GUJARAT TECHNOLOGICAL UNIVERSITY

CIVIL ENGINEERING (06)

GEOTECHNICS & APPLIED GEPOLOGY

SUBJECT CODE: 2130606

B.E. 3rd Semester

Type of course: Applied Mechanics

Prerequisite: Geological cycle
Basic rock types
Properties of material
Fundamental knowledge of engineering mathematics.
Knowledge of principles of mechanics

Rationale: Geotechnics is required to equip the students to understand the properties and behavior of soil for the design of structures. To introduce students with basic principles of geosciences and their applications in civil engineering.

Teaching and Examination Scheme:

Teaching Scheme			Credits	Examination Marks						Total Marks
				Theory Marks			Practical Marks			
L	T	P	C	ESE (E)	PA (M)		PA (V)		PA (I)	
					PA	ALA	ESE	OEP		
4	0	1	5	70	20	10	20	10	20	150

Sr. No.	Topics	Teaching Hrs.	Module Weightage
	Module 1		
1	**Introduction:** Definition, brief history, scope, and limitations of Geotechnics.	01	30
2	**Origin and Nature of Soil:** Geological cycle, Physical and chemical agencies for soil, Formation - residual, transported, alluvial, marine and lacustrine, glacial drift, loess and colluvial soils. General characteristics of different types of soils. Overview of different types of soils in Gujarat / India.	02	
3	**Index Properties, Relationships and Tests:** Phase diagram, Basic terms and definitions, Functional relationships,Determination of index properties, Relative density for granular soil.	05	
4	**Particle Size Analysis:** Size and nomenclature of soil particles as per IS, Sieve analysis, Sedimentation analysis, Particle size distribution curve and its uses.	03	
5	**Soil Structure:** Shape of the particles, Texture and structure of the soil. Types of the structure, properties, conditions for the formation of different structures.	02	

6	**Soil Consistency:** Consistency limits and its determination, different indices, Field moisture equivalent, Activity, Sensitivity & Thixotropy of soil.	03	
7	**Soil Classification:** Objectives, Basis, Textural, Unified soil classification, IS classification method, group index. Field identification and General characteristics of the soil.	03	
Module 2			
8	**Soil Water:** Free water and held water, Structural water and absorbed water, Capillary	02	20
9	**Permeability and Seepage:** Darcy's law and its validity, Factors affecting permeability, Laboratory permeability tests, Introduction to field permeability test, Permeability of stratified soil masses, Laplace equation (2-D), Seepage pressure, Quick condition, Flow net, its characteristics and application.	07	
Module 3			
10	**Physical Geology:** Branches and scope of Geology; Surface processes and landforms: **Weathering** and **Erosion**; Introduction to **geological agents** (river, wind, oceans, glaciers, groundwater) and their actions (erosion, transport and deposition). **Interior of the Earth**: internal structure of earth, study of core, mental and crust of the Earth. Processes responsible for **volcanism** (Process of volcanic eruption, types of volcanoes and volcanic hazard) and **earthquake** (Causes of earthquake occurrence, Distribution (seismic zoning), Seismo-tectonic setup of India, seismic hazard: Tsunamis, Active fault rupture, liquefaction). **Plate Tectonics**: Introduction to the concept of plate tectonics, mechanism responsible for plate movement, types of plate boundaries, processes and features associated with plate boundaries. Continental drift and sea floor spreading.	06	25
11	**Mineralogy and Petrology:** **Physical properties of minerals**, major rock forming minerals, occurrence and use of minerals. Introduction to major **rock types** (Igneous, sedimentary and metamorphic rocks); their **genesis, classification** and **structures**; **engineering properties of rocks**, advantages and disadvantages of different rock types at constructions sites.	06	
Module 4			
12	**Geological time-scale and laws of stratigraphy:** Introduction to geological time scale and stratigraphy, Laws of stratigraphy.	01	25
13	**Structural geology:** Introduction to **primary** and **secondary** geological structures. Study of geological **faults, folds, joints** and **active faulting**. Their origin, types and engineering consideration. **Geological mapping:** study of Strike and dip using models and numerical problems, preparation of	07	

	geological cross section.		
14	**Hydrogeology:** Hydrological cycle and groundwater occurrence.	01	
15	**Geology in Civil Engineering:** **Geological investigations** during planning for tunnels, dams-reservoirs-runways-roads and buildings. **Landslide** and mass movement: Introduction, types, mitigation and prevention of landslide and mass movement. **Remote sensing and Geographical Information System (GIS)**: Introduction to remote sensing and GIS, use of remote sensing and GIS in geological investigations and geological hazard mitigation.	07	

