



Kot Bhalwal, Jammu



Model Institute of Engineering  
& Technology (Autonomous)  
Dr. Arun K. Gupta Teaching-Learning Centre

## Department of CIVIL ENGINEERING

### Details of Lesson Plan

S.No.	Particulars	Details
1.	Course Name	Geotechnical engineering
2.	Course Code	CE-302
3.	Academic Year	2024-25
4.	Semester	5TH
5.	Number of Lesson plans	52
6.	Faculty Assigned	Iliyas Khaleel

Faculty Signature



Version 1.1



Please Do Not Print Unless Necessary



Lesson Plan No. 1	Course Name: Geotechnical Engineering Topic: Introduction to Stress in soils	Course No.: CE-302
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<b>Objectives</b>	At the end of the lesson the student shall be able to: a. articulate the concept of stress. b. Understand concept of stress due to point load. c. illustrate stress strain parameters for different loads. d. appreciate advantages of geostatic stress including both horizontal and vertical stress.
<b>Teaching Aids (if any)</b>	a. Chalk and talk. b. Use of Nearpod tool for online quiz
<b>Teaching Development</b>	<ol style="list-style-type: none"><li><b>1. Introduction (5 minutes)</b><ul style="list-style-type: none"><li>- Ask questions. What do you mean by stress and strain? What are the different types of loads? What do you mean by geotechnical engineering? How to draw stress strain curve?</li><li>- Introduce the concept of stress and strain. Show Figure on slide.</li><li>- Talk about the concept of stress strain in soil mechanics.</li><li>- Introduce the formal definition of stresses in soil.</li><li>- Highlight the important characteristics of geotechnical engineering.</li><li>- Highlight the different types of loads that are applied on soil and the stress caused by these loads.</li></ul></li><li><b>2. Development (30 minutes)</b><ul style="list-style-type: none"><li>- Stress in soil.</li><li>- Introduction to various loads which causes stress in soil.</li><li>- Explain the concept of Boussinesq's equation to find out stress caused due to concentrated load.</li><li>- Illustrate with examples to demonstrate how point load causes vertical and horizontal stress in soil.</li><li>- Derive the equation for vertical and horizontal stress caused due to point load.</li></ul></li></ol> <p>Exercise (5 minutes) – Find the Stress caused due to 5KN point load at the ground surface using Boussinesq's equation.</p> <ol style="list-style-type: none"><li>a. Problem: Calculate the stress at a specific point D which is 6m directly below load. Also calculate the vertical stress at the same point.</li></ol>
<b>Closure</b>	<ol style="list-style-type: none"><li>1. Summarize the Lesson Learning Outcomes and get affirmation from students on these.</li><li>2. Suggested Reading</li></ol>



	<p><a href="http://www.digimat.in/nptel/courses/video/105105168/L20.html">http://www.digimat.in/nptel/courses/video/105105168/L20.html</a></p> <p>3. Homework</p> <ul style="list-style-type: none"><li>- Determine the stress at a given point in the Simply supported beam by using the concept of Boussinesq's equation.</li></ul> <p>Spend 5 minutes to wrap up and consolidate the learnings</p>
<b>Evaluation</b>	<p>1. Reflective Questions (What, Why, Who?). Allow students to answer and discuss.</p> <p>2. Nearpod Quiz on stresses in soil mechanics.</p> <p>Spend 5 minutes to evaluate student assimilation of the lesson contents</p>



<b>Lesson Plan No. 2</b>	<b>Course Name: Geotechnical Engineering Topic: Stress due to line load and strip load</b>	<b>Course No.: CE-302</b>
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<b>Objectives</b>	At the end of the lesson the student shall be able to: a. Understand the role of line and strip load. b. Understand concept of stress due to line load and strip load. c. Evaluation of stresses subjected to line load and strip load. d. How to use Boussinesq's equation to find stresses in soil.
<b>Teaching Aids (if any)</b>	a. Use of chalk and black board. b. Use of Nearpod tool for online quiz
<b>Teaching Development</b>	<ul style="list-style-type: none"><li>- <b>Introduction</b> (5 minutes)</li><li>- Start with engaging questions to prompt audience participation:</li><li>- Have you studied the concept of stresses in structures?</li><li>- Can you think of an example where stress is significant in a foundation?</li><li>- Emphasize the importance of stress in structures.</li><li>- Evaluation of stresses subjected to line load and strip load.</li></ul> <p><b>Development</b> (30 minutes)</p> <ul style="list-style-type: none"><li>- Vertical Stress in soil.</li><li>- Introduction to various loads which causes stress in soil.</li><li>- Explain the concept of Boussinesq's equation to find out stress caused due to line load and strip load.</li><li>- Illustrate with examples to demonstrate how point load causes stress in soil.</li><li>- Derive the equation for stress caused due to line load and strip load also find out the maximum stress point.</li></ul> <p>Exercise (5 minutes) – Find the Stress caused due to 5KN/m line load and strip load at 5m below the ground surface using Boussinesq's equation.</p> <p>Problem: Calculate the stress at a specific point D which is 3m wide and 5m below in the given foundation surface with the given loading conditions ie 500N/m</p>
<b>Closure</b>	<ol style="list-style-type: none"><li>1. Summarize the Lesson Learning Outcomes and get affirmation from students on these.</li><li>2. Suggested Reading <a href="https://archive.nptel.ac.in/courses/105/103/105103207/">https://archive.nptel.ac.in/courses/105/103/105103207/</a></li><li>3. Homework Determine the stress at a specific point D which is 3m wide and 5m deep in the given foundation surface with the given loading conditions ie 500N/m</li></ol> <p>Spend 5 minutes to wrap up and consolidate the learnings</p>



<b>Evaluation</b>	<ol style="list-style-type: none"><li>1. Reflective Questions (What, why, Who?). Allow students to answer and discuss.</li><li>2. Nearpod Quiz on Cloud Computing</li></ol>
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Lesson Plan No. 3	Course Name: Geotechnical Engineering Topic: Stresses due to uniformly loaded circular area, rectangular loaded area.	Course No.: CE-302
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<b>Objectives</b>	At the end of the lesson the student shall be able to: a. Understand the Uniformly loaded area and rectangular loaded area. b. Understand concept of stress uniformly loaded area and rectangular loaded area. c. Evaluation of stresses subjected to uniformly loaded area and rectangular loaded area. d. How to use Boussinesq's equation to find stresses in soil.
<b>Teaching Aids (if any)</b>	a. Use of chalk and black board. b. Use of Nearpod tool for online quiz
<b>Teaching Development</b>	<ul style="list-style-type: none"><li>- <b>Introduction</b> (5 minutes)</li><li>- Start with engaging questions to prompt audience participation:<ul style="list-style-type: none"><li>- Have you studied the concept of stresses in structures?</li><li>- Can you think of an example where stress is significant in a foundation?</li></ul></li><li>- Emphasize the importance of pressure bulb in soil.</li><li>- Evaluation of stresses subjected to uniformly loaded area and rectangular loaded area.</li></ul> <p><b>Development</b> (30 minutes)</p> <ul style="list-style-type: none"><li>- Vertical Stress in soil due to uniformly loaded area and rectangular loaded area.</li><li>- Vertical Stress in soil due to circular area.</li><li>- Explain the concept of Boussinesq's equation to find out stress caused due to circular area.</li><li>- Illustrate with examples to demonstrate how circular load causes stress in soil.</li><li>- Derive the equation for stress caused due to circular area UDL and rectangular area also find out the maximum stress point.</li></ul> <p>Exercise (5 minutes) – Find the Stress caused due to 5KN/m UDL and 4KN rectangular load at 5m below the ground surface using Boussinesq's equation.</p> <p>Problem: Calculate the stress at a specific point D which is 3m wide and 5m below in the given foundation surface with the given loading conditions ie 500N/m</p>
<b>Closure</b>	<ol style="list-style-type: none"><li>1. Summarize the Lesson Learning Outcomes and get affirmation from students on these.</li><li>2. Suggested Reading <a href="https://archive.nptel.ac.in/courses/105/103/105103207/">https://archive.nptel.ac.in/courses/105/103/105103207/</a></li><li>3. Homework Determine the stress at a specific point D which is 3m wide and 5m deep in</li></ol>



	<p>the given foundation surface with the given loading conditions ie 500N/m</p> <p>Spend 5 minutes to wrap up and consolidate the learnings</p>
<b>Evaluation</b>	<ol style="list-style-type: none"><li>1. Reflective Questions (What, why, Who?). Allow students to answer and discuss.</li><li>2. Nearpod Quiz on Cloud Computing</li></ol>



<b>Lesson Plan No. 4</b>	<b>Course Name: Geotechnical Engineering</b> <b>Topic: Influence factors, Isobars,</b> <b>Boussinesq's equation and Westergaard's</b> <b>theories.</b>	<b>Course No.: CE-302</b>
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<b>Objectives</b>	At the end of the lesson the student shall be able to: a. Understand the concept of Newmark's influence chart. b. Understand concept of Isobars. c. Evaluation of Westgard's analysis. d. How to use Boussinesq's equation to find stresses in soil.
<b>Teaching Aids (if any)</b>	a. Use of chalk and black board. b. Use of Nearpod tool for online quiz
<b>Teaching Development</b>	<ul style="list-style-type: none"><li>- <b>Introduction</b> (5 minutes)</li><li>- Start with engaging questions to prompt audience participation:<ul style="list-style-type: none"><li>- Have you studied the concept of Isobars?</li><li>- Can you think of an example where stress is significant in a foundation?</li></ul></li><li>- Emphasize the importance of pressure bulb in soil.</li><li>- Evaluation of stresses subjected to concentrated load by Boussinesq's equation.</li></ul> <p><b>Development</b> (30 minutes)</p> <ul style="list-style-type: none"><li>- Isobars and their graphical representation.</li><li>- Newmark's influence chart and use of it.</li><li>- Comparison of stresses due to loads on areas of different shapes.</li><li>- Illustrate with examples to demonstrate how Newmark's influence charts are drawn for different shapes of foundation.</li><li>- Derive the equation for stress caused due to triangular area and trapezoidal area also find out the maximum stress point.</li></ul> <p>Exercise (5 minutes) – Find the Stress caused due to 5KN/m UDL and 4KN rectangular load at 5m below the ground surface using Boussinesq's equation.</p> <p>Problem: Calculate the stress at a specific point D which is 3m below in the given foundation surface and on the centre of embankment take density 18KN/m<sup>3</sup>.</p>
<b>Closure</b>	<ol style="list-style-type: none"><li>1. Summarize the Lesson Learning Outcomes and get affirmation from students on these.</li><li>2. Suggested Reading <a href="https://archive.nptel.ac.in/courses/105/103/105103207/">https://archive.nptel.ac.in/courses/105/103/105103207/</a></li><li>3. Homework Determine the stress at a specific point D which is 5m deep in the given foundation surface with the given loading conditions ie 500N/m</li></ol> <p>Spend 5 minutes to wrap up and consolidate the learnings</p>



<b>Evaluation</b>	<ol style="list-style-type: none"><li>1. Reflective Questions (What, why, Who?). Allow students to answer and discuss.</li><li>2. Nearpod Quiz on Cloud Computing</li></ol>



<b>Lesson Plan No. 5</b>	<b>Course Name: Geotechnical Engineering Topic: Contact pressure and elastic theory</b>	<b>Course No.: CE-302</b>
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<b>Objectives</b>	At the end of the lesson the student shall be able to: <ul style="list-style-type: none"> <li>a. Understand the concept of flexible footing.</li> <li>b. Understand concept of Rigid footing.</li> <li>c. Evaluation of Pressure distribution.</li> <li>d. How to use Elastic theory for pressure distribution.</li> </ul>
<b>Teaching Aids (if any)</b>	<ul style="list-style-type: none"> <li>a. Use of chalk and black board.</li> <li>b. Use of Nearpod tool for online quiz</li> </ul>
<b>Teaching Development</b>	<ul style="list-style-type: none"> <li>- <b>Introduction</b> (5 minutes)</li> <li>- Start with engaging questions to prompt audience participation: <ul style="list-style-type: none"> <li>- Have you studied the concept different types of soil?</li> <li>- Can you think of an example of different types of footings?</li> </ul> </li> <li>- Emphasize the importance of pressure distribution in foundation.</li> <li>- Evaluation of uniform pressure distribution.</li> </ul> <p><b>Development</b> (30 minutes)</p> <ul style="list-style-type: none"> <li>- Pressure distribution of flexible and rigid footings.</li> <li>- Westgard's analysis chart and use of it.</li> <li>- Contact pressure under clay and sand.</li> <li>- Illustrate with examples to demonstrate how Westgard's analysis are drawn for different shapes of foundation.</li> <li>- Limitations of Newmark's influence theory and Elastic theory.</li> </ul> <p>Exercise (5 minutes) – Draw the diagram showing contact pressure under flexible clay and sand and rigid clay and sand footing.</p>
<b>Closure</b>	<ol style="list-style-type: none"> <li>1. Summarize the Lesson Learning Outcomes and get affirmation from students on these.</li> <li>2. Suggested Reading <a href="https://archive.nptel.ac.in/courses/105/103/105103207/">https://archive.nptel.ac.in/courses/105/103/105103207/</a></li> <li>3. Homework Draw the diagram showing contact pressure under flexible clay and sand and rigid clay and sand footing. Spend 5 minutes to wrap up and consolidate the learnings</li> </ol>
<b>Evaluation</b>	<ol style="list-style-type: none"> <li>1. Reflective Questions (What, why, Who?). Allow students to answer and discuss.</li> <li>2. Nearpod Quiz on Cloud Computing</li> </ol>



<b>Lesson Plan No. 6</b>	<b>Course Name: Geotechnical Engineering</b> <b>Topic: Shear strength and Mohr's circle</b>	<b>Course No.: CE-302</b>
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<b>Objectives</b>	At the end of the lesson the student shall be able to: <ol style="list-style-type: none"> <li>articulate the concept of shear stress in soil.</li> <li>Understand concept of principle planes major and minor principal stresses.</li> <li>illustrate Mohr's circle how to draw it.</li> <li>appreciate advantages of Mohr's circle and its uses in finding major and minor principal stresses.</li> </ol>
<b>Teaching Aids (if any)</b>	<ol style="list-style-type: none"> <li>Chalk and talk.</li> <li>Use of Nearpod tool for online quiz</li> </ol>
<b>Teaching Development</b>	<ol style="list-style-type: none"> <li><b>Introduction (5 minutes)</b> <ul style="list-style-type: none"> <li>Ask questions.               <ul style="list-style-type: none"> <li>What do you mean by stress and strain?</li> <li>What are the different types of principal planes?</li> <li>What do you mean by Mohr's circle?</li> <li>How to draw Mohr's circle?</li> </ul> </li> <li>Introduce the concept of major and minor principal stresses. Show Figure on slide.</li> <li>Talk about the concept of stress system with principal planes inclined to coordinate axis.</li> <li>Introduce the formal definition of shear stresses in soil.</li> <li>Highlight the important characteristics of Mohr's circle.</li> <li>Highlight the different types principal planes.</li> </ul> </li> <li><b>Development (30 minutes)</b> <ul style="list-style-type: none"> <li>Shear Stress in soil.</li> <li>Introduction to various types of principal planes.</li> <li>Explain the concept of Mohr's circle how to draw it and who to find principal planes from it.</li> <li>Illustrate with examples to demonstrate Mohr's circle for different conditions</li> <li>Derive the equation for stress system with principal planes for different conditions.</li> </ul> </li> </ol> <p>Exercise (5 minutes) – Find the Major and Minor principal stress for a Mohr's circle of radius 5m.</p>
<b>Closure</b>	<ol style="list-style-type: none"> <li>Summarize the Lesson Learning Outcomes and get affirmation from students on these.</li> <li>Suggested Reading <a href="http://www.digimat.in/nptel/courses/video/105105168/L20.html">http://www.digimat.in/nptel/courses/video/105105168/L20.html</a></li> <li>Homework       <ul style="list-style-type: none"> <li>Draw Mohrs circle if <math>\sigma_1 = 30 \text{KN/m}^2</math> and <math>\sigma_2 = 10 \text{KN/m}^2</math></li> </ul> </li> </ol>



