

**Legends:** **L** - Lecture; **T** - Tutorial/Teacher Guided Student Activity; **P** - Practical; **C** - Credit; **ESE** - End Semester Examination; **PA** - Progressive Assessment

## 5. COURSE DETAILS

Unit	Major Learning Outcomes (in cognitive domain)	Topics and Sub-topics
<b>Unit – I</b>  <b>Introduction</b>	1a. Discuss soil formation cycle & general characteristics of soil. 1b. List structures where soil is used as Construction material. 1c. Describe soil-formation in Geological cycle 1d. State the types of failures due to soil in Civil Engineering structure	1.1 History 1.2 List structures where soil is used as construction material 1.3 Soil-formation in Geological cycle 1.4 State the types of failures due to soil in Civil Engineering structure 1.5 General characteristics of different types of soils 1.6 Overview of different types of soils in Gujarat / India.
<b>Unit – II</b>  <b>Index Properties &amp; Interrelationship</b>	2a. Explain phase diagram of Soil 2b. Discuss various index properties of soil for the purpose of their classification & Use 2c. Describe interrelationship between different index properties	2.1 Three phase diagram 2.1.1 State three constituents of soil 2.1.2 Sketch showing three i. phases of soil 2.1.3 Assumptions in drawing a ii. phase diagram 2.2 Properties of soil like Density, Field density, Dry density, Saturated density, Void ratio, Porosity, Specific Gravit, Degree of saturation, Moisture content, Density Index 2.3 Derive the following relations for a soil sample from fundamentals 2.3.1 $e = n/n-1$ , $n = e/1+e$ 2.3.2 $w \times G = e \times s_r$ 2.3.3 $\gamma_d = \gamma_b / 1 + w$ 2.3.4 $\gamma_b = (G + e \cdot s_r) \gamma_w / (1 + e)$ 2.3.5 $\gamma_{sat} = (G + e) \gamma_w / (1 + e)$ 2.3.6 $\gamma_d = G \gamma_w / 1 + e$ 2.4 Numerical on 2.3

<b>Unit – III</b>  <b>Soil Classification</b>	3a. Discuss methods of Classification 3b. Describe method of I.S. Classification of Soil 3c. Classify Soil based on Consistency Limits	3.1 Classification of soil (Grain size) as per Indian Standard 3.1.1 Basis /criteria of classification i. of soils ii. Three main categories of soils iii. Scale for classifying soil iv. on the basis of grain size 3.2 Mechanical Analysis of soil 3.2.1 Difference between coarse grained and fine grained Soil on the basis of range of grain size and engineering properties 3.2.2 Sieves designation as per i. I.S. code 3.2.3 Coarse & Fine Sieve analysis, b. sedimentation analysis 3.3 Grading Curves and different coefficients i.e. CU and CC a. Clay, silt, sand and gravel as per particle size b. Consistency Limits like Liquid limit, Plastic limit, Shrinkage 3.4 Limit and Plasticity Index`
<b>Unit – IV</b> <b>Compaction</b>	4a. Comprehend the principle and methods of compaction of soil 4b. Differentiate between compaction and consolidation with examples 4c. Determine MDD & OMC of soil by conducting appropriate test	4.1. Compaction and its Application 4.1.1 Effects of compaction on different soil properties like permeability, shear strength, soil settlements-stability of embankments. 4.2. Maximum dry density and O.M.C. 4.2.1 Typical compaction curve 4.2.2 Optimum moisture content (OMC), Maximum dry density (MDD) 4.3. Proctor test 4.3.1 Light compaction 4.3.2 Heavy compaction test 4.3.3 Light compaction test on a given soil sample 4.4. Factors affecting compaction like water content, nature of soil (fine or coarse grained), Grading of soil, compaction energy, thickness of layer 4.5. Compaction and Consolidation 4.6. Role of O.M.C in the field 4.7. Methods of Field Compaction & various Equipment for compaction

