

**Geotechnical Engineering**  
**Unsaturated Soil Mechanics**
**01GT0110 (PEC)**
**Objective of the Course:**

1. To understand the basic mechanisms of soil under specific conditions.
2. To enhance the ability of relating the basic mechanisms of soil to behaviour of the soil under various loading conditions.
3. To develop the understanding of soil behavior and apply it to develop elasto-plastic models based on unsaturated soil conditions

**Credit Earned: 3**
**Students learning outcomes:**

After successful completion of the course, it is expected that student will be able to,

1. To demonstrate basic mechanisms behind index properties and tests on soil
2. To relate behaviour of soils subjected to various loading and drainage conditions.
3. To apply theory of elasticity and plasticity to characterize the stress-strain behaviour of soils.
4. To formulate basic elasto-plastic model based on Unsaturated soil mechanics like cam-clay

**Teaching and Examination Scheme**

Teaching Scheme (Hours)			Credits	Theory Marks			Tutorial/ Practical Marks		Total Marks
Theory	Tutorial	Practical		ESE (E)	CSE (I)	IA (M)	Viva (V)	Term Work (TW)	
03	00	00	03	50	20	30	25	25	150

**Detailed Syllabus**

Sr. No.	Title of the unit	Number of hours
<b>1</b>	<b>Stresses and strains in soils</b>	<b>12</b>
	Stresses and strains in soils - stress, strain paths invariants - one-dimensional and isotropic compression of soils and idealisation; state boundary of compression of soils; stress paths and soil tests; critical state line and Roscoe surface; Drained and undrained planes; Critical state line for sands; Behaviour of over-consolidated soils and Hvorslev surface;	
<b>2</b>	<b>Behaviour of soils before failure</b>	<b>12</b>
	Behaviour of soils before failure; Interpretation of index tests in the light of critical state concepts; Cam-clay models, Determination of critical state parameters.	

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<b>3</b>	<b>Flow through unsaturated soils.</b>	<b>12</b>
	Identification and classification of expansive and collapsing soils, effective stress concepts, matric and osmotic suction, collapse, heave and strength characteristics of unsaturated soils, flow through unsaturated soils.	
<b>4</b>	<b>Properties for cam-clay</b>	
	Laboratory evaluation of swell pressure and swell potential, tests to evaluate collapse potential. Measurements of soil suction.	<b>6</b>
		<b>42</b>

**Suggested Theory Distribution**

The suggested theory distribution as per Bloom's taxonomy is as per follows. This distribution serves as guidelines for teachers and students to achieve effective teaching-learning process

Distribution of Theory for course delivery and evaluation					
Remember	Understand	Apply	Analyze	Evaluate	Create
5%	5%	20%	25%	25%	20%

**Instructional Method and Pedagogy:**

1. Use of Learning Management system like canvas
2. Demonstration through presentations on power point and videos and lectures
3. Brainstorming and group discussion sessions
4. Collaborative learning

**Recommended Study Material:**
**Reference Book:**

1. Jean-Louis Briaud, Geotechnical Engineering: Unsaturated and Saturated Soils, John Wiley & Sons, Inc., New Jersey, 2013.
2. Murray E.J, Sivakumar V., Unsaturated Soils: A fundamental interpretation of Soil behaviour, Wiley-Blackwell, 2010.
3. Ng C.W.W and Menzies B, Advanced unsaturated soil mechanics and engineering, CRC Press, 2019.
4. Lu, N. and Likos, W.J., Unsaturated soil mechanics, Wiley, 2004 (2)
5. Fredlund, D. J., Rahardjo, R., and Fredlund, M.D. Unsaturated Soil Mechanics in Engineering Practice, Wiley, 2012.