

GUJARAT TECHNOLOGICAL UNIVERSITY, AHMEDABAD, GUJARAT

COURSE CURRICULUM

**Course Title: Soil Mechanics
(3340605)**

Diploma Programme in which this course is offered	Semester in which offered
Civil Engineering /Transportation Engineering	4 th Semester

1. RATIONALE

Soil and its Engineering Properties are highly important in order to make Civil Engineering Structure safe and serviceable. In , INDIA , from region to region ,Soil has varying properties and characteristics and is subjected to various stresses and problems like the water logging, liquefaction of soil , seepage through soil and settlement of Soil. Students have to study these phenomena of Soil and will have to apply this knowledge to Construction of Structures on soil according to Soil available on the field.

2. COMPETENCY (Programme Outcomes (POs) According to NBA terminology)

The course content should be taught and implemented with the aim to develop required theoretical knowledge & associated practical significance so that they acquire following competencies activities.

1. Comprehend Engineering Properties / characteristics of Soil with respect to Construction and Engineering Applications
2. Determine various properties & parameters of different Soil
3. Evaluate Engineering Properties / characteristics of Soil for their suitability for Engineering Structures.

3. TEACHING AND EXAMINATION SCHEME

Teaching Scheme (In Hours)			Total Credits (L+T+P)	Examination Scheme				Total Marks
				Theory Marks		Practical Marks		
L	T	P	C	ESE	PA	ESE	PA	150
03	00	02	05	70	30	20	30	

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

4. COURSE DETAILS

Unit	Major Learning Outcomes	Topics and Sub-topics
Unit – I Introduction	1. Comprehend formation process of soil	1.1 History 1.2 List structures where soil is used as construction material 1.3 Soil-formation in Geological cycle 1.4 Name the types of failure 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.
Unit – II Index Properties & Interrelationship	1. Describe phase diagram of Soil 2. Discuss various index properties of soil for the purpose of their classification & Use 3. Find out interrelationship between index properties	2.1 Three phase diagram 2.1.1 State three constituents of soil 2.1.2 Sketch showing three phases of soil 2.1.3 Assumptions in drawing a phase diagram 2.2 Properties of soil like Density, Field density, Dry density, Saturated density, Void ratio, Porosity, Specific Gravity, 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

<p>Unit – III</p> <p>Soil Classification</p>	<ol style="list-style-type: none"> 1. Explain Methods of Classification 2. Describe I.S. Classification of Soil 3. Classify Soil based on Consistency Limits 	<ol style="list-style-type: none"> 3.1 Classification of soil (Grain size) as per Indian Standard <ol style="list-style-type: none"> 3.1.1 State the basis of classification of soils 3.1.2 Three main categories of soils 3.1.3 Scale for classifying soil on the basis of grain size 3.2 Mechanical Analysis of soil <ol style="list-style-type: none"> 3.2.1 Distinguish between coarse grained and fine grained Soil on the basis of range of grain size and engineering properties 3.2.2 Designation of sieves as per I.S. code 3.2.3 Coarse & Fine Sieve analysis , sedimentation analysis 3.3 Grading Curves and different coefficients i.e. CU and CC 3.4 Clay, silt, sand and gravel as per particle size 3.5 Consistency Limits like Liquid limit , Plastic limit , Shrinkage Limit and Plasticity Index`
<p>Unit – IV</p> <p>Compaction</p>	<ol style="list-style-type: none"> 1. Comprehend the Principal & Methods of compaction of soil 2. Determine MDD & OMC of Soil by conducting appropriate test 	<ol style="list-style-type: none"> 4.1 Compaction and its Application <ol style="list-style-type: none"> 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. <ol style="list-style-type: none"> 4.2.1 Typical compaction curve 4.2.2 Optimum moisture content (OMC) , Maximum dry density (MDD) 4.3 Proctor test <ol style="list-style-type: none"> 4.3.1 Light compaction 4.3.2 Heavy compaction test 4.3.1 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

<p>Unit – V</p> <p>Permeability & Seepage</p>	<p>1. Determine Permeability of given Soil & explaining its implication with respect to use of Soil</p> <p>2. Comprehend the concept of Seepage Analysis in order to describe quick sand condition</p>	<p>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> $K = (Q \times L) / (t \times h \times A)$ $K = (2.3 \times a \times L) / (A \times t) \log_{10} \frac{h_1}{h_2}$ <p>5.5 Seepage pressure</p> <p>5.5.1 Seepage pressure.</p> <p>5.5.2 Quick sand condition,.</p> <p>5.5.3 Flow net, its characteristics and application.</p>
<p>Unit-VI</p> <p>Shear Strength</p>	<p>1. Evaluate shear parameters of Various types of soil explaining 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</p> $S = C + \sigma_n \tan \phi$ <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, 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</p>

