Course Type	Course Code	Name of Course	L	T	P	Credit
DC	NGPC 502	Geotechnical Modelling	3	1	0	4

Course Objectives:
Elastic and Electromagnetic Properties of Near surface soil. Understanding fundamental concept of different near-surface geophysical techniques. Understanding basics of different geotechnical modelling techniques. Understanding on the association of rock physics principles with geotechnical parameters. Soil characterizations, soil migration and relevant parameterization.
Learning Outcomes:
Understanding of rock and soil physics for near surface geophysics and association with geotechnical parameters, modelling and analysis.

Sl. No.	Description of Lectures	Lecture Hrs. (L + T)	Learning Outcome
1.	Definition of near surface geophysics, its branches and uses. Near surface problems, their models and fundamental parameters. Geophones, seismic energy sources used for near surface investigation. 2- and 3-layers travel time, velocity and depth determinations, modelling and analysis for reflection and refraction at horizontal interface. Concept of various tomography, fundamentals of up-hole seismic tomography, Cross-hole seismic tomography, Up-hole shear-wave velocity tomography and their application for near surface investigation.	7L + 2T	Near surface seismic investigation and modeling for basement analysis regarding geotechnical characterizations.
2.	Basic principle and applications of active and passive MASW Techniques. Basic principle and applications SASW, ReMi and GPR techniques for near surface characterization. Data acquisition, processing and interpretation of these techniques for overburden and basement characterization.	6L + 2T	Basement characterization and evaluation for near surface modeling.
3.	Different parameters of soils and its computation. Liquefaction and lateral spreading - Liquefaction related phenomena, liquefaction susceptibility. Evaluation of different liquefaction parameters relevant to cyclic stress and cyclic strain approaches, lateral deformation and spreading, criteria for mapping liquefaction hazard zones. Ground improvement techniques for liquefaction remediation.	6L + 2T	Detail understanding and evaluation of liquefaction parameters and modelling.
4.	True and apparent resistivity, resistivities of common rocks and minerals. Electrode configurations—Schlumberger and Wenner, Vertical Electrical Sounding and mapping,		Compaction and water content analysis of near surface medium for geotechnical modeling.

	Interpretation of 2- and 3-layered VES curves. Electrical resistivity tomography (ERT) for near surface characterization. GPR study for near surface modelling.	**4L + 1T**	
5.	Seismic Cone Penetrometer Test, Cone Penetration Test, Standard Penetration Test, Cyclic Stress Ratio, Cyclic Resistance Ratio, estimation of blow count 'N' of SPT from Shear Wave, seismic and SPT site classification.	**5L + 1T**	Near surface characterization using geotechnical engineering approaches
6.	Geotechnical instrumentation: Vibrating wire strain gage, Load cell, crack and joint meter, borehole extensometer, incline meter, pore pressure meter.	**4L + 2T**	Monitoring and assessment of hazards using Geotechnical instrumentation
7.	Soil classification. Computation of V_{S30}, N_{30}. Stress-strain analysis for soils. Damping and non-linearity of soil character. Seismic site classification for structural engineers. IS 1893-1: 2016 codal provision for seismic site classification. Comparative assessment of provisions of NEHRP, IBC 2009, Eurocode 8 (2007) and IS 1893-1: 2016.	**4L + 2T**	Different soils and its parameterization. Seismic site classification and codal provisions
8.	Slope stability analysis: failure surfaces, progressive failure, limit equilibrium analysis, stress deformation analysis, pseudo-static analysis, Newmark sliding block analysis.	**6L +2T**	Stability and failure of soil masses on a slope having different geometries.
	Total Classes	**42L + 14T**	

Tutorials

1. Mathematical modeling and analysis of 2- and 3-layers cases based on seismic refraction method.
2. Mathematical modeling and analysis of 2- and 3-layers cases based on seismic reflection method.
3. Computation of amplitude variation of reflected and transmitted seismic waves.
4. Resistivity mapping and vertical electrical sounding for 2- and 3-layers.
5. Data analysis of SASW and MASW.
6. Cone penetration resistance quantifications of soils.
7. Data analysis of standard penetration test (SPT).
8. Low-strain and high-strain testing of soils.
9. Cyclic stress loading and shear stress analysis of soils.
10. Cyclic stress ratio modelling of soils.
11. Factor of safety quantifications for slope stability analysis.
12. Stress-strain modelling for soil through hysteresis loop.
13. Yield acceleration computation for slope stability analysis.
14. GPR data analysis
15. Cross-hole velocity modelling.

Text Books

1. Kramer, S. L., "Geotechnical Earthquake Engineering", Pearson Education.

Reference Books

1. Ansal, A., "Recent Advances in Earthquake Geotechnical Engineering and Microzonation", Springer
2. William Lowrie, 2007, Fundamental of Geophysics. Cambridge University Press pp 381.
3. Telford, W. M., Geldart, L. P., Sheriff, R. E. and Keys, D. A., 1990, Applied Geophysics. Cambridge University Press, pp770.