	- Spend 5 minutes to wrap up and consolidate the learnings
<b>Evaluation</b>	<ol style="list-style-type: none"><li>1. Reflective Questions (What, Why, Who?). Allow students to answer and discuss.</li><li>2. Nearpod Quiz on stresses in soil mechanics.</li></ol> <p>Spend 5 minutes to evaluate student assimilation of the lesson contents</p>



<b>Lesson Plan No. 7</b>	<b>Course Name: Geotechnical Engineering</b> <b>Topic: Major and Minor Principal stresses.</b>	<b>Course No.: CE-302</b>
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<b>Objectives</b>	At the end of the lesson the student shall be able to: a. articulate the concept of shear stress in soil. b. Understand concept of principle planes major and minor principal stresses. c. illustrate Mohr's circle how to draw it. d. appreciate advantages of Mohr's circle and its uses in finding major and minor principal stresses.
<b>Teaching Aids (if any)</b>	a. Chalk and talk. b. Use of Nearpod tool for online quiz
<b>Teaching Development</b>	<ol style="list-style-type: none"><li><b>1. Introduction (5 minutes)</b><ul style="list-style-type: none"><li>- Ask questions. What do you mean by stress and strain? What are the different types of principal planes? What do you mean by Mohr's circle? How to draw Mohr's circle?</li><li>- Introduce the concept of major and minor principal stresses. Show Figure on slide.</li><li>- Talk about the concept of stress system with principal planes inclined to coordinate axis.</li><li>- Introduce the formal definition of shear stresses in soil.</li><li>- Highlight the important characteristics of Mohr's circle.</li><li>- Highlight the different types principal planes.</li></ul></li><li><b>2. Development (30 minutes)</b><ul style="list-style-type: none"><li>- Shear Stress in soil.</li><li>- Introduction to various types of principal planes.</li><li>- Explain the concept of Mohr's circle how to draw it and who to find principal planes from it.</li><li>- Illustrate with examples to demonstrate Mohr's circle for different conditions</li><li>- Derive the equation for stress system with principal planes for different conditions.</li></ul></li></ol> <p>Exercise (5 minutes) – Find the Major and Minor principal stress for a Mohr's circle of radius 5m.</p>
<b>Closure</b>	<ol style="list-style-type: none"><li>1. Summarize the Lesson Learning Outcomes and get affirmation from students on these.</li><li>2. Suggested Reading <a href="http://www.digimat.in/nptel/courses/video/105105168/L20.html">http://www.digimat.in/nptel/courses/video/105105168/L20.html</a></li><li>3. Homework<ul style="list-style-type: none"><li>- Draw Mohrs circle if <math>\sigma_1 = 30 \text{KN/m}^2</math> and <math>\sigma_2 =</math></li></ul></li></ol>



	<p>10KN/m<sup>3</sup></p> <p>- Spend 5 minutes to wrap up and consolidate the learnings</p>
<b>Evaluation</b>	<ol style="list-style-type: none"><li>1. Reflective Questions (What, Why, Who?). Allow students to answer and discuss.</li><li>2. Nearpod Quiz on stresses in soil mechanics.</li></ol> <p>Spend 5 minutes to evaluate student assimilation of the lesson contents</p>



<b>Lesson Plan No. 8</b>	<b>Course Name: Geotechnical Engineering Topic: Mohr-Coulomb theory.</b>	<b>Course No.: CE-302</b>
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<b>Objectives</b>	At the end of the lesson the student shall be able to: <ul style="list-style-type: none"> <li>a. articulate the concept of Mohr-Coulomb theory.</li> <li>b. Understand concept of revised Mohr-Coulomb theory.</li> <li>c. illustrate the concept of cohesion and angle of friction</li> <li>d. appreciate advantages of Mohr-Coulomb theory.</li> </ul>
<b>Teaching Aids (if any)</b>	<ul style="list-style-type: none"> <li>a. Chalk and talk.</li> <li>b. Use of Nearpod tool for online quiz</li> </ul>
<b>Teaching Development</b>	<ol style="list-style-type: none"> <li>1. <b>Introduction</b> (5 minutes) <ul style="list-style-type: none"> <li>- Ask questions. What do you mean by failure plane? What do you mean by major and minor principal plane? What are the steps to draw Mohr's circle? How to draw stress strain curve?</li> <li>- Introduce the concept of Mohr-Coulomb theory.</li> <li>- Talk about the concept of stress strain in soil mechanics.</li> <li>- Introduce the formal definition of cohesion and angle of internal friction.</li> <li>- Highlight the important characteristics of Mohr-Coulomb theory.</li> <li>- Highlight the different limitations of Mohr-Coulomb theory. .</li> </ul> </li> <li>2. <b>Development</b> (30 minutes) <ul style="list-style-type: none"> <li>- Mohr-Coulomb theory.</li> <li>- Mohr-Coulomb failure creation and modified failure envelop</li> <li>- Draw Mohr's circle for Mohr-Coulomb theory.</li> <li>- Illustrate with examples to demonstrate how Mohr-Coulomb theory and its failure plane can be shown in Mohr's circle.</li> <li>- Explain the limitations of Mohr-Coulomb theory.</li> </ul> </li> </ol> <p>Exercise (5 minutes) – Draw the Mohr's circle if <math>\sigma_1=30\text{KN/m}^3</math> and <math>\sigma_2=40\text{KN/m}^3</math>.</p>
<b>Closure</b>	<ol style="list-style-type: none"> <li>1. Summarize the Lesson Learning Outcomes and get affirmation from students on these.</li> <li>2. Suggested Reading <a href="http://www.digimat.in/nptel/courses/video/105105168/L20.html">http://www.digimat.in/nptel/courses/video/105105168/L20.html</a></li> <li>3. Homework <ul style="list-style-type: none"> <li>- Draw the Mohr's circle if <math>\sigma_1=30\text{KN/m}^3</math> and <math>\sigma_2=40\text{KN/m}^3</math>. Find out the max shear stress and failure envelope from it.</li> </ul> </li> </ol> <p>Spend 5 minutes to wrap up and consolidate the learnings</p>



<b>Evaluation</b>	<ol style="list-style-type: none"><li>1. Reflective Questions (What, Why, Who?). Allow students to answer and discuss.</li><li>2. Nearpod Quiz on stresses in soil mechanics.</li></ol> <p>Spend 5 minutes to evaluate student assimilation of the lesson contents</p>
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<b>Lesson Plan No. 9</b>	<b>Course Name: Geotechnical Engineering</b> <b>Topic: Direct shear test.</b>	<b>Course No.: CE-302</b>
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<b>Objectives</b>	At the end of the lesson the student shall be able to: <ul style="list-style-type: none"> <li>a. articulate the concept of shear stress in soil.</li> <li>b. Understand concept of different types of drainage conditions</li> <li>c. illustrate Direct shear test in lab.</li> <li>d. appreciate advantages and limitations of Direct shear test.</li> </ul>
<b>Teaching Aids (if any)</b>	<ul style="list-style-type: none"> <li>a. Chalk and talk.</li> <li>b. Use of Nearpod tool for online quiz</li> </ul>
<b>Teaching Development</b>	<ol style="list-style-type: none"> <li>1. <b>Introduction</b> (5 minutes) <ul style="list-style-type: none"> <li>- Ask questions. What do you mean shear stress? What are the different types of shear tests in lab? What do you mean by Mohr's circle? How to draw Mohr's circle?</li> <li>- Introduce the concept of Direct shear test</li> <li>- Talk about the Limitations of direct shear test.</li> <li>- Introduce the formal definition of shear stresses in soil.</li> <li>- Highlight the important characteristics of Direct shear test.</li> <li>- Highlight the different types of drainage conditions.</li> </ul> </li> <li>2. <b>Development</b> (30 minutes) <ul style="list-style-type: none"> <li>- Shear Stress in soil.</li> <li>- Introduction to various types of shear tests in lab and field.</li> <li>- Explain the concept of Direct shear test and its failure envelope.</li> <li>- Illustrate with examples to demonstrate Direct shear test and its limitations.</li> <li>- Explain the apparatus and procedure of Direct shear test.</li> </ul> </li> </ol> <p>Exercise (5 minutes) – Represent graphically the results of Direct shear test show its failure plane and find out the angle of cohesion.</p>
<b>Closure</b>	<ol style="list-style-type: none"> <li>1. Summarize the Lesson Learning Outcomes and get affirmation from students on these.</li> <li>2. Suggested Reading <a href="http://www.digimat.in/nptel/courses/video/105105168/L20.html">http://www.digimat.in/nptel/courses/video/105105168/L20.html</a></li> <li>3. Homework <ul style="list-style-type: none"> <li>- From the direct shear test results draw Mohrs circle if <math>\sigma_1 = 30 \text{KN/m}^2</math> and <math>\sigma_2 = 10 \text{KN/m}^2</math></li> <li>- Spend 5 minutes to wrap up and consolidate the learnings</li> </ul> </li> </ol>
<b>Evaluation</b>	<ol style="list-style-type: none"> <li>1. Reflective Questions (What, Why, Who?). Allow students to answer and discuss.</li> <li>2. Nearpod Quiz on stresses in soil mechanics.</li> </ol>



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Spend 5 minutes to evaluate student assimilation of the lesson contents
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<b>Lesson Plan No. 10</b>	<b>Course Name: Geotechnical Engineering</b> <b>Topic: Triaxial shear test.</b>	<b>Course No.: CE-302</b>
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<b>Objectives</b>	At the end of the lesson the student shall be able to: a. articulate the concept of shear stress in soil. b. Understand concept of different types of drainage conditions c. illustrate Triaxial shear test in lab. d. appreciate advantages and limitations of triaxial shear test over Triaxial shear test.
<b>Teaching Aids (if any)</b>	a. Chalk and talk. b. Use of Nearpod tool for online quiz
<b>Teaching Development</b>	<ol style="list-style-type: none"><li><b>1. Introduction (5 minutes)</b><ul style="list-style-type: none"><li>- Ask questions. What do you mean shear stress? What are the different types of shear tests in lab? What do you mean by Mohr's circle? How to draw Mohr's circle?</li><li>- Introduce the concept of Triaxial shear test</li><li>- Talk about the advantages of Triaxial shear test.</li><li>- Introduce the formal definition of shear stresses in soil.</li><li>- Highlight the important characteristics of Triaxial shear test on cohesive and cohesionless soil.</li><li>- Highlight the different types of drainage conditions.</li></ul></li><li><b>2. Development (30 minutes)</b><ul style="list-style-type: none"><li>- Shear Stress in soil.</li><li>- Introduction to various types of shear tests in lab and field.</li><li>- Explain the concept of Triaxial shear test and its failure envelope.</li><li>- Illustrate with examples to demonstrate Triaxial shear test and its limitations.</li><li>- Explain the apparatus and procedure of Triaxial shear test.</li></ul></li></ol> <p>Exercise (5 minutes) – Represent graphically the results of Triaxial shear test show its failure plane and find out the angle of cohesion.</p>
<b>Closure</b>	<ol style="list-style-type: none"><li>1. Summarize the Lesson Learning Outcomes and get affirmation from students on these.</li><li>2. Suggested Reading <a href="http://www.digimat.in/nptel/courses/video/105105168/L20.html">http://www.digimat.in/nptel/courses/video/105105168/L20.html</a></li><li>3. Homework<ul style="list-style-type: none"><li>- From the Triaxial shear test results draw Mohrs circle if <math>\sigma_1 = 30 \text{KN/m}^3</math> and <math>\sigma_2 = 10 \text{KN/m}^3</math></li><li>- Spend 5 minutes to wrap up and consolidate the learnings</li></ul></li></ol>
<b>Evaluation</b>	<ol style="list-style-type: none"><li>1. Reflective Questions (What, Why, Who?). Allow students to answer and discuss.</li></ol>



	2. Nearpod Quiz on stresses in soil mechanics. Spend 5 minutes to evaluate student assimilation of the lesson contents
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<b>Lesson Plan No. 11</b>	<b>Course Name: Geotechnical Engineering</b> <b>Topic: Unconfined compression test.</b>	<b>Course No.: CE-302</b>
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<b>Objectives</b>	At the end of the lesson the student shall be able to: a. articulate the concept of shear stress in soil. b. Understand concept of different types of drainage conditions c. illustrate Unconfined compression test in lab. d. appreciate advantages and limitations of Unconfined compression test over triaxial and direct shear test.
<b>Teaching Aids (if any)</b>	a. Chalk and talk. b. Use of Nearpod tool for online quiz
<b>Teaching Development</b>	<ol style="list-style-type: none"><li><b>1. Introduction (5 minutes)</b><ul style="list-style-type: none"><li>- Ask questions. What do you mean shear stress? What are the different types of shear tests in lab? What do you mean by Mohr's circle? How to draw Mohr's circle?</li><li>- Introduce the concept of Unconfined compression test</li><li>- Talk about the advantages of Unconfined compression test.</li><li>- Introduce the formal definition of shear stresses in soil.</li><li>- Highlight the important characteristics of Unconfined compression test on cohesive and cohesionless soil.</li><li>- Highlight the different types of drainage conditions.</li></ul></li><li><b>2. Development (30 minutes)</b><ul style="list-style-type: none"><li>- Shear Stress in soil.</li><li>- Introduction to various types of shear tests in lab and field.</li><li>- Explain the concept of Unconfined compression test and its failure envelope.</li><li>- Illustrate with examples to demonstrate Unconfined compression test and its limitations.</li><li>- Explain the apparatus and procedure of Unconfined compression test.</li></ul></li></ol> <p>Exercise (5 minutes) – Represent graphically the results of Unconfined compression test show its failure plane and find out the angle of cohesion.</p>
<b>Closure</b>	<ol style="list-style-type: none"><li>1. Summarize the Lesson Learning Outcomes and get affirmation from students on these.</li><li>2. Suggested Reading <a href="http://www.digimat.in/nptel/courses/video/105105168/L20.html">http://www.digimat.in/nptel/courses/video/105105168/L20.html</a></li><li>3. Homework<ul style="list-style-type: none"><li>- From the Unconfined compression test results draw Mohr's circle if <math>\sigma_1 = 30 \text{ kN/m}^2</math> and <math>\sigma_2 = 10 \text{ kN/m}^2</math></li><li>- Spend 5 minutes to wrap up and consolidate the learnings</li></ul></li></ol>



