p>4.3 Coefficient of permeability</p> <ul style="list-style-type: none"> 4.3.1 Give relevant data to calculate coefficient of permeability using the appropriate expression from the following two $k = \frac{Q L}{t h A} \text{ for constant head method and}$ $k = 2.303 \frac{a L}{A t} \log_{10} \left(\frac{h_1}{h_2} \right) \text{ for falling head method}$ <p>4.4 Constant head method for permeability</p> <ul style="list-style-type: none"> 4.4.1 Explain the mathematical relations to calculate coefficient of permeability by constant head method for permeability
5.	<p>COMPACTION</p> <p>5.1 Definition and scope</p> <ul style="list-style-type: none"> 5.1.1 Define compaction 5.1.2 Explain the effects of compaction of different soil properties like permeability, shear strength, soil settlements-stability of embankments etc. <p>5.2 Maximum dry density and O.M.C.</p> <ul style="list-style-type: none"> 5.2.1 Draw a typical compaction curve 5.2.2 Define : (a) Optimum moisture content (OMC) (b) Maximum dry density (MDD) <p>5.3 Proctor test (a) Light compaction (b) Heavy compaction test</p> <ul style="list-style-type: none"> 5.3.1 Conduct the light compaction test on a given soil sample

	<p>5.4 Factors affecting compaction</p> <p>5.4.1 List the factors that affect compaction (a) water content (b) nature of soil (fine or coarse grained)(c) Grading of soils (d) compaction energy (e) thickness of layer</p> <p>5.5 Difference between compaction and consolidation</p> <p>5.5.1 Distinguish : (i) Compaction (ii) Consolidation</p> <p>5.6 Role of O.M.C in the field</p> <p>5.6.1 State the role of O.M.C in the field</p> <p>5.7 Methods of compaction</p> <p>5.7.1 Name the two standard tests for compaction</p> <p>5.7.2 Describe the general procedure of the tests.</p> <p>5.8 List the Equipment for compaction</p>
6.	<p>SHEAR STRENGTH</p> <p>6.1 Definition</p> <p>6.1.1 Define: (a) Cohesion (b) internal friction (c) Shear strength</p> <p>6.1.2 Explain Coulomb's law for shear strength $S = C + \sigma_n \tan \phi$</p> <p>6.2 Shear stress of soil</p> <p>6.2.1 List the shear tests used to determine shear strength of soil in laboratory</p> <p>6.2.2 Describe the procedure of direct shear test (Box shear test)</p> <p>6.3 Types of soil C-soil, ϕ-soil, C-ϕ soil.</p> <p>6.3.1 Draw failure envelope by drawing Mohr's circle from the data obtained during direct shear test</p> <p>6.3.2 Calculate the values C and ϕ from the failure envelope of direct shear test on soil</p>
7.	<p>BEARING CAPACITY</p> <p>7.1 Definition.</p> <p>7.1.1 Define: bearing capacity of soil</p> <p>7.2 Bearing capacity of various soils.</p> <p>7.2.1 List the bearing capacities of different types of soil</p> <p>7.3 Methods of improving bearing capacity of soils.</p> <p>7.4 Methods for determining bearing capacity of soils</p> <p>7.5 Foundation on soils of various bearing capacity</p> <p>7.5.1 State the main types of foundations on soils of various bearing capacity</p> <p>7.6 Liquefaction</p> <p>7.6.1 Definition</p> <p>7.6.2 Mechanism</p> <p>7.6.3 Effects</p> <p>7.6.4 Mitigation</p>

8.	<p>RETAINING WALL AND EARTH PRESSURE</p> <p>8.1 Lateral earth pressure.</p> <p>8.1.1 Define earth pressure</p> <p>8.1.2 State the type of earth pressure</p> <p>8.1.3 Define lateral earth pressure</p> <p>8.2 Active & passive earth pressure.</p> <p>8.2.1 Distinguish : (a) Active earth pressure (b) Passive earth pressure</p> <p>8.2.2 Understand theories of earth pressure</p> <p>8.2.3 Understand effect of surcharge on earth pressure</p> <p>8.3 Stability of retaining wall.</p> <p>8.3.1 State conditions of stability of retaining wall</p>
9.	<p>FIELD IDENTIFICATION</p> <p>9.1 Definition and scope.</p> <p>9.1.1 Define: field identification</p> <p>9.2 Important field Identification tests.</p> <p>9.2.1 State the three main field tests: (a) Dry strength (b) Dilatancy (c) Toughness</p> <p>9.2.2 Describe the procedure of each test mentioned in 9.2.1</p> <p>9.2.3 Given a soil sample of a fine grained soil, classify it on the basis of the field identification tests.</p>

Laboratory Experiments

1. Determination of field moisture content of soil
2. Determination of bulk density and dry density of soil by core cutter method
3. Determination of specific gravity of sand by pycnometer
4. Determination of bulk density and dry density of soil by sand replacement method
5. Sieve analysis of soil
6. Determination of consistency limits i.e. Liquid limit, Plastic limit, Shrinkage limit
7. Identification of soil
8. Determination of permeability of soil by constant head method
9. Determination of permeability of soil by falling head method
10. Determination of shear parameters of soil by box shear test
11. Proctor test to determine OMC and MDD

Reference Books:

Sr. No.	Name of Books	Author
1.	Introductory Soil Mechanics	S.N.Awasthy J.K.Publishing House, Bhopal
2.	A Text Book of Soil Mechanics	Bharat Singh Nemchand Prakashan, Roorkee.
3.	A Text Book of Soil Mechanics	Dr.S.B.Sehgal Metropolitan Book Co. Pvt. Ltd., New Delhi.
4.	Soil Mechanics & foundation	B.C.Punmia Standard Book House, New Delhi
5.	Text Book of Soil Mechanics and Foundation Engineering	V.N.S.Murthy U.B.S. Publishers' & Distributors,NewDelhi.
6.	I.S. 2720 (part I to VII,XI, XIII, XXVIII, XXXI)	B.I.S. Publication, New Delhi.
7.	I.S. 1892, 2132, 2809.	B.I.S. Publication, New Delhi.
8.	Soil Sampling & Testing (Manual)	T.R.Ramanna, A.K.Duggal , S.Krisnamurthy T.T.T.I., Sector26, Chandigarh
9.	Soil Mechanics	Alfreds R. Jumikis East-West Press Pvt. Ltd., New Delhi.
10.	ModernGeotechnical Engineering	Dr. Alam Singh Jodhpur University, Jodhpur.
11.	Physical & Geotechnical properties of soils	Joseph E. Bowles McGraw-Hill Book Co., New Delhi.
12.	Soil Mechanics	T.William Lambe & Robert V. Whitman Wiley Eastern Limited, New Delhi