VII Bearing Capacity of soil	1. Explain concept of bearing capacity of soil 2. Describe various Methods to determine bearing capacity of soil 3. Explain the concept & mechanism 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 7.6.1 Definition 7.6.2 Mechanism
VIII Soil Investigation & Exploration	1. Discuss various methods of Investigation & exploration of Soil	8.1 Objectives of exploration of Soil. 8.1.1 Planning of exploration program 8.1.2 Soil samples and soil samples. 8.1.3 Field penetration Test : SPT 8.1.4 Introduction to geophysical methods

5. 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
Total		42	20	17	33	70

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

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

6. SUGGESTED LIST OF EXERCISES/PRACTICAL

The practical/exercises should be properly designed and implemented with an attempt to reinforce theoretical knowledge and develop requisite skills & attitude so that students acquire competence & ability related to determination, interpretation & evaluation of soil for its use & application. Following is the list of experiments for guidance.

Sr. No.	Unit No.	Practical/Exercise	Apprx. Hrs. Required
1	II	Determine field moisture content of soil	02
2	II	Determine bulk density and dry density of soil by core cutter method	02
3	II	Determine specific gravity of sand by pycnometer	02
4	II	Determine bulk density and dry density of soil by sand replacement method	04
5	III	Conduct Sieve analysis of given soil for its classification	04
6	III	Determine consistency Limits i.e. Liquid limit, Plastic limit, Shrinkage limit	04
7	V	Determine permeability of soil by constant head method	02
8	V	Determine permeability of soil by falling head method	02
9	VI	Determine shear parameters of soil by box shear test	02
10	IV	Determine OMC and MDD by Proctor Test	04
		TOTAL HOURS	28

7. SUGGESTED LIST OF STUDENT ACTIVITIES

1. Collect few samples & find out different Properties of Soil from nearby site
2. Undertake Site visit related to Road Compaction & prepare report
3. Undertake Site visit related to SPT on field & prepare report
4. Visit to Soil Testing Laboratory for awareness related to other Soil Testing Equipment, Soil Testing Report

8. SPECIAL INSTRUCTIONAL STRATEGIES (If Any)

1. Show Video Clips of Soil Testing and interact with students by asking questions
2. Show Picture Clips through Power Point regarding Testing of soil and its Commercial report
3. Video program on soil engineering tests – NITTTR - Bhopal

9. SUGGESTED LEARNING RESOURCES**(A) List of Books:**

S. No.	Title of Books	Author	Publication
1.	Soil Mechanics & Foundation	Dr. B C Punamia	Standard Book House
2.	Modern Geo Technical Engineering	Dr. Alam singh	Jodhpur University
3.	Textbook of Soil Mechanics & Foundation Engineering	V N S Murthy	UBS Publisher
4.	Soil Sampling & Testing Manual	Dr A K Duggal	NITTTR , Chandigarh
5.	IS 2720 , IS 1892 , IS 2132 & IS 2809	----	BIS , New Delhi

B. List of Major Equipment/Materials

1. Core Cutter
2. Hot Air Oven
3. Sand Pouring Cylinder
4. Pycnometer Bottle
5. Permeability Apparatus
6. Set of IS Sieves
7. Casgrande Apparatus
8. Direct Shear Apparatus
9. Electronic Weighing Balance
10. Heavy & Light Proctor Test Apparatus

C List of Software/Learning Websites

1. www.issnge.org
2. www.springer.com
3. www.britannica.com
4. www.trb.org

10. COURSE CURRICULUM DEVELOPMENT COMMITTEE**Faculty Members from Polytechnics**

1. PROF. B G RAJGOR, H.O.D, APP. MECH. , BBIT , V. V. NAGAR
2. Prof. K.VENKATESHWARLU , H.O.D , T F G , Adipur
3. Prof. C.H.BHATT, DR. S. & S.S. GHANDHY COLLEGE, SURAT
4. Prof. K K PATEL, H.O.D, G. P RAJKOT

Coordinator and Faculty Members from NITTTR Bhopal

1. Dr. V H RADHAKRISHNAN , Professor In Civil Engineering , NITTTR - Bhopal