<b>Evaluation</b>	<ol style="list-style-type: none"><li>1. Reflective Questions (What, Why, Who?). Allow students to answer and discuss.</li><li>2. Nearpod Quiz on stresses in soil mechanics.</li></ol> <p>Spend 5 minutes to evaluate student assimilation of the lesson contents</p>
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<b>Lesson Plan No. 12</b>	<b>Course Name: Geotechnical Engineering</b> <b>Topic: Drainage conditions of shear tests.</b>	<b>Course No.: CE-302</b>
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<b>Objectives</b>	At the end of the lesson the student shall be able to: a. articulate the concept of shear stress in soil. b. Understand concept of different types of drainage conditions c. illustrate confined and unconfined conditions. d. appreciate advantages and limitations of Vane shear test.
<b>Teaching Aids (if any)</b>	a. Chalk and talk. b. Use of Nearpod tool for online quiz
<b>Teaching Development</b>	<ol style="list-style-type: none"><li><b>1. Introduction (5 minutes)</b><ul style="list-style-type: none"><li>- Ask questions. What do you mean shear stress? What are the different types of shear tests in lab? What do you mean by confined and unconfined condition of shear tests? What do you mean by consolidation?</li><li>- Introduce the concept of drainage conditions of various shear tests.</li><li>- Talk about the advantages of vane shear test.</li><li>- Relation between undrained shear strength and effective overburden pressure.</li><li>- Highlight the important characteristics of Vane shear test.</li><li>- Highlight the different types of drainage conditions.</li></ul></li><li><b>2. Development (30 minutes)</b><ul style="list-style-type: none"><li>- Shear Stress in soil.</li><li>- Introduction to various types of drainage conditions in shear tests.</li><li>- Explain the concept of Vane shear test.</li><li>- Illustrate with examples to demonstrate different drainage conditions for all shear tests.</li><li>- Derive the equation for vane shear test.</li></ul></li></ol> <p>Exercise (5 minutes) – Find the relationship between undrained shear strength and effective overburden pressure.</p>
<b>Closure</b>	<ol style="list-style-type: none"><li>1. Summarize the Lesson Learning Outcomes and get affirmation from students on these.</li><li>2. Suggested Reading <a href="http://www.digimat.in/nptel/courses/video/105105168/L20.html">http://www.digimat.in/nptel/courses/video/105105168/L20.html</a></li><li>3. Homework<ul style="list-style-type: none"><li>- Draw Mohrs circle graph between undrained shear strength effective overburden pressure and <math>C_u</math>.</li><li>- Spend 5 minutes to wrap up and consolidate the learnings</li></ul></li></ol>
<b>Evaluation</b>	1. Reflective Questions (What, Why, Who?). Allow students to



	<p>answer and discuss.</p> <p>2. Nearpod Quiz on stresses in soil mechanics.</p> <p>Spend 5 minutes to evaluate student assimilation of the lesson contents</p>
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Lesson Plan No. 13	Course Name: Geotechnical Engineering Topic: Lateral earth pressure at rest.	Course No.: CE-302
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<b>Objectives</b>	At the end of the lesson the student shall be able to: a. articulate the concept of Earth pressure. b. Understand concept of different types of lateral earth pressure. c. Illustrate earth pressure at rest active earth pressure and passive earth pressure. d. Graphical representation of variation of pressure in retaining wall.
<b>Teaching Aids (if any)</b>	a. Chalk and talk. b. Use of Nearpod tool for online quiz
<b>Teaching Development</b>	<ol style="list-style-type: none"><li><b>1. Introduction (5 minutes)</b><ul style="list-style-type: none"><li>- Ask questions. What do you mean retaining wall? What are the different types of retaining wall? What do you mean by Pressure? What do you mean by active and passive earth pressure?</li><li>- Introduce the concept of Retaining wall and lateral earth pressure</li><li>- Talk about active and passive earth pressure.</li><li>- Different earth pressure at rest.</li><li>- Highlight the variation of earth pressure.</li><li>- Highlight the different types of earth pressures.</li></ul></li><li><b>2. Development (30 minutes)</b><ul style="list-style-type: none"><li>- Retaining wall and its types.</li><li>- Introduction to various types of Lateral earth pressure at rest.</li><li>- Explain the concept of active and passive earth pressure.</li><li>- Illustrate with examples variation of pressure in retaining walls.</li><li>- Derive the equation for earth pressure at rest.</li></ul></li></ol> <p>Exercise (5 minutes) – Find the relation for total pressure at the base of retaining wall</p>
<b>Closure</b>	<ol style="list-style-type: none"><li>1. Summarize the Lesson Learning Outcomes and get affirmation from students on these.</li><li>2. Suggested Reading <a href="http://www.digimat.in/nptel/courses/video/105105168/L20.html">http://www.digimat.in/nptel/courses/video/105105168/L20.html</a></li><li>3. Homework<ul style="list-style-type: none"><li>- Determine the lateral earth pressure at rest per unit length of wall if a clay layer 2m thick of density 17KN/m<sup>3</sup> and angle of 30 degree is sandwiched by a sand layer 3m of density 19KN/m<sup>3</sup> and angle of 30 degree. Find out the location of resultant pressure if density of water is 10KN/m<sup>3</sup>. Water table is 2m below surface.</li><li>- Spend 5 minutes to wrap up and consolidate the learnings</li></ul></li></ol>



<b>Evaluation</b>	<ol style="list-style-type: none"><li>1. Reflective Questions (What, Why, Who?). Allow students to answer and discuss.</li><li>2. Nearpod Quiz on stresses in soil mechanics.</li></ol> <p>Spend 5 minutes to evaluate student assimilation of the lesson contents</p>
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<b>Lesson Plan No. 14</b>	<b>Course Name: Geotechnical Engineering</b> <b>Topic: Rankine's theory.</b>	<b>Course No.: CE-302</b>
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<b>Objectives</b>	At the end of the lesson the student shall be able to: a. articulate the concept of Earth pressure. b. Understand concept of different types of lateral earth pressure. c. Illustrate earth pressure at rest active earth pressure and passive earth pressure. d. Graphical representation of variation of pressure in retaining wall.
<b>Teaching Aids (if any)</b>	a. Chalk and talk. b. Use of Nearpod tool for online quiz
<b>Teaching Development</b>	<ol style="list-style-type: none"><li><b>1. Introduction (5 minutes)</b><ul style="list-style-type: none"><li>- Ask questions. What do you mean retaining wall? What are the different surfaces of retaining wall? What do you mean by cohesion? What do you mean by active and passive earth pressure?</li><li>- Introduce the concept of angle of internal friction pressure</li><li>- Talk about active and passive earth pressure.</li><li>- Different earth pressure at rest.</li><li>- Highlight the importance of Rankine's theory.</li><li>- Rankine's earth pressure when surface is inclined.</li></ul></li><li><b>2. Development (30 minutes)</b><ul style="list-style-type: none"><li>- Rankine's theory and its applications.</li><li>- Introduction to various limitations of Rankine's theory.</li><li>- Explain the concept of active and passive earth pressure using Rankine's theory.</li><li>- Illustrate with examples Rankine's theory in cohesion and cohesionless soils.</li><li>- Derive the equation for active and passive earth pressure using Rankine's theory.</li></ul></li></ol> <p>Exercise (5 minutes) – Find the relation for total pressure at the base of retaining wall</p>
<b>Closure</b>	<ol style="list-style-type: none"><li>1. Summarize the Lesson Learning Outcomes and get affirmation from students on these.</li><li>2. Suggested Reading <a href="http://www.digimat.in/nptel/courses/video/105105168/L20.html">http://www.digimat.in/nptel/courses/video/105105168/L20.html</a></li><li>3. Homework<ul style="list-style-type: none"><li>- Draw pressure distribution diagram for various earth pressures.</li><li>- Spend 5 minutes to wrap up and consolidate the learnings</li></ul></li></ol>
<b>Evaluation</b>	<ol style="list-style-type: none"><li>1. Reflective Questions (What, Why, Who?). Allow students to answer and discuss.</li></ol>



	2. Nearpod Quiz on stresses in soil mechanics. Spend 5 minutes to evaluate student assimilation of the lesson contents
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Lesson Plan No. 15	Course Name: Geotechnical Engineering Topic: Active and Passive earth pressure.	Course No.: CE-302
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<b>Objectives</b>	At the end of the lesson the student shall be able to: a. articulate the concept of Earth pressure. b. Understand concept of different types of lateral earth pressure. c. Illustrate earth pressure at rest active earth pressure and passive earth pressure. d. Graphical representation of variation of pressure in retaining wall.
<b>Teaching Aids (if any)</b>	a. Chalk and talk. b. Use of Nearpod tool for online quiz
<b>Teaching Development</b>	<ol style="list-style-type: none"><li><b>1. Introduction (5 minutes)</b><ul style="list-style-type: none"><li>- Ask questions. What do you mean retaining wall? What are the different surfaces of retaining wall? What do you mean by cohesion? What do you mean by active and passive earth pressure?</li><li>- Introduce the concept of angle of internal friction pressure</li><li>- Talk about active and passive earth pressure.</li><li>- Different earth pressure at rest.</li><li>- Highlight the importance of angle of cohesion in soil.</li><li>- Rankine's earth pressure for cohesion and cohesionless soils.</li></ul></li><li><b>2. Development (30 minutes)</b><ul style="list-style-type: none"><li>- Active and passive earth pressure.</li><li>- Introduction to various limitations of Rankine's theory.</li><li>- Explain the concept of active and passive earth pressure using Rankine's theory.</li><li>- Illustrate with examples Rankine's theory in cohesion and cohesionless soils.</li><li>- Derive the equation for active and passive earth pressure using Rankine's theory.</li></ul></li></ol> <p>Exercise (5 minutes) – Find the relation for total pressure at the base of retaining wall</p>
<b>Closure</b>	<ol style="list-style-type: none"><li>1. Summarize the Lesson Learning Outcomes and get affirmation from students on these.</li><li>2. Suggested Reading <a href="http://www.digimat.in/nptel/courses/video/105105168/L20.html">http://www.digimat.in/nptel/courses/video/105105168/L20.html</a></li><li>3. Homework<ul style="list-style-type: none"><li>- Draw pressure distribution diagram for various earth pressures.</li><li>- Spend 5 minutes to wrap up and consolidate the learnings</li></ul></li></ol>
<b>Evaluation</b>	<ol style="list-style-type: none"><li>1. Reflective Questions (What, Why, Who?). Allow students to answer and discuss.</li></ol>



	2. Nearpod Quiz on stresses in soil mechanics. Spend 5 minutes to evaluate student assimilation of the lesson contents
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<b>Lesson Plan No. 16</b>	<b>Course Name: Geotechnical Engineering</b> <b>Topic: Stability of slopes.</b>	<b>Course No.: CE-302</b>
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<b>Objectives</b>	At the end of the lesson the student shall be able to: a. articulate the concept slope in soil mechanics. b. Understand importance of stability of slopes. c. Illustrate with examples stability of slopes in canals highways dams and retaining walls. d. Different factor of safety in stability of slopes.
<b>Teaching Aids (if any)</b>	a. Chalk and talk. b. Use of Nearpod tool for online quiz
<b>Teaching Development</b>	<ol style="list-style-type: none"><li><b>1. Introduction (5 minutes)</b><ul style="list-style-type: none"><li>- Ask questions. How is railway embankment formed? What do you mean by slope of soil? What do you mean by shear strength of soil? What are the factors affecting shear strength of soil?</li><li>- Introduce the concept of stability of soil?</li><li>- Talk about various uses of slope stability in engineering.</li><li>- Different earth pressure at rest.</li><li>- Highlight the importance of angle of cohesion in soil.</li><li>- Rankine's earth pressure for cohesion and cohesionless soils.</li></ul></li><li><b>2. Development (30 minutes)</b><ul style="list-style-type: none"><li>- Stability of slopes in highway railways and canals.</li><li>- Different definitions of factors of safety used in soil stability.</li><li>- Explain the various types of soil failures</li><li>- Illustrate with examples uses of soil stability in civil engineering.</li><li>- Derive the equation for various factor of safety in soil stability.</li></ul></li></ol> <p>Exercise (5 minutes) – Determine FOS for long natural slope in over consolidated clay <math>c=10\text{KN/m}^2</math> and <math>\phi=25</math> degree unit weight saturated <math>\gamma=20\text{KN/m}^3</math> is inclined at 10 degree to horizontal?</p>
<b>Closure</b>	<ol style="list-style-type: none"><li>1. Summarize the Lesson Learning Outcomes and get affirmation from students on these.</li><li>2. Suggested Reading <a href="http://www.digimat.in/nptel/courses/video/105105168/L20.html">http://www.digimat.in/nptel/courses/video/105105168/L20.html</a></li><li>3. Homework<ul style="list-style-type: none"><li>- Find FOS for different angle and unit weight of soil?.</li><li>- Spend 5 minutes to wrap up and consolidate the learnings</li></ul></li></ol>
<b>Evaluation</b>	<ol style="list-style-type: none"><li>1. Reflective Questions (What, Why, Who?). Allow students to answer and discuss.</li><li>2. Nearpod Quiz on stresses in soil mechanics.</li></ol>



Model Institute of Engineering  
& Technology (Autonomous)  
**Lesson Plan**

Kot Bhalwal, Jammu

Spend 5 minutes to evaluate student assimilation of the lesson contents
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<b>Lesson Plan No. 16</b>	<b>Course Name: Geotechnical Engineering</b> <b>Topic: Types of slopes and their failure mechanism.</b>	<b>Course No.: CE-302</b>
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<b>Objectives</b>	At the end of the lesson the student shall be able to: <ul style="list-style-type: none"> <li>a. articulate the concept slope in soil mechanics.</li> <li>b. Understand types of slopes and their failure.</li> <li>c. Illustrate with examples stability of slopes in canals highways dams and retaining walls.</li> <li>d. Stability of infinite slope of cohesionless soil.</li> <li>e. Stability of infinite slope of cohesive soil.</li> </ul>
<b>Teaching Aids (if any)</b>	<ul style="list-style-type: none"> <li>a. Chalk and talk.</li> <li>b. Use of Nearpod tool for online quiz</li> </ul>
<b>Teaching Development</b>	<ul style="list-style-type: none"> <li>- <b>Introduction</b> (5 minutes)</li> <li>- Ask questions. How is railway embankment formed? What do you mean by slope of soil? What do you mean by shear strength of soil? What are the factors affecting shear strength of soil?</li> <li>- Introduce the concept of stability of soil?</li> <li>- Talk about various uses of slope stability in engineering.</li> <li>- Different types of slopes and their failure mechanism</li> <li>- Highlight the importance of angle of cohesion in soil.</li> <li>- Stability of infinite slope of cohesionless soil</li> <li>- Stability of infinite slope of cohesive soil</li> <li>- <b>Development</b> (30 minutes)</li> <li>- Stability of slopes in highway railways and canals.</li> <li>- Stability of infinite slope of cohesionless soil.</li> <li>- Stability of infinite slope of cohesive soil.</li> <li>- Explain the various types of soil failures</li> <li>- Illustrate with examples uses of soil stability in civil engineering.</li> <li>- Derive the equation for cohesive and cohesionless soil stability.</li> </ul> <p>Exercise (5 minutes) – Determine FOS for long natural slope in over consolidated clay <math>c=10\text{KN/m}^2</math> and <math>\phi=25</math> degree unit weight saturated <math>\gamma=20\text{KN/m}^3</math> is inclined at 10 degree to horizontal?</p>
<b>Closure</b>	<ol style="list-style-type: none"> <li>1. Summarize the Lesson Learning Outcomes and get affirmation from students on these.</li> <li>2. Suggested Reading <a href="http://www.digimat.in/nptel/courses/video/105105168/L20.html">http://www.digimat.in/nptel/courses/video/105105168/L20.html</a></li> <li>3. Homework <ul style="list-style-type: none"> <li>- Find wedge failure of soil and derive its equation?.</li> <li>- Spend 5 minutes to wrap up and consolidate the learnings</li> </ul> </li> </ol>