Reference Books:

1. Arora K. R., Soil Mechanics & Foundation Engineering, Standard Publications.
2. Punmia B. C., Soil Mechanics & Foundations, Laxmi Publications,
3. Murthy V. N. S., Soil Mechanics & Foundation Engineering, Dhanpat Rai, Engineering
4. Alamsingh; Soil Mechanics & Foundation Engineering; CBS Publishers & Distributors, Delhi
5. Gopal Ranjan & Rao A. S. R., Basic & Applied Soil Mechanics, New Age International Publishers
6. Das Braja M; Principles of Geotechnical Engineering; Thomson Asia Pvt. Ltd.
7. G. H. Davis, Stephen J. Reynolds and Charles F. Kluth, Structural Geology of Rocks and Regions 3rd Edition, Wiley 2012.
8. S. K. Ghosh, Structural Geology: Fundamentals and Modern Developments, Elsevier Ltd, 2013.
9. F. G. Bell, Engineering Geology Second Edition, Elsevier Ltd, 2007..
10. Parbin Singh, Engineering and General Geology, S. K. Kataria & Sons 2010.

Course Outcome:

After learning the course the students shall be able to:

1. Know soil formation, types of soils, types of soils found in various parts of India.
2. Determine the index properties and interrelationships between various soil parameters.
3. Understand the different types of soil classification systems. Classify field soils as per particle size and atterberg's indices.
4. Know types of soil water found in nature, it's permeability characteristics and seepage determination.
5. Students will understand forces acting upon the surface of the Earth. Students will be able to appreciate processes and geological agents involved in the shaping surface of the earth, and will learn about the landforms produced as a result of these processes.
6. Students will be made familiar with the internal structure of the Earth, its properties and processes.
7. Students will learn theory of continental drift and sea-floor spreading. Students will also be able to understand mechanism and processes involved with plate tectonics, types of plate boundaries, processes happening at the plate-boundaries and geological features produced at the plate-boundaries.
8. Students will be able to know about hazards due to volcanic and seismic activity.
9. Students will be able to identify major mineral and rock types in hand-specimen.
10. Students will become familiar with the different types of geological structure and understand hazard associated with their presence at site.
11. Students will be able to predict the likely engineering behaviour of rocks under specified geologic conditions.
12. Students will be able to interpret engineering geologic maps.
13. Students will learn about use of satellite data and GIS for engineering geology.

List of Experiments:
Geotechnics lab:

1. Visual identification and specific gravity
2. Sieve Analysis
3. Hydrometer Analysis
4. Liquid and Plastic Limit Test
5. Shrinkage limit Test
6. In-situ Density-Core Cutter & Sand Replacement method
7. Permeability Test: Constant and Variable Head

Geology Lab:

1. Study of physical properties of major rock forming minerals.
2. Study of rock specimen.
3. Study of Strike and dip using models.
4. Numerical problems related to dip, strike and outcrop.
5. Preparation of geological cross section.
6. Case study: Geologic problems encountered during civil engineering projects.
7. Interpretation of satellite data and use of GIS software.

Field Application:

To collect various soil samples from local area and classify the soil as per IS.
Geologic field tour to study different types of geological structures and rocks.

Design Oriented Problems:

1. Prepare a chart showing soils available at different regions of Gujarat State with tentative soil properties, Which actually results in prediction of soil behavior approximately.
2. Prepare a working model to make student understand concept of permeability for different types of soil.
3. Prepare a working model which demonstrates horizontal and vertical permeability for stratified mass.

Term Work:

Term work shall consist of laboratory work (Minimum 05 Experiments from listed below) and tutorials (minimum 15 problems) based on above course. Practical examinations shall consist of oral based on term work and above course.

List of Open Source Software/learning website:www.nptel.iitm.ac.in/courses/

*PA (M): 10 marks for Active Learning Assignments, 20 marks for other methods of PA

ACTIVE LEARNING ASSIGNMENTS: Preparation of power-point slides, which include videos, animations, pictures, graphics for better understanding theory and practical work – The faculty will allocate chapters/ parts of chapters to groups of students so that the entire syllabus to be covered. The power-point slides should be put up on the web-site of the College/ Institute, along with the names of the students of the group, the name of the faculty, Department and College on the first slide. The best three works should submit to GTU.