

| Course Type | Course Code | Name of Course                 | L | T | P | Credit |
|-------------|-------------|--------------------------------|---|---|---|--------|
| DE          | NCED506     | Slope and Retaining Structures | 3 | 0 | 0 | 3      |

### Course Objective

The course aims to provide knowledge of slope stability analyses and earth pressure problems in retaining structures

### Learning Outcomes

Upon successful completion of this course, the students should be able to:

- Evaluate earth pressures on retaining structures
- Evaluate the stability of slopes and earthen dams,
- Design braced excavation for deep cuts and excavations in the ground.

| Unit No. | Topics to be Covered                                                                                                                                                                                                                                                                                                    | Contact Hours | Learning Outcome                                                                                              |
|----------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------|---------------------------------------------------------------------------------------------------------------|
| 1        | <b>Stability of Earth Slopes</b><br>Infinite and Finite slopes analysis, Swedish circle method, friction circle method, Bishop's method, Morgenstern's method. Effect of soil layering and reinforcement. Taylor's stability number and use of charts, stability analysis of earth dam slopes for different conditions. | 10L           | Theory and hands-on experience in stability calculation for a slope with various soil and loading conditions. |
| 2        | <b>Landslide Analysis</b><br>Introduction to landslide and their types, slope monitoring for landslide early warning, experimental and numerical landslide modelling. Slope stabilization techniques.                                                                                                                   | 4L            | Introduction to landslide analysis.                                                                           |
| 3        | <b>Lateral Earth Pressure</b><br>Theories of lateral earth pressure, active and passive earth pressures in soils, Rankine's and Coulomb's earth pressure theories. Linear and composite failure surfaces, effects due to wall friction and wall inclination. Earth pressure determination under seismic conditions.     | 10L           | Theory and hands-on experience in earth pressure determination.                                               |
| 4        | <b>Retaining Structures</b><br>Rigid and flexible retaining structures: Types, stability analysis, Cantilever sheet piles, Anchored bulkheads-free earth method, Fixed earth method, Moment reduction factors, Anchorage of sheet piles.                                                                                | 12L           | Theory and hands-on experience in stability calculations in flexible and rigid retaining wall.                |

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|---|--------------------------------------------------------------------------------------------------------------------------------------------------|------------|-----------------------------------------------------------------|
| 5 | <b>Braced Excavation</b><br>Construction methods, pressure distribution in sands and clays. Stability bottom heave, seepage, ground deformation. | 6L         | Analysis and design of support structures for deep excavations. |
|   | <b>Total Contact Hours</b>                                                                                                                       | <b>42L</b> |                                                                 |

**Text Books:**

1. Clayton, C. R., Woods, R. I., & Milititsky, J. (2014). Earth Pressure and Earth Retaining Structures.
2. Duncan, J. M., Wright, S. G., & Brandon, T. L. (2014). Soil Strength and Slope Stability. John Wiley & Sons.

**Reference Books:**

1. Abramson, L. W., Lee, T. S., Sharma, S., & Boyce, G. M. (2001). Slope Stability and Stabilization Methods. John Wiley & Sons.
2. B. M. Das (2011). Principles of Foundation Engineering. Cengage learning.
3. Budhu M. (2008). Foundations and Earth Retaining Structures , John Wiley & Sons.
4. Highland, L.M., and Bobrowsky, Peter, (2008) The landslide handbook—A guide to understanding landslides: Reston, Virginia, U.S. Geological Survey Circular.