<b>Evaluation</b>	<ol style="list-style-type: none"><li>1. Reflective Questions (What, Why, Who?). Allow students to answer and discuss.</li><li>2. Nearpod Quiz on stresses in soil mechanics.</li></ol> <p>Spend 5 minutes to evaluate student assimilation of the lesson contents</p>
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<b>Lesson Plan No. 18</b>	<b>Course Name: Geotechnical Engineering</b> <b>Topic: Analysis of finite and infinite slope.</b>	<b>Course No.: CE-302</b>
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<b>Objectives</b>	At the end of the lesson the student shall be able to: <ul style="list-style-type: none"> <li>a. articulate the concept slope in soil mechanics.</li> <li>b. Stability of finite slope of cohesionless soil.</li> <li>c. Stability of finite slope of cohesive soil.</li> <li>d. Stability of infinite slope of cohesionless soil.</li> <li>e. Stability of infinite slope of cohesive soil.</li> </ul>
<b>Teaching Aids (if any)</b>	<ul style="list-style-type: none"> <li>a. Chalk and talk.</li> <li>b. Use of Nearpod tool for online quiz</li> </ul>
<b>Teaching Development</b>	<ul style="list-style-type: none"> <li>- <b>Introduction</b> (5 minutes)</li> <li>- Ask questions. How is railway embankment formed? What do you mean by slope of soil? What do you mean by shear strength of soil? What are the factors affecting shear strength of soil?</li> <li>- Introduce the concept of stability of soil?</li> <li>- Talk about various uses of slope stability in engineering.</li> <li>- Stability of finite slope of cohesive soil. Stability of infinite slope of cohesionless soil.</li> <li>- Stability of infinite slope of cohesive soil</li> <li>- Stability of infinite slope of cohesive soil</li> <li>- <b>Development</b> (30 minutes)</li> <li>- Stability of slopes in highway railways and canals.</li> <li>- Stability of infinite slope of cohesionless soil.</li> <li>- Stability of infinite slope of cohesive soil.</li> <li>- Explain the various types of soil failures</li> <li>- Illustrate with examples uses of soil stability in civil engineering.</li> <li>- Derive the equation for cohesive and cohesionless soil stability.</li> </ul> <p>Exercise (5 minutes) – Determine FOS for long natural slope in over consolidated clay <math>c=10\text{KN/m}^2</math> and <math>\phi=25^\circ</math> unit weight saturated <math>\gamma_{sat}=20\text{KN/m}^3</math> is inclined at <math>10^\circ</math> to horizontal?</p>
<b>Closure</b>	<ol style="list-style-type: none"> <li>1. Summarize the Lesson Learning Outcomes and get affirmation from students on these.</li> <li>2. Suggested Reading <a href="http://www.digimat.in/nptel/courses/video/105105168/L20.html">http://www.digimat.in/nptel/courses/video/105105168/L20.html</a></li> <li>3. Homework <ul style="list-style-type: none"> <li>- Find wedge failure of soil and derive its equation?.</li> <li>- Spend 5 minutes to wrap up and consolidate the learnings</li> </ul> </li> </ol>
<b>Evaluation</b>	1. Reflective Questions (What, Why, Who?). Allow students to



	<p>answer and discuss.</p> <p>2. Nearpod Quiz on stresses in soil mechanics.</p> <p>Spend 5 minutes to evaluate student assimilation of the lesson contents</p>
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Lesson Plan No. 19	Course Name: Geotechnical Engineering Topic: Friction circle method	Course No.: CE-302
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<b>Objectives</b>	At the end of the lesson the student shall be able to: a. articulate the concept slope in homogeneous soils. b. Stability of dry soil and submerged soil. c. Stability of slope under sudden drawdown condition. d. Stability of slope under steady seepage condition. e. Stability of slope during construction.
<b>Teaching Aids (if any)</b>	a. Chalk and talk. b. Use of Nearpod tool for online quiz
<b>Teaching Development</b>	<ul style="list-style-type: none"><li>- <b>Introduction</b> (5 minutes)</li><li>- Ask questions. How is construction slope formed? What do you mean by dry and submerged soil? What do you mean by seepage of soil? What are the factors affecting shear strength of soil?</li><li>- Introduce the concept of stability of homogeneous soil?</li><li>- Talk about Stability of dry soil and submerged soil.</li><li>- Stability of slope under sudden drawdown condition.</li><li>- Stability of slope under steady seepage condition.</li><li>- Stability of slope during construction</li><li>- Stability of infinite slope of cohesive soil</li><li>- <b>Development</b> (30 minutes)</li><li>- Stability of slope under sudden drawdown condition.</li><li>- Stability of slope under steady seepage condition.</li><li>- Stability of slope during construction.</li><li>- Explain the various types of soil failures</li><li>- Illustrate with examples uses of soil stability in civil engineering.</li><li>- Derive the equation for friction circle method for stability of dry and submerged soil.</li></ul> <p>Exercise (5 minutes) – Determine FOS using friction circle method for long natural slope in over consolidated clay <math>c=10\text{KN/m}^2</math> and <math>\phi_i=25^\circ</math> unit weight saturated <math>\gamma_{sat}=20\text{KN/m}^3</math> is inclined at <math>10^\circ</math> to horizontal?</p>
<b>Closure</b>	<ol style="list-style-type: none"><li>1. Summarize the Lesson Learning Outcomes and get affirmation from students on these.</li><li>2. Suggested Reading <a href="http://www.digimat.in/nptel/courses/video/105105168/L20.html">http://www.digimat.in/nptel/courses/video/105105168/L20.html</a></li><li>3. Homework<ul style="list-style-type: none"><li>- Find wedge failure of soil and derive its equation?.</li><li>- Spend 5 minutes to wrap up and consolidate the learnings</li></ul></li></ol>



<b>Evaluation</b>	<ol style="list-style-type: none"><li>1. Reflective Questions (What, Why, Who?). Allow students to answer and discuss.</li><li>2. Nearpod Quiz on stresses in soil mechanics.</li></ol> <p>Spend 5 minutes to evaluate student assimilation of the lesson contents</p>
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<b>Lesson Plan No. 20</b>	<b>Course Name: Geotechnical Engineering</b> <b>Topic: Site investigation and soil exploration</b>	<b>Course No.: CE-302</b>
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<b>Objectives</b>	At the end of the lesson the student shall be able to: a. articulate the concept site selection. b. Factors affecting site selection. c. Planning of civil engineering site. d. Stages in sub surface exploration. e. Depth of exploration.
<b>Teaching Aids (if any)</b>	a. Chalk and talk. b. Use of Nearpod tool for online quiz
<b>Teaching Development</b>	<ul style="list-style-type: none"><li>- <b>Introduction</b> (5 minutes)</li><li>- Ask questions. What is construction site? How is construction site choosing for project? What are the factors that affects the site selection? What are the factors affecting depth of exploration?</li><li>- Introduce the concept of site investigation and soil exploration?</li><li>- Talk about planning a subsurface exploration programme.</li><li>- Stages in sub surface exploration and detailed exploration</li><li>- Reconnaissance survey in soil exploration.</li><li>- Depth of exploration for different conditions.</li><li>- Lateral extent of exploration and methods of exploration.</li><li>- <b>Development</b> (30 minutes)</li><li>- Introduce the concept of site investigation and soil exploration. Open excavation methods of exploration.</li><li>- Borings for exploration and its different methods.</li><li>- Explain the various types of soil samplers.</li><li>- Illustrate with examples uses of site investigation in civil engineering.</li></ul>
<b>Closure</b>	<ol style="list-style-type: none"><li>1. Summarize the Lesson Learning Outcomes and get affirmation from students on these.</li><li>2. Suggested Reading <a href="http://www.digimat.in/nptel/courses/video/105105168/L20.html">http://www.digimat.in/nptel/courses/video/105105168/L20.html</a></li><li>3. Homework<ul style="list-style-type: none"><li>- Find the area ratio inside clearance and outside clearance of sample?.</li><li>- Spend 5 minutes to wrap up and consolidate the learnings</li></ul></li></ol>
<b>Evaluation</b>	<ol style="list-style-type: none"><li>1. Reflective Questions (What, Why, Who?). Allow students to answer and discuss.</li><li>2. Nearpod Quiz on stresses in soil mechanics.</li></ol> <p>Spend 5 minutes to evaluate student assimilation of the lesson contents</p>



Lesson Plan No. 21	Course Name: Geotechnical Engineering Topic: Methods of soil exploration	Course No.: CE-302
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<b>Objectives</b>	At the end of the lesson the student shall be able to: a. articulate the concept site selection. b. Factors affecting site selection. c. Planning of civil engineering site. d. Stages in sub surface exploration. e. Depth of exploration.
<b>Teaching Aids (if any)</b>	a. Chalk and talk. b. Use of Nearpod tool for online quiz
<b>Teaching Development</b>	<ul style="list-style-type: none"><li>- <b>Introduction</b> (5 minutes)</li><li>- Ask questions. What is construction site? How is construction site choosing for project? What are the factors that affects the site selection? What are the factors affecting depth of exploration?</li><li>- Introduce the concept of site investigation and soil exploration?</li><li>- Talk about planning a subsurface exploration programme.</li><li>- Stages in sub surface exploration and detailed exploration</li><li>- Reconnaissance survey in soil exploration.</li><li>- Depth of exploration for different conditions.</li><li>- Lateral extent of exploration and methods of exploration.</li><li>- <b>Development</b> (30 minutes)</li><li>- Introduce the concept of site investigation and soil exploration. Open excavation methods of exploration.</li><li>- Borings for exploration and its different methods.</li><li>- Explain the various types of soil samplers.</li><li>- Illustrate with examples uses of site investigation in civil engineering.</li></ul>
<b>Closure</b>	<ol style="list-style-type: none"><li>1. Summarize the Lesson Learning Outcomes and get affirmation from students on these.</li><li>2. Suggested Reading <a href="http://www.digimat.in/nptel/courses/video/105105168/L20.html">http://www.digimat.in/nptel/courses/video/105105168/L20.html</a></li><li>3. Homework<ul style="list-style-type: none"><li>- Find the area ratio inside clearance and outside clearance of sample?.</li><li>- Spend 5 minutes to wrap up and consolidate the learnings</li></ul></li></ol>
<b>Evaluation</b>	<ol style="list-style-type: none"><li>1. Reflective Questions (What, Why, Who?). Allow students to answer and discuss.</li><li>2. Nearpod Quiz on stresses in soil mechanics.</li></ol> <p>Spend 5 minutes to evaluate student assimilation of the lesson contents</p>



<b>Lesson Plan No. 22</b>	<b>Course Name: Geotechnical Engineering</b> <b>Topic: Cone penetration test.</b>	<b>Course No.: CE-302</b>
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<b>Objectives</b>	At the end of the lesson the student shall be able to: a. Procedure of Static cone penetration test. b. Procedure of dynamic cone penetration test. c. Procedure of Vane shear test. d. Uses of Static cone penetration test. e. Uses of dynamic cone penetration test.
<b>Teaching Aids (if any)</b>	a. Chalk and talk. b. Use of Nearpod tool for online quiz
<b>Teaching Development</b>	<ul style="list-style-type: none"><li>- <b>Introduction</b> (5 minutes)</li><li>- Ask questions. What is insitu and lab test? How is construction site choosing for project? What are the factors that affects the site selection? What are the factors affecting depth of exploration?</li><li>- Introduce the concept of site investigation and soil exploration?</li><li>- Talk about planning a subsurface exploration programme.</li><li>- Stages in sub surface exploration and detailed exploration</li><li>- Reconnaissance survey in soil exploration.</li><li>- Depth of exploration for different conditions.</li><li>- Lateral extent of exploration and methods of exploration.</li><li>- <b>Development</b> (30 minutes)</li><li>- Introduce the concept of Static cone penetration test.</li><li>- Introduce the concept of dynamic cone penetration test.</li><li>- Introduce the concept of Insitu vane shear test.</li><li>- Explain the various uses of cone penetration test.</li><li>- Illustrate with examples uses of cone penetration test in site investigation.</li></ul>
<b>Closure</b>	<ol style="list-style-type: none"><li>1. Summarize the Lesson Learning Outcomes and get affirmation from students on these.</li><li>2. Suggested Reading <a href="http://www.digimat.in/nptel/courses/video/105105168/L20.html">http://www.digimat.in/nptel/courses/video/105105168/L20.html</a></li><li>3. Homework<ul style="list-style-type: none"><li>- Prepare a DPR of soil exploration report?.</li><li>- Spend 5 minutes to wrap up and consolidate the learnings</li></ul></li></ol>
<b>Evaluation</b>	<ol style="list-style-type: none"><li>1. Reflective Questions (What, Why, Who?). Allow students to answer and discuss.</li><li>2. Nearpod Quiz on stresses in soil mechanics.</li></ol> <p>Spend 5 minutes to evaluate student assimilation of the lesson contents</p>



<b>Lesson Plan No. 23</b>	<b>Course Name: Geotechnical Engineering</b> <b>Topic: Standard penetration test.</b>	<b>Course No.: CE-302</b>
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<b>Objectives</b>	At the end of the lesson the student shall be able to: a. Procedure of Standard penetration test. b. Corrections for Standard penetration test. c. Procedure of Vane shear test. d. Uses of Standard penetration test. e. Corelation between loose and dense soil.
<b>Teaching Aids (if any)</b>	a. Chalk and talk. b. Use of Nearpod tool for online quiz
<b>Teaching Development</b>	<ul style="list-style-type: none"><li>- <b>Introduction</b> (5 minutes)</li><li>- Ask questions. What is the difference between loose and dense soil? What is the difference between soft and hard soil? What are the factors that affecting the penetration of soil? What are the factors affecting depth of exploration?</li><li>- Introduce the concept of site investigation and soil exploration?</li><li>- Talk about planning a subsurface exploration programme.</li><li>- Stages in sub surface exploration and detailed exploration</li><li>- Reconnaissance survey in soil exploration.</li><li>- Depth of exploration for different conditions.</li><li>- Lateral extent of exploration and methods of exploration.</li><li>- <b>Development</b> (30 minutes)</li><li>- Introduce the concept of Standard penetration test.</li><li>- Introduce the concept of corrections in Standard penetration test.</li><li>- Introduce the concept of Insitu vane shear test.</li><li>- Explain the various uses of Standard penetration test.</li><li>- Illustrate with examples uses of Standard penetration test in site investigation.</li></ul>
<b>Closure</b>	<ol style="list-style-type: none"><li>1. Summarize the Lesson Learning Outcomes and get affirmation from students on these.</li><li>2. Suggested Reading <a href="http://www.digimat.in/nptel/courses/video/105105168/L20.html">http://www.digimat.in/nptel/courses/video/105105168/L20.html</a></li><li>3. Homework<ul style="list-style-type: none"><li>- Prepare a DPR of soil exploration report?.</li><li>- Spend 5 minutes to wrap up and consolidate the learnings</li></ul></li></ol>
<b>Evaluation</b>	<ol style="list-style-type: none"><li>1. Reflective Questions (What, Why, Who?). Allow students to answer and discuss.</li><li>2. Nearpod Quiz on stresses in soil mechanics.</li></ol> <p>Spend 5 minutes to evaluate student assimilation of the lesson contents</p>



