

GUJARAT TECHNOLOGICAL UNIVERSITY

BRANCH NAME: GEOTECHNICAL ENGINEERING
SUBJECT NAME: SUBSURFACE INVESTIGATION & INSTRUMENTATIONS

SUBJECT CODE:3714308
M.E. Semester-I

Type of course: CORE-II

Prerequisite: Knowledge of geotechnical engineering

Rationale: This subject is introduced in the first semester as a core subject with a view that student can understand the importance of sub soil investigation and its consequences, plan and execute soil investigation program starting from bore hole survey to preparation of report based on both direct and indirect methods, making analysis more supportive by using geophysical methods, carrying out and interpretation of data using specific tests like pile integrity tests, Block vibration test, Down-hole hole test, etc. Making student aware of latest soil methods including NDT, centrifuge and XRD and usage of instrumentation for various infrastructural projects.

Teaching and Examination Scheme :

Teaching Scheme			Credits C	Examination Marks				Total Marks
L	T	P		Theory Marks		Practical Marks		
				ESE (E)	PA (M)	ESE (V)	PA (I)	
3	0	2	4	70	30	30	20	150

Content:

Sr. No.	Content	Total Hrs	% Weightage
1	Planning of ground investigation program for different types of infrastructure projects in various site conditions, Soil exploration techniques – soil samplers and sampling, number and disposition of trial pits, depth of exploration, sampling disturbances, storage, labeling and transportation of samples, sampler design, influence on properties, Recording of field data, Interpretation and analysis of Laboratory & field testing data, Codal provisions for subsurface investigation, Reporting, Safety measures	09	22
2	Methods of site investigation: Direct methods, semi-direct methods and indirect methods, Drilling methods. Boring in soils and rocks, methods of stabilizing the bore holes, measurement of water table, field record. Field tests: In-situ shear test, in-situ permeability test, SPT, DCPT, SCPT, in-situ vane shear test, plate load test. Geophysical methods: Electrical resistivity and Seismic refraction methods	11	27
3	[a] Pile load tests, lateral load tests and its codal provisions. Pile integrity tests.	06	15

	[b] Tests related to machine foundation, Block vibration test, Down-hole test and Cross-hole test, etc		
4	Introduction to Dilatometer Test, Pressure Meter Test, Dynamic triaxial test, pneumatic shear test, NDT for soils: falling weight deflectometer (FWD), spectral analysis of surface wave (SASW) test	08	15
5	Instrumentation: Piezometers, settlement gauges, (mechanical and electronic), pressure transducers, strain gauges, earth pressure cells, extensometers, load cells, data logger/data acquisition systems, etc., analysis of periodic readings / measurements to assess behaviour and deviation from expected designed behaviour, case studies. Modern testing techniques: Scanning Electron Microscopy (SEM), XRD, EDAX analysis of soil, Centrifuge testing and modeling	08	21

Reference Books:

1. Hanna T H, "Foundation Instrumentation", Trans Tech Publication, Ohio, 1985
2. Dunicliff J & Gree G E, "Geotechnical Instrumentation for Monitoring Field Performance", John Wiley, 1988
3. Singh Alam, "Soil Engineering in Theory and Practice", Asia Pub. House. 1981.
4. Schnaid, F., "In Situ Testing in Geomechanics", Taylor and Francis. 2009
5. Gopal Ranjan & A S R Rao, "Basic & Applied Soil Mechanics", New Age International Publishers
6. Bowles, J.E., Foundation Analysis and Design, McGraw-Hill International Edition, 1997.
7. I.S. codes, relevant to Geotechnical Instrumentation

Course Outcome:

After learning the course the students should be able to:

1. Students can plan subsurface investigation based on the requirement of civil engineering project and site condition. Can finalize depth and number of boreholes
2. Students can execute different subsurface exploration tests, collect disturbed/undisturbed samples for laboratory tests and can suggest design parameters.
3. Student exposed to different methods for estimation of dynamic soil properties required for design purpose.
4. Students can develop instrumentation scheme for monitoring of critical sites

List of Experiments:

1. Exploratory boring by different methods including auger boring
2. SPT, SCPT, DCPT, PLT
3. Field Demonstration of electrical resistivity profiling method
4. Field Demonstration of pile load and pile integrity test
5. Field Demonstration of Block vibration test, Down-hole test and Cross-hole test

Field Project: Students can undergo one week field geotechnical exploration work on prestigious infrastructural projects and submit a report on same as part of practical work.

Major Equipment:

1. Augur boring set
2. SPT setup
3. SCPT setup

4. DCPT setup
5. PLT setup
6. Dynamic / Automated triaxial testing machine
7. Block vibration test setup
8. SASW setup

List of Open Source Software/learning website:

- NPTEL lecture series
- MIT open source material