B. Tech. Civil Engineering				
Course code: Course Title	**Course Structure.**			**Pre-Requisite**
CE410: Advanced Geotechnical Engineering	**L**	**T**	**P**	**CE 301 Geotechnical Engineering**
	3	**0**	**2**	

Course Objective: To familiarize the students with modern and advanced concepts of Geotechnical Engineering and its related applications in Civil Engineering.

S. No	Course Outcomes (CO)
CO1	Application of knowledge and practical skills in soil exploration techniques, in-situ testing, reliability-based site characterization, and microstructural soil analysis for geotechnical engineering.
CO2	Knowledge of innovative ground improvement techniques, sustainable geotechnical practices, and eco-friendly materials, waste utilization, and sustainability assessment in foundation design.
CO3	Identify, formulate, and analyse the retaining structure substantiated and concluded using the engineering knowledge
CO4	Advancements in geotechnical engineering, AI, and geosynthetics with embedded sensor technologies.
CO5	Provide an in-depth understanding of advanced foundation engineering, including load transfer mechanisms, foundation behaviour under complex conditions, non-destructive testing techniques, and numerical modelling for accurate performance prediction

S. No	Contents	Contact hours
UNIT 1	**Introduction:** Soil Exploration & Site Characterization; Geophysical methods: seismic refraction, electrical resistivity; Soil microstructure analysis: Scanning Electron Microscopy, X-Ray Diffraction	8
UNIT 2	**Ground Improvement:** Microbially induced calcite precipitation, biopolymers, geosynthetics, and soil stablisation; vacuum preloading, thermal ground modification, electro-osmosis and energy geotechniques; fly ash, industrial by-products for sustainable soil stabilization; harnessing microbially induced calcite precipitates to use in improving the engineering properties of loose sandy soils	8
UNIT 3	**Earth Pressure Theories & Retaining Structures:** Introduction, determination of lateral earth pressure at rest; retaining structures under active and passive earth pressure; deformation necessary for dynamic elastic and plastic conditions, Mononobe-Okabe solution, plastic flow and stress distribution, vibration control of flexible retention systems.	8

UNIT 4	**Sensors in Geotechnical Engineering:** Geotechnical Infrastructure: Adaptive designs for rural and urban areas with locally available geomaterials; sustainable geotechnical construction materials and methodologies; utilization of AI in geotechnical Engineering, including machine learning and image processing; sensors in geostructures; influence of frequency on piezo-dynamics of confined geomaterials.	8
UNIT 5	**Foundations:** Load transfer in foundations: elastic and plastic soil-foundation interaction models; pile foundations under cyclic loading, scouring effects, offshore and marine pile behaviour; Numerical analysis of shallow and deep foundation; heavy axle loads on mining roads; Pile groups subjected to axial and torsional loads in flow-controlled geomaterial.	10
	TOTAL	**42**

List of experiments:

1. To determine shear strength parameters of soil using unconfined compressive shear test.
2. To obtain load-displacement curves for dynamic loads using digital vibration meter
3. To obtain stress-strain plot for soil subjected to dynamic load using piezo-sensors.
4. To determine acceleration-velocity-displacement profile of a geomaterial
5. To determine the dynamic response of foundations using block vibration test
6. Numerical simulation of retaining wall for active and passive earth pressure
7. Numerical simulation of shallow & deep foundations

References

S. No.	Name of Books/Authors/Publishers	Year of Publication / Reprint
1	Foundation analysis and design by J.E. Bowles, published by McGraw-Hill.	1982
2	Fundamentals of Soil Dynamics by B M Das, Published by Elsevier Science Ltd.	1982
3	Introduction to Geosynthetic Engineering by S.K. Shukla, published by CRC Press.	2016
4	Analysis and Design of Foundations and Retaining Structures Subjected to Seismic Loads by Swami Saran, published by Dreamtech Pres.s	2020