<b>Lesson Plan No. 24</b>	<b>Course Name: Geotechnical Engineering</b> <b>Topic: Types of samplers.</b>	<b>Course No.: CE-302</b>
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<b>Objectives</b>	At the end of the lesson the student shall be able to: a. Design feature affecting the sample disturbance. b. Split spoon sampler its drawing and uses. c. Scraper bucket sampler its drawing and its uses. d. Shelby tubes and thin-walled sampler and their advantages. e. Piston and Denison sampler.
<b>Teaching Aids (if any)</b>	a. Chalk and talk. b. Use of Nearpod tool for online quiz
<b>Teaching Development</b>	<ul style="list-style-type: none"><li>- <b>Introduction</b> (5 minutes)</li><li>- Ask questions. What is disturbed sample? How is construction site choosing for project? What do you mean by undisturbed sample? What are the uses of disturbed and undisturbed sample?</li><li>- Introduce the concept of samplers used in construction site?</li><li>- Split spoon sampler its drawing and uses.</li><li>- Scraper bucket sampler its drawing and its uses.</li><li>- Shelby tubes and thin-walled sampler and their advantages.</li><li>- Piston and Denison sampler.</li><li>- <b>Development</b> (30 minutes)</li><li>- Split spoon sampler its drawing and uses.</li><li>- Scraper bucket sampler its drawing and its uses.</li><li>- Shelby tubes and thin-walled sampler and their advantages.</li><li>- Piston and Denison sampler.</li><li>- Illustrate with examples uses of samplers in civil engineering.</li></ul>
<b>Closure</b>	<ol style="list-style-type: none"><li>1. Summarize the Lesson Learning Outcomes and get affirmation from students on these.</li><li>2. Suggested Reading <a href="http://www.digimat.in/nptel/courses/video/105105168/L20.html">http://www.digimat.in/nptel/courses/video/105105168/L20.html</a></li><li>3. Homework<ul style="list-style-type: none"><li>- Find the advantages of disturbed and undisturbed sample?</li><li>- Spend 5 minutes to wrap up and consolidate the learnings</li></ul></li></ol>
<b>Evaluation</b>	<ol style="list-style-type: none"><li>1. Reflective Questions (What, Why, Who?). Allow students to answer and discuss.</li><li>2. Nearpod Quiz on stresses in soil mechanics.</li></ol> <p>Spend 5 minutes to evaluate student assimilation of the lesson contents</p>



Lesson Plan No. 25	Course Name: Geotechnical Engineering Topic: Foundation and its classification.	Course No.: CE-302
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<b>Objectives</b>	At the end of the lesson the student shall be able to: a. articulate the concept of foundation and its uses. b. Understand concept of ultimate, net ultimate, net safe, net allowable bearing capacity. c. illustrate the concept of shallow and deep footings. d. Gross and net footing pressure.
<b>Teaching Aids (if any)</b>	a. Chalk and talk. b. Use of Nearpod tool for online quiz
<b>Teaching Development</b>	<ol style="list-style-type: none"><li><b>1. Introduction (5 minutes)</b><ul style="list-style-type: none"><li>- Ask questions. What do you mean by footing? What do you mean by foundation? How shallow and deep footing can be classified? Define bearing capacity?</li><li>- Introduce the concept of foundation.</li><li>- Talk about the concept of types of foundation.</li><li>- Introduce the formal definition of shallow and deep footings.</li><li>- Highlight the important characteristics of shallow and deep foundation.</li><li>- Highlight the different bearing pressures applied in footings</li></ul></li><li><b>2. Development (30 minutes)</b><ul style="list-style-type: none"><li>- Define ultimate bearing capacity, net ultimate bearing capacity, net safe bearing capacity, gross safe bearing capacity, net safe settlement pressure and net allowable bearing pressure.</li><li>- Foundation its uses and classification of foundation.</li><li>- Derive the equation for gross and net footing pressure for foundation backfilled and foundation not backfilled.</li><li>- Explain the difference between foundation and footing.</li></ul></li></ol> <p>Exercise (5 minutes) – Determine the ultimate bearing capacity of strip footing 1.2m wide and depth of foundation 1m take angle=35 degree unit weight of soil 18KN/m<sup>3</sup> and cohesion=15KN/m<sup>2</sup>.</p>
<b>Closure</b>	<ol style="list-style-type: none"><li>1. Summarize the Lesson Learning Outcomes and get affirmation from students on these.</li><li>2. Suggested Reading <a href="http://www.digimat.in/nptel/courses/video/105105168/L20.html">http://www.digimat.in/nptel/courses/video/105105168/L20.html</a></li><li>3. Homework<ul style="list-style-type: none"><li>- Determine the ultimate bearing capacity of strip footing 2m wide and depth of foundation 1.5m take angle=35-degree unit weight of soil 18KN/m<sup>3</sup> and cohesion=15KN/m<sup>2</sup>.</li></ul></li></ol>



	- Spend 5 minutes to wrap up and consolidate the learnings
<b>Evaluation</b>	<ol style="list-style-type: none"><li>1. Reflective Questions (What, Why, Who?). Allow students to answer and discuss.</li><li>2. Nearpod Quiz on stresses in soil mechanics.</li></ol> <p>Spend 5 minutes to evaluate student assimilation of the lesson contents</p>



<b>Lesson Plan No. 47</b>	<b>Course Name: Geotechnical Engineering Topic: Site investigation and geophysical methods adopted for tunneling purposes.</b>	<b>Course No.: CE-302</b>
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<b>Objectives</b>	At the end of the lesson the student shall be able to: a. articulate the concept of alignment of tunnels. b. Understand site investigation of tunnels. c. illustrate the geophysical methods of exploration of tunnels d. appreciate the use of total station in tunnels.
<b>Teaching Aids (if any)</b>	a. Chalk and talk. b. Use of Nearpod tool for online quiz
<b>Teaching Development</b>	<ol style="list-style-type: none"><li><b>1. Introduction (5 minutes)</b><ul style="list-style-type: none"><li>- Ask questions. What do you mean by total station? What do you mean by mountain passes? What are the uses of tunnels? How to build a tunnel?</li><li>- Introduce the different geophysical methods of exploration of Tunnels.</li><li>- Talk about the step-by-step procedure for taking the coordinates of tunnels.</li><li>- Introduce the site investigation of tunnels.</li><li>- Highlight the different machines used in tunnels.</li><li>- Highlight the use of total station tunnels</li></ul></li><li><b>2. Development (30 minutes)</b><ul style="list-style-type: none"><li>- Tunnelling and how site is selected for a tunnel to construct.</li><li>- Explain the different geophysical methods of tunnel exploration.</li><li>- Draw the various coordinates of tunnel and finally draw its alignment.</li><li>- Illustrate with examples to demonstrate how ground water and soft rock obstructs to construct a tunnel.</li><li>- Explain the use of total station in tunnels.</li></ul></li></ol> <p>Exercise (5 minutes) – Draw the elevation and cross section for horseshoe shaped tunnels for a given radius and coordinates.</p>
<b>Closure</b>	<ol style="list-style-type: none"><li>1. Summarize the Lesson Learning Outcomes and get affirmation from students on these.</li><li>2. Suggested Reading <a href="http://www.digimat.in/nptel/courses/video/105105168/L20.html">http://www.digimat.in/nptel/courses/video/105105168/L20.html</a></li><li>3. Homework<ul style="list-style-type: none"><li>- Find out the names and length of tunnels in your locality</li></ul></li></ol> <p>Spend 5 minutes to wrap up and consolidate the learnings</p>



<b>Evaluation</b>	<ol style="list-style-type: none"><li>1. Reflective Questions (What, Why, Who?). Allow students to answer and discuss.</li><li>2. Nearpod Quiz on tunnels.</li></ol> <p>Spend 5 minutes to evaluate student assimilation of the lesson contents</p>
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Lesson Plan No. 26	Course Name: Geotechnical Engineering Topic: Choice and necessity of foundation, Rankine's analysis.	Course No.: CE-302
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<b>Objectives</b>	At the end of the lesson the student shall be able to: a. articulate the concept of Shallow foundation and its types. b. Understand concept of ultimate, net ultimate, net safe, net allowable bearing capacity. c. illustrate the concept of Rankine's analysis for bearing capacity. d. Factors affecting the choice and selection of foundation.
<b>Teaching Aids (if any)</b>	a. Chalk and talk. b. Use of Nearpod tool for online quiz
<b>Teaching Development</b>	<p>1. <b>Introduction</b> (5 minutes)</p> <ul style="list-style-type: none"><li>- Ask questions. What do you mean by footing? What do you mean by foundation? How shallow and deep footing can be classified? Define bearing capacity?</li><li>- Introduce the concept of foundation.</li><li>- Talk about the concept of types of foundation.</li><li>- Introduce the formal definition of shallow and deep footings.</li><li>- Highlight the important characteristics of shallow and deep foundation.</li><li>- Highlight the different bearing pressures applied in footings</li></ul> <p>2. <b>Development</b> (30 minutes)</p> <ul style="list-style-type: none"><li>- Define Strip footing, isolated footing, combined footing, strap footing, raft footing.</li><li>- Foundation and its depth calculation for various footing.</li><li>- Different types of loads acting on foundation.</li><li>- Rankine's analysis for ultimate bearing capacity on foundation.</li></ul> <p>Exercise (5 minutes) – Determine the ultimate bearing capacity of strip footing 1.2m wide and depth of foundation 1m take angle=35 degree unit weight of soil 18KN/m<sup>3</sup> and cohesion=15KN/m<sup>2</sup> using Rankine's analysis.</p>
<b>Closure</b>	<p>1. Summarize the Lesson Learning Outcomes and get affirmation from students on these.</p> <p>2. Suggested Reading <a href="http://www.digimat.in/nptel/courses/video/105105168/L20.html">http://www.digimat.in/nptel/courses/video/105105168/L20.html</a></p> <p>3. Homework</p> <ul style="list-style-type: none"><li>- Determine the ultimate bearing capacity of strip footing 2m wide and depth of foundation 1.5m take angle=35-degree unit weight of soil 18KN/m<sup>3</sup> and cohesion=15KN/m<sup>2</sup>.</li><li>- Spend 5 minutes to wrap up and consolidate the learnings</li></ul>



<b>Evaluation</b>	<ol style="list-style-type: none"><li>1. Reflective Questions (What, Why, Who?). Allow students to answer and discuss.</li><li>2. Nearpod Quiz on stresses in soil mechanics.</li></ol> <p>Spend 5 minutes to evaluate student assimilation of the lesson contents</p>
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Lesson Plan No. 27	Course Name: Geotechnical Engineering Topic: Terzaghi's analysis and is code method for determining bearing capacity.	Course No.: CE-302
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<b>Objectives</b>	At the end of the lesson the student shall be able to: a. Terzaghi's analysis to determine bearing capacity of foundation. b. Prandtl's analysis to determine bearing capacity of foundation. c. illustrate the concept of Terzaghi's bearing capacity theory. d. IS codal method for bearing capacity of shallow foundation.
<b>Teaching Aids (if any)</b>	a. Chalk and talk. b. Use of Nearpod tool for online quiz
<b>Teaching Development</b>	<ol style="list-style-type: none"><li><b>1. Introduction (5 minutes)</b><ul style="list-style-type: none"><li>- Ask questions. What do you mean by footing? What do you mean by foundation? How shallow and deep footing can be classified? Define bearing capacity?</li><li>- Introduce the concept of Terzaghi's theory.</li><li>- Talk about the concept of Prandtl's analysis.</li><li>- Introduce the formal definition of shallow and deep footings.</li><li>- Highlight the important characteristics of shallow and deep foundation.</li><li>- Highlight the different bearing pressures applied in footings</li></ul></li><li><b>2. Development (30 minutes)</b><ul style="list-style-type: none"><li>- Terzaghi's analysis to determine bearing capacity of foundation.</li><li>- Prandtl's analysis to determine bearing capacity of foundation.</li><li>- illustrate the concept of Terzaghi's bearing capacity theory.</li><li>- IS codal method for bearing capacity of shallow foundation.</li></ul></li></ol> <p>Exercise (5 minutes) – Determine the ultimate bearing capacity of strip footing 1.2m wide and depth of foundation 1m take angle=35 degree unit weight of soil 18KN/m<sup>3</sup> and cohesion=15KN/m<sup>2</sup> using Terzaghi's analysis.</p>
<b>Closure</b>	<ol style="list-style-type: none"><li>1. Summarize the Lesson Learning Outcomes and get affirmation from students on these.</li><li>2. Suggested Reading <a href="http://www.digimat.in/nptel/courses/video/105105168/L20.html">http://www.digimat.in/nptel/courses/video/105105168/L20.html</a></li><li>3. Homework<ul style="list-style-type: none"><li>- Determine the ultimate bearing capacity of strip footing 2m wide and depth of foundation 1.5m take angle=35-degree unit weight of soil 18KN/m<sup>3</sup> and cohesion=15KN/m<sup>2</sup> IS codal method.</li><li>- Spend 5 minutes to wrap up and consolidate the learnings</li></ul></li></ol>



<b>Evaluation</b>	<ol style="list-style-type: none"><li>1. Reflective Questions (What, Why, Who?). Allow students to answer and discuss.</li><li>2. Nearpod Quiz on bearing capacity of soil.</li></ol> <p>Spend 5 minutes to evaluate student assimilation of the lesson contents</p>
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<b>Lesson Plan No. 28</b>	<b>Course Name: Geotechnical Engineering Topic: Pile foundation its classification and uses.</b>	<b>Course No.: CE-302</b>
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<b>Objectives</b>	At the end of the lesson the student shall be able to: <ol style="list-style-type: none"> <li>articulate the concept of Pile foundation and its uses.</li> <li>Understand different types of pile foundation and their uses.</li> <li>illustrate the concept of shallow and deep footings.</li> <li>Methods used to determine load carrying capacity of pile foundation.</li> </ol>
<b>Teaching Aids (if any)</b>	<ol style="list-style-type: none"> <li>Chalk and talk.</li> <li>Use of Nearpod tool for online quiz</li> </ol>
<b>Teaching Development</b>	<ol style="list-style-type: none"> <li><b>Introduction (5 minutes)</b> <ul style="list-style-type: none"> <li>Ask questions.               <ul style="list-style-type: none"> <li>What do you mean by footing?</li> <li>What do you mean by Pile foundation?</li> <li>How shallow and deep footing can be classified?</li> <li>Define load carrying capacity?</li> </ul> </li> <li>Introduce the concept of Pile foundation.</li> <li>Talk about the concept of types of Pile foundation.</li> <li>Introduce the formal definition of shallow and deep footings.</li> <li>Highlight the important characteristics of shallow and deep Pile foundation.</li> <li>Highlight the necessity and load carrying capacity of pile foundation</li> </ul> </li> <li><b>Development (30 minutes)</b> <ul style="list-style-type: none"> <li>Pile foundation its uses and classification of Pile foundation.</li> <li>Necessity of pile foundation.</li> <li>Methods of pile driving.</li> <li>Construction of bored piles.</li> <li>Explain the load carrying capacity of piles and the methods to determine this.</li> </ul> </li> </ol> <p>Exercise (5 minutes) – Determine the safe load on concrete pile of 30 cm diameter driven into a medium dense sand of angle of friction=35 degree unit weight of soil=21KN/m<sup>3</sup>, K=1, <math>\tan\phi=.70</math> for a depth of 8m.</p>
<b>Closure</b>	<ol style="list-style-type: none"> <li>Summarize the Lesson Learning Outcomes and get affirmation from students on these.</li> <li>Suggested Reading <a href="http://www.digimat.in/nptel/courses/video/105105168/L20.html">http://www.digimat.in/nptel/courses/video/105105168/L20.html</a></li> <li>Homework       <ul style="list-style-type: none"> <li>Determine the safe load on concrete pile of 20 cm diameter driven into a medium dense sand of angle of friction=35 degree</li> </ul> </li> </ol>



	unit weight of soil=21KN/m <sup>3</sup> , K=1.1, tan@=.80 for a depth of 10m.
<b>Evaluation</b>	<ol style="list-style-type: none"><li>1. Reflective Questions (What, Why, Who?). Allow students to answer and discuss.</li><li>2. Nearpod Quiz on pile foundation and its types.</li></ol> <p>Spend 5 minutes to evaluate student assimilation of the lesson contents</p>