<b>Unit – V</b>  <b>Permeability &amp; Seepage</b>	<p>5.a Explain concept of permeability &amp; its implications with respect to use of soil.</p> <p>5.b Determine 'permeability' of given soil.</p> <p>5.c Comprehend the concept of Seepage Analysis in relation to 'quick sand condition' with examples.</p>	<p>5.1 5.1 Permeable and Impermeable soils</p> <p>5.1.1 Permeability and Impermeability</p> <p>5.1.2 Flow of water through pipe and Through soil</p> <p>5.2 Factors affecting the permeability</p> <p>5.2.1 The factors affecting permeability of soil</p> <p>5.2.2 Factors used to control the permeability of soil to desired extent in various Civil engineering structures</p> <p>5.3 Methods to find Coefficient of Permeability</p> <p>5.3.1 Constant Head Method</p> <p>5.3.2 Falling Head Method</p> <p>5.4 Coefficient of permeability</p> <p>5.4.1 Numerical based on</p> $K = (Q \times L) / (t \times h \times A)$ $K = (2.3 \times a \times L) / (A \times t) \log_{10} h_1 / h_2$ <p>5.5 Seepage pressure</p> <p>5.1 Seepage pressure.</p> <p>5.2 Quick sand condition.</p> <p>5.3 Flow net, its characteristics and application.</p>
<b>Unit-VI</b>  <b>Shear Strength</b>	<p>6a. Explain different terms used in the context of 'shear strength' of soil.</p> <p>6b. Evaluate shear parameters of various types of soil, with their practical significance</p>	<p>6.1. Definition</p> <p>6.1.1 Define: (a) Cohesion (b) internal friction (c) Shear strength</p> <p>6.1.2 Coulomb's law for shear strength <math>S = C + \sigma_n \tan \phi</math></p> <p>6.2. Shear strength of soil</p> <p>6.2.1 Different shear tests used to determine shear strength of soil in laboratory</p> <p>6.2.2 Procedure of direct shear test (Box shear test)</p> <p>6.3. Types of soil C-soil, <math>\phi</math>-soil, C-<math>\phi</math> 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 <math>\phi</math></p> <p>i. from the failure envelope of</p> <p>ii. direct shear test on soil</p>

<b>VII</b>  <b>Bearing Capacity of soil</b>	7a. Explain concept of bearing capacity of soil. 7b. Describe various methods to determine bearing capacity of soil. 7c. Explain the concept & occurrence mechanism & effect of 'Liquefaction' of soil.	7.1 Bearing capacity of soil 7.1.1 Net Bearing capacity 7.1.2 Safe Bearing Capacity 7.1.3 Ultimate Bearing Capacity 7.1.4 Bearing Capacity of various soil 7.2 Methods – Plate Load Test, Penetration Test & using $C - \Phi$ parameters for determining bearing capacity of soil and to improve bearing capacity of soil 7.2.1 Foundation on soils of various bearing Capacity 7.3 Liquefaction 7.4 Definition 7.5 Occurrence & effect Effects of Liquefaction Remedial for Liquefaction
<b>VIII</b>  <b>Soil Investigation &amp; Exploration</b>	8a. Discuss various methods & appropriate use for investigation & exploration of soil.	8.1 Purposes of exploration of soil. 8.2 Planning of exploration program 8.3 Soil samples and collection. 8.4 Field penetration Test: SPT 8.5 Introduction to geophysical methods

## 6. SUGGESTED SPECIFICATION TABLE WITH HOURS & MARKS (THEORY)

Unit	Unit Title	Teaching Hours	Distribution of Theory Marks			
			R Level	U Level	A Level	Total Marks
I	Introduction	02	02	00	00	02
II	Index Properties & Interrelationships	07	02	04	08	14
III	Classification of Soil	07	04	02	08	14
IV	Compaction of Soil	06	03	03	04	10
V	Permeability & Seepage	06	03	03	04	10
VI	Shear Strength	05	02	02	03	07
VII	Bearing Capacity of soil	05	02	02	03	07
VIII	Soil Investigation & Exploration	04	02	01	03	06
<b>Total</b>		<b>42</b>	<b>20</b>	<b>17</b>	<b>33</b>	<b>70</b>

Legends: R = Remember, U = Understand, A= Apply and above Level (Bloom's revised taxonomy)

Note: This specification table shall be treated as a general guideline for students and teachers. The actual distribution of marks in the question paper may vary slightly from above table

## 7. SUGGESTED LIST OF EXERCISES/PRACTICAL

The practical/exercises should be properly designed and implemented with an attempt to develop different types of skills (**outcomes in psychomotor and affective domain**) so that students are able to acquire the competencies/programme outcomes. Following is the list of practical exercises for guidance.