GUJARAT TECHNOLOGICAL UNIVERSITY

Program Name: Master of Engineering

Level: PG

Branch: Geotechnical Engineering

Course / Subject Code: ME01076021

Course / Subject Name : Subsurface Investigations & Instrumentations

w.e.f. Academic Year:	2024-25
Semester:	1st Semester
Category of the Course:	PCC

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.

Course Outcome:

After Completion of the Course, Student will able to:

No	Course Outcomes
01	Students can plan subsurface investigation based on the requirement of civil engineering project and site condition. Can finalize depth and number of boreholes
02	Students can execute different subsurface exploration tests, collect disturbed/undisturbed samples for laboratory tests and can suggest design parameters
03	Student exposed to different methods for estimation of dynamic soil properties required for design purpose
04	Students can develop instrumentation scheme for monitoring of critical sites

Teaching and Examination Scheme:

Teaching Scheme (in Hours)			Total Credits L+T+(PR/2)	Assessment Pattern and Marks				Total Marks
				Theory		Tutorial/ Practical		
L	T	PR	C	ESE (E)	PA/ CA (M)	PA/CA(I)	ESE (V)	
3	0	2	4	70	30	20	30	150

Course Content:

Unit No.	Content	No.of Hours	%of 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.	9	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	12	27
3.	[a] Pile load tests, lateral load tests and its codal provisions. Pile integrity tests. [b] Tests related to machine foundation, Block vibration test, Down-hole test and Cross-hole test, etc.	8	17
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.	8	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 behavior and deviation from expected designed behavior, case studies. Modern testing techniques: Scanning Electron Microscopy (SEM), XRD, EDAX analysis of soil, Centrifuge testing and modeling.	8	19
	Total	**45**	**100**

Suggested Specification Table with Marks (Theory):

DistributionofTheoryMarks					
R Level	**U Level**	**A Level**	**N Level**	**E Level**	**C Level**
25	25	20	15	10	5

WhereR:Remember;U:Understanding;A:Application,N:AnalyzeandE:EvaluateC:Create(aspe r Revised Bloom's Taxonomy)

References/Suggested Learning Resources:

(a) Books:

1. .Hanna T H, "Foundation Instrumentation", Trans Tech Publication, Ohio, 1985
2. Dunnicliff 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

(b)Open source software and website:

1. NPTEL lecture series
2. MIT open source material

Suggested Course Practical List:

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

ListofLaboratory/LearningResourcesRequired:

1. Major Equipment:
2. Augur boring set
3. SPT setup

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

Suggested Project List:

1) Visit of NABL accredited soil/rock testing laboratory/research station

2) Preparation of Borelog report based on anyone site of Ahmedabad or any other location.

Suggested Activities for Students:

1) Visits of ongoing Infrastructure projects and foundation testing.
2) Referring IS CODES and Practicing Manuals

****