<b>Lesson Plan No. 29</b>	<b>Course Name: Geotechnical Engineering</b> <b>Topic: Bearing capacity of piles and pile load test.</b>	<b>Course No.: CE-302</b>
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<b>Objectives</b>	At the end of the lesson the student shall be able to: a. articulate the concept of bearing capacity of Pile. b. Understand different methods to determine bearing capacity of pile foundation. c. illustrate the concept of pile load test and its uses. d. Static and dynamic methods to determine bearing capacity of pile foundation.
<b>Teaching Aids (if any)</b>	a. Chalk and talk. b. Use of Nearpod tool for online quiz
<b>Teaching Development</b>	<ol style="list-style-type: none"><li><b>1. Introduction (5 minutes)</b><ul style="list-style-type: none"><li>- Ask questions. What do you mean by footing? What do you mean by Pile foundation? How shallow and deep footing can be classified? Define load carrying capacity?</li><li>- Introduce the concept of static method for driven piles in sand.</li><li>- Talk about the concept of Meyerhof's method to determine bearing capacity of Pile foundation.</li><li>- Introduce the concept of static method for driven piles in saturated clay.</li><li>- Introduce the concept of dynamic method for driven piles in sand</li><li>- Introduce the concept of static method for driven piles in saturated clay.</li><li>- In-situ tests for pile capacity.</li></ul></li><li><b>2. Development (30 minutes)</b><ul style="list-style-type: none"><li>- Introduce the concept of static method for driven piles in sand.</li><li>- Talk about the concept of Meyerhof's method to determine bearing capacity of Pile foundation.</li><li>- Introduce the concept of static method for driven piles in saturated clay.</li><li>- Introduce the concept of dynamic method for driven piles in sand</li><li>- Introduce the concept of static method for driven piles in saturated clay.</li><li>- Penetration test and pile load test procedure and uses.</li></ul></li></ol> <p>Exercise (5 minutes) – Determine the safe load on concrete pile of 30 cm diameter driven into a medium dense sand of angle of friction=35 degree unit weight of soil=21KN/m<sup>3</sup>, K=1, <math>\tan\phi = .70</math> for a depth of 8m.</p>
<b>Closure</b>	1. Summarize the Lesson Learning Outcomes and get affirmation



	<p>from students on these.</p> <ol style="list-style-type: none"><li>2. Suggested Reading <a href="http://www.digimat.in/nptel/courses/video/105105168/L20.html">http://www.digimat.in/nptel/courses/video/105105168/L20.html</a></li><li>3. Homework<ul style="list-style-type: none"><li>- Determine the safe load on concrete pile of 20 cm diameter driven into a medium dense sand of angle of friction=35 degree unit weight of soil=21KN/m<sup>3</sup>, K=1.1, tan@=.80 for a depth of 10m.</li></ul></li></ol>
<b>Evaluation</b>	<ol style="list-style-type: none"><li>1. Reflective Questions (What, Why, Who?). Allow students to answer and discuss.</li><li>2. Nearpod Quiz on penetration tests on pile foundation.</li></ol> <p>Spend 5 minutes to evaluate student assimilation of the lesson contents</p>



<b>Lesson Plan No. 30</b>	<b>Course Name: Geotechnical Engineering</b> <b>Topic: Well foundation and its construction.</b>	<b>Course No.: CE-302</b>
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<b>Objectives</b>	At the end of the lesson the student shall be able to: a. articulate the concept of Well foundation. b. Understand the construction of well foundation. c. illustrate the advantages of well foundation. d. Grip length forces acting on well foundation.
<b>Teaching Aids (if any)</b>	a. Chalk and talk. b. Use of Nearpod tool for online quiz
<b>Teaching Development</b>	<ol style="list-style-type: none"><li><b>1. Introduction (5 minutes)</b><ul style="list-style-type: none"><li>- Ask questions. What do you mean by footing? What do you mean by well foundation? How shallow and deep footing can be classified? Define load carrying capacity?</li><li>- Introduce the concept of well foundation.</li><li>- Talk about the different component parts of well foundation.</li><li>- Introduce the different shapes of well foundation and their uses.</li><li>- Introduce the concept of grip length.</li><li>- Different forces acting on well foundation.</li><li>- Terzaghi's analysis of well foundation</li></ul></li><li><b>2. Development (30 minutes)</b><ul style="list-style-type: none"><li>- Introduce the concept of well foundation.</li><li>- Talk about the different component parts of well foundation.</li><li>- Introduce the different shapes of well foundation and their uses.</li><li>- Introduce the concept of grip length.</li><li>- To determine the different forces acting on well foundation.</li><li>- Design of individual components of well foundation.</li></ul></li></ol> <p>Exercise (5 minutes) – Design the well foundation using IRC method if HFL=103.5m, bed level=100m, scour level=88m, base level==78m, external diameter=8m, width of pile at top=1.5m, total load=500KN, total moment=3000KNm.</p>
<b>Closure</b>	<ol style="list-style-type: none"><li>1. Summarize the Lesson Learning Outcomes and get affirmation from students on these.</li><li>2. Suggested Reading <a href="http://www.digimat.in/nptel/courses/video/105105168/L20.html">http://www.digimat.in/nptel/courses/video/105105168/L20.html</a></li><li>3. Homework<ul style="list-style-type: none"><li>- Design the well foundation using IRC method if HFL=103.5m, bed level=100m, scour level=88m, base level==78m, external diameter=8m, width of pile at top=1.5m, total load=1500KN, total moment=3200KNm..</li></ul></li></ol>
<b>Evaluation</b>	1. Reflective Questions (What, Why, Who?). Allow students to



	<p>answer and discuss.</p> <p>2. Nearpod Quiz on well foundation.</p> <p>Spend 5 minutes to evaluate student assimilation of the lesson contents</p>
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Lesson Plan No. 31	Course Name: Geotechnical Engineering Topic: Caissons foundation and its construction.	Course No.: CE-302
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<b>Objectives</b>	At the end of the lesson the student shall be able to: a. articulate the concept of Caissons foundation. b. Understand the construction of Caissons foundation. c. illustrate the advantages of Caissons foundation. d. Types of caissons and forces acting on Caissons foundation.
<b>Teaching Aids (if any)</b>	a. Chalk and talk. b. Use of Nearpod tool for online quiz
<b>Teaching Development</b>	<ol style="list-style-type: none"><li><b>1. Introduction (5 minutes)</b><ul style="list-style-type: none"><li>- Ask questions. What do you mean by footing? What do you mean by Caissons foundation? How shallow and deep footing can be classified? Define load carrying capacity?</li><li>- Introduce the concept of Caissons foundation.</li><li>- Talk about the different component parts of Caissons foundation.</li><li>- Introduce the different shapes of Caissons foundation and their uses.</li><li>- Introduce the concept of grip length.</li><li>- Different forces acting on Caissons foundation.</li><li>- Terzaghi's analysis of Caissons foundation</li></ul></li><li><b>2. Development (30 minutes)</b><ul style="list-style-type: none"><li>- Introduce the concept of Caissons foundation.</li><li>- Talk about the different component parts of Caissons foundation.</li><li>- Introduce the different shapes of Caissons foundation and their uses.</li><li>- Introduce the concept of grip length.</li><li>- To determine the different forces acting on Caissons foundation.</li><li>- Design of individual components of Caissons foundation.</li></ul></li></ol> <p>Exercise (5 minutes) – Design the Caissons foundation using IRC method if HFL=103.5m, bed level=100m, scour level=88m, base level=78m, external diameter=8m, width of pile at top=1.5m, total load=500KN, total moment=3000KNm.</p>
<b>Closure</b>	<ol style="list-style-type: none"><li>1. Summarize the Lesson Learning Outcomes and get affirmation from students on these.</li><li>2. Suggested Reading <a href="http://www.digimat.in/nptel/courses/video/105105168/L20.html">http://www.digimat.in/nptel/courses/video/105105168/L20.html</a></li><li>3. Homework<ul style="list-style-type: none"><li>- Design the Caissons foundation using IRC method if HFL=103.5m, bed level=100m, scour level=88m, base</li></ul></li></ol>



	level=78m, external diameter=8m, width of pile at top=1.5m, total load=1500KN, total moment=3200KNm..
<b>Evaluation</b>	<ol style="list-style-type: none"><li>1. Reflective Questions (What, Why, Who?). Allow students to answer and discuss.</li><li>2. Nearpod Quiz on Caissons foundation.</li></ol> <p>Spend 5 minutes to evaluate student assimilation of the lesson contents</p>



<b>Lesson Plan No. 32</b>	<b>Course Name: Geotechnical Engineering</b> <b>Topic: Grip length, Bearing capacity, Settlement.</b>	<b>Course No.: CE-302</b>
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<b>Objectives</b>	At the end of the lesson the student shall be able to: <ul style="list-style-type: none"> <li>a. articulate the concept of bearing capacity in foundation.</li> <li>b. Understand concept of ultimate, net ultimate, net safe, net allowable bearing capacity.</li> <li>c. illustrate the concept of settlements in sand and clay.</li> <li>d. Grip length and its derivation.</li> </ul>
<b>Teaching Aids (if any)</b>	<ul style="list-style-type: none"> <li>a. Chalk and talk.</li> <li>b. Use of Nearpod tool for online quiz</li> </ul>
<b>Teaching Development</b>	<ol style="list-style-type: none"> <li>1. <b>Introduction</b> (5 minutes) <ul style="list-style-type: none"> <li>- Ask questions. What do you mean by footing? What do you mean by foundation? How clay and sand behave under settlement? Define bearing capacity?</li> <li>- Introduce the concept of bearing capacity in foundation.</li> <li>- Talk about the concept of types bearing capacity.</li> <li>- Introduce the formal definition of bearing capacity.</li> <li>- Highlight the important characteristics settlements in clay and sand under isolated and raft footings.</li> <li>- Highlight the different bearing pressures applied in footings</li> </ul> </li> <li>2. <b>Development</b> (30 minutes) <ul style="list-style-type: none"> <li>- Define ultimate bearing capacity, net ultimate bearing capacity, net safe bearing capacity, gross safe bearing capacity, net safe settlement pressure and net allowable bearing pressure.</li> <li>- Important characteristics settlements in clay and sand under isolated and raft footings.</li> <li>- Derive the equation for gross and net footing pressure for foundation backfilled and foundation not backfilled.</li> <li>- Explain the difference between foundation and footing.</li> </ul> </li> </ol> <p>Exercise (5 minutes) – Determine the ultimate bearing capacity of strip footing 1.2m wide and depth of foundation 1m take angle=35 degree unit weight of soil 18KN/m<sup>3</sup> and cohesion=15KN/m<sup>2</sup>.</p>
<b>Closure</b>	<ol style="list-style-type: none"> <li>1. Summarize the Lesson Learning Outcomes and get affirmation from students on these.</li> <li>2. Suggested Reading <a href="http://www.digimat.in/nptel/courses/video/105105168/L20.html">http://www.digimat.in/nptel/courses/video/105105168/L20.html</a></li> <li>3. Homework <ul style="list-style-type: none"> <li>- Determine the ultimate bearing capacity of strip footing 2m wide and depth of foundation 1.5m take angle=35-degree unit</li> </ul> </li> </ol>



	<p>weight of soil 18KN/m<sup>3</sup> and cohesion=15KN/m<sup>2</sup>.</p> <p>- Spend 5 minutes to wrap up and consolidate the learnings</p>
<b>Evaluation</b>	<ol style="list-style-type: none"><li>1. Reflective Questions (What, Why, Who?). Allow students to answer and discuss.</li><li>2. Nearpod Quiz on bearing capacity in soil mechanics.</li></ol> <p>Spend 5 minutes to evaluate student assimilation of the lesson contents</p>



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<b>Lesson Plan No. 33</b>	<b>Course Name: Geotechnical Engineering Topic: Forces acting on well foundation &amp; sinking of wells.</b>	<b>Course No.: CE-302</b>
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<b>Objectives</b>	At the end of the lesson the student shall be able to: a. articulate the concept of Well foundation. b. Understand the measures for rectifications of tilts and shifts. c. illustrate the causes of sinking of wells. d. Grip length forces acting on well foundation.
<b>Teaching Aids (if any)</b>	a. Chalk and talk. b. Use of Nearpod tool for online quiz
<b>Teaching Development</b>	<ol style="list-style-type: none"><li><b>Introduction</b> (5 minutes)<ul style="list-style-type: none"><li>Ask questions. What do you mean by sinking? What do you mean by well foundation? Define rectification of wells? Define sinking of wells?</li></ul></li><li>Introduce the concept of well foundation.</li><li>Talk about the different component parts of well foundation.</li><li>Introduce the different shapes of well foundation and their uses.</li><li>Introduce the concept of grip length.</li><li>Different forces acting on well foundation.</li></ol> <ol style="list-style-type: none"><li><b>Development</b> (30 minutes)<ul style="list-style-type: none"><li>Introduce the concept of well foundation.</li><li>Talk about the sinking of wells and its causes.</li><li>Measures for rectification of tilts and shifts.</li><li>Introduce the concept of grip length.</li><li>To determine the different forces acting on well foundation.</li><li>Design of individual components of well foundation.</li></ul></li></ol> <p>Exercise (5 minutes) – Design the well foundation using IRC method if HFL=103.5m, bed level=100m, scour level=88m, base level=78m, external diameter=8m, width of pile at top=1.5m, total load=500KN, total moment=3000KNm.</p>
<b>Closure</b>	<ol style="list-style-type: none"><li>Summarize the Lesson Learning Outcomes and get affirmation from students on these.</li><li>Suggested Reading <a href="http://www.digimat.in/nptel/courses/video/105105168/L20.html">http://www.digimat.in/nptel/courses/video/105105168/L20.html</a></li><li>Homework<ul style="list-style-type: none"><li>Design the well foundation using IRC method if HFL=103.5m, bed level=100m, scour level=88m, base level=78m, external diameter=8m, width of pile at top=1.5m, total load=1500KN, total moment=3200KNm..</li></ul></li></ol>
<b>Evaluation</b>	<ol style="list-style-type: none"><li>Reflective Questions (What, Why, Who?). Allow students to answer and discuss.</li><li>Nearpod Quiz on well foundation.</li></ol>



Kot Bhalwal, Jammu

Model Institute of Engineering  
& Technology (Autonomous)  
**Lesson Plan**

	Spend 5 minutes to evaluate student assimilation of the lesson contents
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Kot Bhalwal, Jammu



Lesson Plan No. 34	Course Name: Geotechnical Engineering Topic: Rectification of Tilts and Shifts.	Course No.: CE-302
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<b>Objectives</b>	At the end of the lesson the student shall be able to: a. articulate the concept of Well foundation. b. Understand the measures for rectifications of tilts and shifts. c. illustrate the causes of sinking of wells. d. Grip length forces acting on well foundation.
<b>Teaching Aids (if any)</b>	a. Chalk and talk. b. Use of Nearpod tool for online quiz
<b>Teaching Development</b>	<ol style="list-style-type: none"><li><b>Introduction</b> (5 minutes)<ul style="list-style-type: none"><li>Ask questions. What do you mean by strutting? What do you mean by wooden sleeper? Define rectification of wells? Define sinking of wells?</li></ul></li><li><b>Development</b> (30 minutes)<ul style="list-style-type: none"><li>Introduce the concept of well foundation.</li><li>Talk about the different component parts of well foundation.</li><li>Introduce the different shapes of well foundation and their uses.</li><li>Introduce the concept of grip length.</li><li>Different forces acting on well foundation.</li></ul></li></ol> <p>Exercise (5 minutes) – Design the well foundation using IRC method if HFL=103.5m, bed level=100m, scour level=88m, base level=78m, external diameter=8m, width of pile at top=1.5m, total load=500KN, total moment=3000KNm.</p>
<b>Closure</b>	<ol style="list-style-type: none"><li>Summarize the Lesson Learning Outcomes and get affirmation from students on these.</li><li>Suggested Reading <a href="http://www.digimat.in/nptel/courses/video/105105168/L20.html">http://www.digimat.in/nptel/courses/video/105105168/L20.html</a></li><li>Homework<ul style="list-style-type: none"><li>Design the well foundation using IRC method if HFL=103.5m, bed level=100m, scour level=88m, base level=78m, external diameter=8m, width of pile at top=1.5m, total load=1500KN, total moment=3200KNm..</li></ul></li></ol>
<b>Evaluation</b>	<ol style="list-style-type: none"><li>Reflective Questions (What, Why, Who?). Allow students to answer and discuss.</li><li>Nearpod Quiz on well foundation.</li></ol>



Kot Bhalwal, Jammu

# Model Institute of Engineering & Technology (Autonomous) Lesson Plan

	Spend 5 minutes to evaluate student assimilation of the lesson contents
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Lesson Plan No. 35	Course Name: Geotechnical Engineering Topic: Caissons foundation and its types.	Course No.: CE-302
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<b>Objectives</b>	At the end of the lesson the student shall be able to: a. articulate the concept of Caissons foundation. b. Understand the construction of Caissons foundation. c. illustrate the advantages of Caissons foundation. d. Types of caissons and forces acting on Caissons foundation.
<b>Teaching Aids (if any)</b>	a. Chalk and talk. b. Use of Nearpod tool for online quiz
<b>Teaching Development</b>	<ol style="list-style-type: none"><li><b>1. Introduction (5 minutes)</b><ul style="list-style-type: none"><li>- Ask questions. What do you mean by footing? What do you mean by Caissons foundation? How shallow and deep footing can be classified? Define load carrying capacity?</li><li>- Introduce the concept of Caissons foundation.</li><li>- Talk about the different component parts of Caissons foundation.</li><li>- Introduce the different shapes of Caissons foundation and their uses.</li><li>- Introduce the concept of grip length.</li><li>- Different forces acting on Caissons foundation.</li><li>- Terzaghi's analysis of Caissons foundation</li></ul></li><li><b>2. Development (30 minutes)</b><ul style="list-style-type: none"><li>- Introduce the concept of Caissons foundation.</li><li>- Talk about the different component parts of Caissons foundation.</li><li>- Introduce the different shapes of Caissons foundation and their uses.</li><li>- Introduce the concept of grip length.</li><li>- To determine the different forces acting on Caissons foundation.</li><li>- Design of individual components of Caissons foundation.</li></ul></li></ol> <p>Exercise (5 minutes) – Design the Caissons foundation using IRC method if HFL=103.5m, bed level=100m, scour level=88m, base level=78m, external diameter=8m, width of pile at top=1.5m, total load=500KN, total moment=3000KNm.</p>
<b>Closure</b>	<ol style="list-style-type: none"><li>1. Summarize the Lesson Learning Outcomes and get affirmation from students on these.</li><li>2. Suggested Reading <a href="http://www.digimat.in/nptel/courses/video/105105168/L20.html">http://www.digimat.in/nptel/courses/video/105105168/L20.html</a></li><li>3. Homework<ul style="list-style-type: none"><li>- Design the Caissons foundation using IRC method if HFL=103.5m, bed level=100m, scour level=88m, base</li></ul></li></ol>



	level=78m, external diameter=8m, width of pile at top=1.5m, total load=1500KN, total moment=3200KNm..
<b>Evaluation</b>	<ol style="list-style-type: none"><li>1. Reflective Questions (What, Why, Who?). Allow students to answer and discuss.</li><li>2. Nearpod Quiz on Caissons foundation.</li></ol> <p>Spend 5 minutes to evaluate student assimilation of the lesson contents</p>



Lesson Plan No. 36	Course Name: Geotechnical Engineering Topic: Shapes of different types of foundation.	Course No.: CE-302
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<b>Objectives</b>	At the end of the lesson the student shall be able to: a. articulate the concept of Circular foundation. b. Understand the construction of double-D foundation. c. illustrate the advantages of octagonal foundation. d. Types of rectangular foundation.
<b>Teaching Aids (if any)</b>	a. Chalk and talk. b. Use of Nearpod tool for online quiz
<b>Teaching Development</b>	<ol style="list-style-type: none"><li><b>1. Introduction (5 minutes)</b><ul style="list-style-type: none"><li>- Ask questions. What do you mean by footing? What are the different shapes of foundation? How shallow and deep footing can be classified? Define load carrying capacity?</li><li>- Introduce the concept of Circular foundation and its uses.</li><li>- Talk about the different component parts of octagonal foundation.</li><li>- Introduce the different shapes of Caissons foundation and their uses.</li><li>- Introduce the concept of grip length.</li><li>- Different forces acting on Caissons foundation.</li><li>- Terzaghi's analysis of Caissons foundation</li></ul></li><li><b>2. Development (30 minutes)</b><ul style="list-style-type: none"><li>- Introduce the concept of Caissons foundation.</li><li>- Talk about the different component parts of Caissons foundation.</li><li>- Introduce the different shapes of Caissons foundation and their uses.</li><li>- Introduce the concept of grip length.</li><li>- To determine the different forces acting on Caissons foundation.</li><li>- Design of individual components of Caissons foundation.</li></ul></li></ol> <p>Exercise (5 minutes) – Design the Caissons foundation using IRC method if HFL=103.5m, bed level=100m, scour level=88m, base level=78m, external diameter=8m, width of pile at top=1.5m, total load=500KN, total moment=3000KNm.</p>
<b>Closure</b>	<ol style="list-style-type: none"><li>1. Summarize the Lesson Learning Outcomes and get affirmation from students on these.</li><li>2. Suggested Reading <a href="http://www.digimat.in/nptel/courses/video/105105168/L20.html">http://www.digimat.in/nptel/courses/video/105105168/L20.html</a></li><li>3. Homework<ul style="list-style-type: none"><li>- Design the Caissons foundation using IRC method if HFL=103.5m, bed level=100m, scour level=88m, base</li></ul></li></ol>



	level=78m, external diameter=8m, width of pile at top=1.5m, total load=1500KN, total moment=3200KNm..
<b>Evaluation</b>	<ol style="list-style-type: none"><li>1. Reflective Questions (What, Why, Who?). Allow students to answer and discuss.</li><li>2. Nearpod Quiz on Caissons foundation.</li></ol> <p>Spend 5 minutes to evaluate student assimilation of the lesson contents</p>



<b>Lesson Plan No. 37</b>	<b>Course Name: Geotechnical Engineering Topic: Introduction to geosynthetics</b>	<b>Course No.: CE-302</b>
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<b>Objectives</b>	At the end of the lesson the student shall be able to: a. articulate the concept of geosynthetics. b. Understand the advantages of geosynthetics. c. illustrate the development of geosynthetics in India and world. d. Classification of geosynthetics.
<b>Teaching Aids (if any)</b>	a. PPT. b. Use of Nearpod tool for online quiz
<b>Teaching Development</b>	<ol style="list-style-type: none"><li><b>1. Introduction</b> (5 minutes)<ul style="list-style-type: none"><li>- Ask questions. What do you mean by waterlogging? What do you mean by grouting? What are the advantages of fibres? Use of fibres in geomatics engineering?</li><li>- Introduce the concept of Geosynthetics.</li><li>- Talk about the development of geosynthetics in India and world.</li><li>- Introduce the formal definition geosynthetics and its development.</li><li>- Highlight the important characteristics of geosynthetics.</li><li>- Highlight the different advantages of geosynthetics in soil mechanics</li></ul></li><li><b>2. Development</b> (30 minutes)<ul style="list-style-type: none"><li>- Geosynthetics its development in India and world.</li><li>- Classification of geosynthetics.</li><li>- Advantages of geosynthetics in soil mechanics and other civil engineering fields.</li><li>- Illustrate with examples the use of geosynthetics fibres in foundation.</li><li>- Explain the limitations of using geosynthetics fibres.</li></ul></li></ol>
<b>Closure</b>	<ol style="list-style-type: none"><li>1. Summarize the Lesson Learning Outcomes and get affirmation from students on these.</li><li>2. Suggested Reading <a href="http://www.digimat.in/nptel/courses/video/105105168/L20.html">http://www.digimat.in/nptel/courses/video/105105168/L20.html</a></li><li>3. Homework<ul style="list-style-type: none"><li>- From the current civil engineering projects find out where geosynthetics fibres are used.</li></ul></li></ol> <p>Spend 5 minutes to wrap up and consolidate the learnings</p>
<b>Evaluation</b>	1. Reflective Questions (What, Why, Who?). Allow students to



	<p>answer and discuss.</p> <p>2. Nearpod Quiz on Geosynthetics in soil mechanics.</p> <p>Spend 5 minutes to evaluate student assimilation of the lesson contents</p>
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<b>Lesson Plan No. 38</b>	<b>Course Name: Geotechnical Engineering</b> <b>Topic: Development of various geosynthetics</b>	<b>Course No.: CE-302</b>
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<b>Objectives</b>	At the end of the lesson the student shall be able to: <ol style="list-style-type: none"> <li>articulate the history of geosynthetics.</li> <li>Understand the advantages of geosynthetics.</li> <li>illustrate the development of geosynthetics in India and world.</li> <li>Classification of geosynthetics.</li> </ol>
<b>Teaching Aids (if any)</b>	<ol style="list-style-type: none"> <li>PPT.</li> <li>Use of Nearpod tool for online quiz</li> </ol>
<b>Teaching Development</b>	<ol style="list-style-type: none"> <li><b>Introduction</b> (5 minutes)           <ul style="list-style-type: none"> <li>Ask questions.               <ul style="list-style-type: none"> <li>What do you mean by waterlogging?</li> <li>What do you mean by grouting?</li> <li>What are the advantages of fibres?</li> <li>Use of fibres in geomatics engineering?</li> </ul> </li> <li>Introduce the history of Geosynthetics.</li> <li>Talk about the development of geosynthetics in India and world.</li> <li>Introduce the formal definition geosynthetics and its development.</li> <li>Highlight the important characteristics of geosynthetics.</li> <li>Highlight the different advantages of geosynthetics in soil mechanics</li> </ul> </li> <li><b>Development</b> (30 minutes)           <ul style="list-style-type: none"> <li>Geosynthetics its development in India and world.</li> <li>Classification of geosynthetics.</li> <li>Advantages of geosynthetics in soil mechanics and other civil engineering fields.</li> <li>Illustrate with examples the use of geosynthetics fibres in foundation.</li> <li>Explain the limitations of using geosynthetics fibres.</li> </ul> </li> </ol>
<b>Closure</b>	<ol style="list-style-type: none"> <li>Summarize the Lesson Learning Outcomes and get affirmation from students on these.</li> <li>Suggested Reading <a href="http://www.digimat.in/nptel/courses/video/105105168/L20.html">http://www.digimat.in/nptel/courses/video/105105168/L20.html</a></li> <li>Homework           <ul style="list-style-type: none"> <li>From the current civil engineering projects find out where geosynthetics fibres are used.</li> </ul> </li> </ol> <p>Spend 5 minutes to wrap up and consolidate the learnings</p>
<b>Evaluation</b>	<ol style="list-style-type: none"> <li>Reflective Questions (What, Why, Who?). Allow students to</li> </ol>



	<p>answer and discuss.</p> <p>2. Nearpod Quiz on Geosynthetics in soil mechanics.</p> <p>Spend 5 minutes to evaluate student assimilation of the lesson contents</p>
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<b>Lesson Plan No. 39</b>	<b>Course Name: Geotechnical Engineering Topic: Applications of Geosynthetics.</b>	<b>Course No.: CE-302</b>
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<b>Objectives</b>	At the end of the lesson the student shall be able to: <ol style="list-style-type: none"> <li>articulate the concept of geosynthetics.</li> <li>Understand the advantages of geosynthetics.</li> <li>Uses of geosynthetics in India and world in different engineering fields.</li> <li>How waterproofing is done by using geosynthetics.</li> </ol>
<b>Teaching Aids (if any)</b>	<ol style="list-style-type: none"> <li>PPT.</li> <li>Use of Nearpod tool for online quiz</li> </ol>
<b>Teaching Development</b>	<ol style="list-style-type: none"> <li><b>Introduction</b> (5 minutes)           <ul style="list-style-type: none"> <li>Ask questions.               <ul style="list-style-type: none"> <li>What do you mean by waterlogging?</li> <li>What do you mean by grouting?</li> <li>What are the advantages of fibres?</li> <li>Use of fibres in geomatics engineering?</li> </ul> </li> <li>Introduce the history of Geosynthetics.</li> <li>Talk about the development of geosynthetics in India and world.</li> <li>Introduce the formal definition geosynthetics and its development.</li> <li>Highlight the important characteristics of geosynthetics.</li> <li>Highlight the different advantages of geosynthetics in soil mechanics</li> </ul> </li> <li><b>Development</b> (30 minutes)           <ul style="list-style-type: none"> <li>Geosynthetics its development in India and world.</li> <li>Classification of geosynthetics.</li> <li>Advantages of geosynthetics in soil mechanics and other civil engineering fields.</li> <li>Illustrate with examples the use of geosynthetics fibres in foundation.</li> <li>Explain the limitations of using geosynthetics fibres.</li> </ul> </li> </ol>
<b>Closure</b>	<ol style="list-style-type: none"> <li>Summarize the Lesson Learning Outcomes and get affirmation from students on these.</li> <li>Suggested Reading <a href="http://www.digimat.in/nptel/courses/video/105105168/L20.html">http://www.digimat.in/nptel/courses/video/105105168/L20.html</a></li> <li>Homework           <ul style="list-style-type: none"> <li>From the current civil engineering projects find out where geosynthetics fibres are used.</li> </ul> </li> </ol> <p>Spend 5 minutes to wrap up and consolidate the learnings</p>



<b>Evaluation</b>	<ol style="list-style-type: none"><li>1. Reflective Questions (What, Why, Who?). Allow students to answer and discuss.</li><li>2. Nearpod Quiz on Geosynthetics in soil mechanics.</li></ol> <p>Spend 5 minutes to evaluate student assimilation of the lesson contents</p>
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<b>Lesson Plan No. 40</b>	<b>Course Name: Geotechnical Engineering Topic: Geotextiles and their uses.</b>	<b>Course No.: CE-302</b>
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<b>Objectives</b>	At the end of the lesson the student shall be able to: a. articulate the concept of Geotextiles. b. Understand the advantages of Geotextiles. c. illustrate the development of Geotextiles in India and world. d. Classification of Geotextiles.
<b>Teaching Aids (if any)</b>	a. PPT. b. Use of Nearpod tool for online quiz
<b>Teaching Development</b>	<ol style="list-style-type: none"><li><b>1. Introduction</b> (5 minutes)<ul style="list-style-type: none"><li>- Ask questions. What do you mean by waterlogging? What do you mean by grouting? What are the advantages of fibres? Use of fibres in geomatics engineering?</li><li>- Introduce the concept of Geotextiles.</li><li>- Talk about the development of Geotextiles in India and world.</li><li>- Introduce the formal definition Geotextiles and its development.</li><li>- Highlight the important characteristics of Geotextiles.</li><li>- Highlight the different advantages of Geotextiles in soil mechanics</li></ul></li><li><b>2. Development</b> (30 minutes)<ul style="list-style-type: none"><li>- Geotextiles its development in India and world.</li><li>- Classification of Geotextiles.</li><li>- Advantages of Geotextiles in soil mechanics and other civil engineering fields.</li><li>- Illustrate with examples the use of Geotextiles fibres in foundation.</li><li>- Explain the limitations of using Geotextiles fibres.</li></ul></li></ol>
<b>Closure</b>	<ol style="list-style-type: none"><li>1. Summarize the Lesson Learning Outcomes and get affirmation from students on these.</li><li>2. Suggested Reading <a href="http://www.digimat.in/nptel/courses/video/105105168/L20.html">http://www.digimat.in/nptel/courses/video/105105168/L20.html</a></li><li>3. Homework<ul style="list-style-type: none"><li>- From the current civil engineering projects find out where Geotextiles fibres are used.</li></ul></li></ol> <p>Spend 5 minutes to wrap up and consolidate the learnings</p>
<b>Evaluation</b>	<ol style="list-style-type: none"><li>1. Reflective Questions (What, Why, Who?). Allow students to answer and discuss.</li><li>2. Nearpod Quiz on Geotextiles in soil mechanics.</li></ol>



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	Spend 5 minutes to evaluate student assimilation of the lesson contents
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<b>Lesson Plan No. 41</b>	<b>Course Name: Geotechnical Engineering Topic: Geogrids and its uses.</b>	<b>Course No.: CE-302</b>
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<b>Objectives</b>	At the end of the lesson the student shall be able to: <ol style="list-style-type: none"> <li>articulate the concept of Geogrids.</li> <li>Understand the advantages of Geogrids.</li> <li>illustrate the development of Geogrids in India and world.</li> <li>Classification of Geogrids.</li> </ol>
<b>Teaching Aids (if any)</b>	<ol style="list-style-type: none"> <li>PPT.</li> <li>Use of Nearpod tool for online quiz</li> </ol>
<b>Teaching Development</b>	<ol style="list-style-type: none"> <li><b>Introduction</b> (5 minutes)           <ul style="list-style-type: none"> <li>Ask questions.               <ul style="list-style-type: none"> <li>What do you mean by waterlogging?</li> <li>What do you mean by grouting?</li> <li>What are the advantages of fibres?</li> <li>Use of fibres in geomatics engineering?</li> </ul> </li> <li>Introduce the concept of Geogrids.</li> <li>Talk about the development of Geogrids in India and world.</li> <li>Introduce the formal definition Geogrids and its development.</li> <li>Highlight the important characteristics of Geogrids.</li> <li>Highlight the different advantages of Geogrids in soil mechanics</li> </ul> </li> <li><b>Development</b> (30 minutes)           <ul style="list-style-type: none"> <li>Geogrids its development in India and world.</li> <li>Classification of Geogrids.</li> <li>Advantages of Geogrids in soil mechanics and other civil engineering fields.</li> <li>Illustrate with examples the use of Geogrids fibres in foundation.</li> <li>Explain the limitations of using Geogrids fibres.</li> </ul> </li> </ol>
<b>Closure</b>	<ol style="list-style-type: none"> <li>Summarize the Lesson Learning Outcomes and get affirmation from students on these.</li> <li>Suggested Reading <a href="http://www.digimat.in/nptel/courses/video/105105168/L20.html">http://www.digimat.in/nptel/courses/video/105105168/L20.html</a></li> <li>Homework           <ul style="list-style-type: none"> <li>From the current civil engineering projects find out where Geogrids fibres are used.</li> </ul> </li> </ol> <p>Spend 5 minutes to wrap up and consolidate the learnings</p>
<b>Evaluation</b>	<ol style="list-style-type: none"> <li>Reflective Questions (What, Why, Who?). Allow students to answer and discuss.</li> <li>Nearpod Quiz on Geogrids in soil mechanics.</li> </ol>



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Spend 5 minutes to evaluate student assimilation of the lesson contents
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<b>Lesson Plan No. 42</b>	<b>Course Name: Geotechnical Engineering</b> <b>Topic: Geonets and its uses.</b>	<b>Course No.: CE-302</b>
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<b>Objectives</b>	At the end of the lesson the student shall be able to: a. articulate the concept of Geonets. b. Understand the advantages of Geonets. c. illustrate the development of Geonets in India and world. d. Classification of Geonets.
<b>Teaching Aids (if any)</b>	a. PPT. b. Use of Nearpod tool for online quiz
<b>Teaching Development</b>	<ol style="list-style-type: none"><li><b>1. Introduction (5 minutes)</b><ul style="list-style-type: none"><li>- Ask questions. What do you mean by waterlogging? What do you mean by grouting? What are the advantages of fibres? Use of fibres in geomatics engineering?</li><li>- Introduce the concept of Geonets.</li><li>- Talk about the development of Geonets in India and world.</li><li>- Introduce the formal definition Geonets and its development.</li><li>- Highlight the important characteristics of Geonets.</li><li>- Highlight the different advantages of Geonets in soil mechanics</li></ul></li><li><b>2. Development (30 minutes)</b><ul style="list-style-type: none"><li>- Geonets its development in India and world.</li><li>- Classification of Geonets.</li><li>- Advantages of Geonets in soil mechanics and other civil engineering fields.</li><li>- Illustrate with examples the use of Geonets fibres in foundation.</li><li>- Explain the limitations of using Geonets fibres.</li></ul></li></ol>
<b>Closure</b>	<ol style="list-style-type: none"><li>1. Summarize the Lesson Learning Outcomes and get affirmation from students on these.</li><li>2. Suggested Reading <a href="http://www.digimat.in/nptel/courses/video/105105168/L20.html">http://www.digimat.in/nptel/courses/video/105105168/L20.html</a></li><li>3. Homework<ul style="list-style-type: none"><li>- From the current civil engineering projects find out where Geonets fibres are used.</li></ul></li></ol> <p>Spend 5 minutes to wrap up and consolidate the learnings</p>
<b>Evaluation</b>	<ol style="list-style-type: none"><li>1. Reflective Questions (What, Why, Who?). Allow students to answer and discuss.</li><li>2. Nearpod Quiz on Geonets in soil mechanics.</li></ol> <p>Spend 5 minutes to evaluate student assimilation of the lesson contents</p>



<b>Lesson Plan No. 43</b>	<b>Course Name: Geotechnical Engineering</b> <b>Topic: Geomembranes and its uses.</b>	<b>Course No.: CE-302</b>
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<b>Objectives</b>	At the end of the lesson the student shall be able to: a. articulate the concept of Geomembranes. b. Understand the advantages of Geomembranes. c. illustrate the development of Geomembranes in India and world. d. Classification of Geomembranes.
<b>Teaching Aids (if any)</b>	a. PPT. b. Use of Nearpod tool for online quiz
<b>Teaching Development</b>	<ol style="list-style-type: none"><li><b>1. Introduction (5 minutes)</b><ul style="list-style-type: none"><li>- Ask questions. What do you mean by waterlogging? What do you mean by grouting? What are the advantages of fibres? Use of fibres in geomatics engineering?</li><li>- Introduce the concept of Geomembranes.</li><li>- Talk about the development of Geomembranes in India and world.</li><li>- Introduce the formal definition Geomembranes and its development.</li><li>- Highlight the important characteristics of Geomembranes.</li><li>- Highlight the different advantages of Geomembranes in soil mechanics</li></ul></li><li><b>2. Development (30 minutes)</b><ul style="list-style-type: none"><li>- Geomembranes its development in India and world.</li><li>- Classification of Geomembranes.</li><li>- Advantages of Geomembranes in soil mechanics and other civil engineering fields.</li><li>- Illustrate with examples the use of Geomembranes fibres in foundation.</li><li>- Explain the limitations of using Geomembranes fibres.</li></ul></li></ol>
<b>Closure</b>	<ol style="list-style-type: none"><li>1. Summarize the Lesson Learning Outcomes and get affirmation from students on these.</li><li>2. Suggested Reading <a href="http://www.digimat.in/nptel/courses/video/105105168/L20.html">http://www.digimat.in/nptel/courses/video/105105168/L20.html</a></li><li>3. Homework<ul style="list-style-type: none"><li>- From the current civil engineering projects find out where Geomembranes fibres are used.</li></ul></li></ol> <p>Spend 5 minutes to wrap up and consolidate the learnings</p>
<b>Evaluation</b>	1. Reflective Questions (What, Why, Who?). Allow students to



	<p>answer and discuss.</p> <p>2. Nearpod Quiz on Geomembranes in soil mechanics.</p> <p>Spend 5 minutes to evaluate student assimilation of the lesson contents</p>
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<b>Lesson Plan No. 44</b>	<b>Course Name: Geotechnical Engineering</b> <b>Topic: Geocomposites and its uses.</b>	<b>Course No.: CE-302</b>
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<b>Objectives</b>	At the end of the lesson the student shall be able to: a. articulate the concept of Geocomposites. b. Understand the advantages of Geocomposites. c. illustrate the development of Geocomposites in India and world. d. Classification of Geocomposites.
<b>Teaching Aids (if any)</b>	a. PPT. b. Use of Nearpod tool for online quiz
<b>Teaching Development</b>	<ol style="list-style-type: none"><li><b>1. Introduction (5 minutes)</b><ul style="list-style-type: none"><li>- Ask questions. What do you mean by waterlogging? What do you mean by grouting? What are the advantages of fibres? Use of fibres in geomatics engineering?</li><li>- Introduce the concept of Geocomposites.</li><li>- Talk about the development of Geocomposites in India and world.</li><li>- Introduce the formal definition Geocomposites and its development.</li><li>- Highlight the important characteristics of Geocomposites.</li><li>- Highlight the different advantages of Geocomposites in soil mechanics</li></ul></li><li><b>2. Development (30 minutes)</b><ul style="list-style-type: none"><li>- Geocomposites its development in India and world.</li><li>- Classification of Geocomposites.</li><li>- Advantages of Geocomposites in soil mechanics and other civil engineering fields.</li><li>- Illustrate with examples the use of Geocomposites fibres in foundation.</li><li>- Explain the limitations of using Geocomposites fibres.</li></ul></li></ol>
<b>Closure</b>	<ol style="list-style-type: none"><li>1. Summarize the Lesson Learning Outcomes and get affirmation from students on these.</li><li>2. Suggested Reading <a href="http://www.digimat.in/nptel/courses/video/105105168/L20.html">http://www.digimat.in/nptel/courses/video/105105168/L20.html</a></li><li>3. Homework<ul style="list-style-type: none"><li>- From the current civil engineering projects find out where Geocomposites fibres are used.</li></ul></li></ol> <p>Spend 5 minutes to wrap up and consolidate the learnings</p>
<b>Evaluation</b>	1. Reflective Questions (What, Why, Who?). Allow students to



	<p>answer and discuss.</p> <p>2. Nearpod Quiz on Geocomposites in soil mechanics.</p> <p>Spend 5 minutes to evaluate student assimilation of the lesson contents</p>
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<b>Lesson Plan No. 45</b>	<b>Course Name: Geotechnical Engineering Topic: Tunnelling and its benefits.</b>	<b>Course No.: CE-302</b>
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<b>Objectives</b>	At the end of the lesson the student shall be able to: a. articulate the concept of tunnels. b. Understand benefits of tunnels. c. illustrate the procedure for construction of tunnels d. appreciate advantages of tunnels over mountain passes.
<b>Teaching Aids (if any)</b>	a. Chalk and talk. b. Use of Nearpod tool for online quiz
<b>Teaching Development</b>	<ol style="list-style-type: none"><li><b>1. Introduction (5 minutes)</b><ul style="list-style-type: none"><li>- Ask questions. What do you mean by highway? What do you mean by mountain passes? What are the uses of tunnels? How to build a tunnel?</li><li>- Introduce the concept of Tunnelling.</li><li>- Talk about the step-by-step procedure for construction of tunnels.</li><li>- Introduce the formal definition of Tunnelling.</li><li>- Highlight the important advantages of tunnels.</li><li>- Highlight the different methods of tunnels</li></ul></li><li><b>2. Development (30 minutes)</b><ul style="list-style-type: none"><li>- Tunnelling and its classification.</li><li>- Explain the procedure for development of tunnel.</li><li>- Draw cross section of different shapes of tunnel.</li><li>- Illustrate with examples to demonstrate the different applications of tunnels.</li><li>- Explain the rock bolting in tunnels.</li></ul></li></ol> <p>Exercise (5 minutes) – Draw the elevation and cross section for horseshoe shaped tunnels for a given radius and coordinates.</p>
<b>Closure</b>	<ol style="list-style-type: none"><li>1. Summarize the Lesson Learning Outcomes and get affirmation from students on these.</li><li>2. Suggested Reading <a href="http://www.digimat.in/nptel/courses/video/105105168/L20.html">http://www.digimat.in/nptel/courses/video/105105168/L20.html</a></li><li>3. Homework<ul style="list-style-type: none"><li>- Find out the names and length of tunnels in your locality</li></ul></li></ol> <p>Spend 5 minutes to wrap up and consolidate the learnings</p>
<b>Evaluation</b>	<ol style="list-style-type: none"><li>1. Reflective Questions (What, Why, Who?). Allow students to answer and discuss.</li><li>2. Nearpod Quiz on tunnels.</li></ol>



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	Spend 5 minutes to evaluate student assimilation of the lesson contents
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Lesson Plan No. 46	Course Name: Geotechnical Engineering Topic: Tunnelling for different purposes.	Course No.: CE-302
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<b>Objectives</b>	At the end of the lesson the student shall be able to: a. articulate the concept of different shapes of tunnels. b. Understand different purposes of tunnels. c. illustrate the procedure for construction of tunnels d. appreciate NATM method of tunnels.
<b>Teaching Aids (if any)</b>	a. Chalk and talk. b. Use of Nearpod tool for online quiz
<b>Teaching Development</b>	<ol style="list-style-type: none"><li><b>1. Introduction (5 minutes)</b><ul style="list-style-type: none"><li>- Ask questions. What do you mean by highway? What do you mean by mountain passes? What are the uses of tunnels? How to build a tunnel?</li><li>- Introduce the different shapes of Tunnels.</li><li>- Talk about the step-by-step procedure for construction of tunnels.</li><li>- Introduce the formal definition of NATM method.</li><li>- Highlight the different rock bolts used in tunnels.</li><li>- Highlight the different methods of tunnels</li></ul></li><li><b>2. Development (30 minutes)</b><ul style="list-style-type: none"><li>- Tunnelling and its classification.</li><li>- Explain the procedure for development of tunnel.</li><li>- Draw cross section of different shapes of tunnel.</li><li>- Illustrate with examples to demonstrate the different applications of tunnels.</li><li>- Explain the rock bolting in tunnels.</li></ul></li></ol> <p>Exercise (5 minutes) – Draw the elevation and cross section for horseshoe shaped tunnels for a given radius and coordinates.</p>
<b>Closure</b>	<ol style="list-style-type: none"><li>1. Summarize the Lesson Learning Outcomes and get affirmation from students on these.</li><li>2. Suggested Reading <a href="http://www.digimat.in/nptel/courses/video/105105168/L20.html">http://www.digimat.in/nptel/courses/video/105105168/L20.html</a></li><li>3. Homework<ul style="list-style-type: none"><li>- Find out the names and length of tunnels in your locality</li></ul></li></ol> <p>Spend 5 minutes to wrap up and consolidate the learnings</p>
<b>Evaluation</b>	<ol style="list-style-type: none"><li>1. Reflective Questions (What, Why, Who?). Allow students to answer and discuss.</li><li>2. Nearpod Quiz on tunnels.</li></ol>



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	Spend 5 minutes to evaluate student assimilation of the lesson contents
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