INSTITUTE OF AERONAUTICAL ENGINEERING
(Autonomous)
Dundigal - 500 043, Hyderabad, Telangana

COURSE CONTENT

GEOLOGY AND SOIL MECHANICS								
IV Semester: CE								
Course Code	**Category**	**Hours/Week**			**Credits**	**Maximum Marks**		
		L	**T**	**P**	**C**	**CIA**	**SEE**	**Total**
ACEE14	Core	3	0	0	3	40	60	100
Contact Classes: 48	**Tutorial Classes: Nil**	**Practical Classes: Nil**				**Total Classes: 48**		
Prerequisite: Concrete Technology								

I. COURSE OVERVIEW:

This course integrates Engineering Geology and Soil Mechanics to provide a unified understanding of earth materials and their engineering behavior. It covers geological processes, rock weathering, soil formation, classification, and the physical properties that influence strength, stability, and seepage. Students will apply these concepts to predict soil performance under different loading and groundwater conditions, bridging geological knowledge with geotechnical engineering practice.

II. COURSE OBJECTIVES:

The students will try to learn:

I. Geological principles relevant to civil engineering, including rock weathering, mineralogy, and geological structures influencing soil behavior.
II. Fundamentals of soil formation, composition, classification, and their role in determining engineering properties.
III. Analytical methods for assessing permeability, seepage, and stress distribution in soils.
IV. Principles of compaction, compressibility, consolidation, and shear strength for safe and sustainable geotechnical design.

II. COURSE OUTCOMES:

At the end of the course students should be able to:

CO1 Explain geological processes, mineral composition, and rock weathering, and relate their influence to soil formation and engineering properties.
CO2 Classify soils using mineralogical, structural, and index property data in accordance with IS classification standards.
CO3 Conduct and interpret laboratory and field tests for determining permeability and analyze seepage patterns using flow nets.
CO4 Apply stress distribution theories to predict vertical stresses and pressure influence zones under different loading conditions.
CO5 Evaluate compaction and consolidation behavior to estimate settlements and assess stress history in soils.
CO6 Determine shear strength parameters for sands and clays under various drainage and geological conditions and apply them in geotechnical design.

IV. COURSE CONTENT:

MODULE –I: ENGINEERING GEOLOGY AND GEOLOGICAL PROCESSES (9)

Importance of geology in civil engineering; case studies of structural failures due to geological drawbacks. Introduction to physical geology, petrology, and structural geology. Rock weathering processes, their effects on engineering properties, and significance for dams, reservoirs, and tunnels. Weathering of common rocks such as granite. Basic mineralogy related to soils, rock cycle, and geological structures influencing construction.

MODULE -II: SOIL FORMATION, COMPOSITION, AND CLASSIFICATION (9)

Soil formation from geological processes; clay mineralogy and soil structure; phases of soil and weight–volume relationships; moisture content and relative density. Grain size distribution – sieve analysis and hydrometer method; consistency limits and indices; IS soil classification system. Influence of parent rock and climate on soil characteristics.

MODULE -III: PERMEABILITY AND STRESS DISTRIBUTION IN SOILS (10)

Capillary rise; Darcy's Law and factors affecting permeability; laboratory and field tests for determining permeability; permeability of layered soils. Seepage through soils – upward/downward seepage, quicksand condition, and flow nets (characteristics and uses).

Stress concepts – total, neutral, and effective stresses. Boussinesq's and Westergaard's stress distribution theories; pressure bulbs; vertical stress variation; Newmark's influence chart.

MODULE -IV: COMPACTION, COMPRESSIBILITY, AND CONSOLIDATION (10)

Mechanism and objectives of soil compaction; factors influencing compaction; effect on soil properties; field compaction equipment and quality control. Compressibility of soils – immediate, primary, and secondary settlement; stress history of clay; e–p and e–log p curves; normally consolidated, over-consolidated, and under-consolidated soils. Pre-consolidation pressure; Terzaghi's one-dimensional consolidation theory; coefficient of consolidation; determination by square-root time and logarithm-of-time methods; computation of settlement and rate of consolidation.

MODULE -V: SHEAR STRENGTH OF SOILS AND GEOLOGICAL RELEVANCE (10)

Principles of shear strength; Mohr–Coulomb failure theories; laboratory tests (direct shear, triaxial, unconfined compression, vane shear) under various drainage conditions; shear strength envelopes. Shear behavior of sands – dilatancy, critical void ratio, liquefaction; shear strength of clays. Influence of geological conditions, rock–soil interface, and weathering on soil strength in engineering projects.

III. TEXTBOOKS:

1. N. Chenna kesavulu, "*Engineering Geology*", McMillan, India Ltd., 2005
2. Braja M. Das, "*Principles of geotechnical engineering*" Cengage learning publishers, 2002.
3. VNS Murthy, "*Soil mechanics and foundation engineering*", CBS publishers and distributors, 2003.
4. Gopal Ranjan and ASR Rao, "*Basic and Applied Soil Mechanics*", New age international Pvt. Ltd, New Delhi,2000.
5. K. R. Arora, "*Soil mechanics and foundation engineering*", standard publishers and distributors, New Delhi, 2005.

VI. REFERENCE BOOKS:

1. C. Venkataramiah, "*Geotechnical Engineering*", New Age International Pvt. Ltd, 2002.
2. B.C. Punmia, Ashok Kumar Jain and Arun Kumar Jain, "*Soil mechanics and foundation*", Laxmi publications Pvt. Ltd, New Delhi, 2005.
3. Manojdutta and Gulati, "*Geotechnical Engineering*", Tata Mc Graw hill publishers New Delhi, 2005.

VII. ELECTRONICS RESOURCES:

1. http://nptel.ac.in/courses/105107120/1
2. http://www.nptel.ac.in/courses/105105105/
3. http://www.nptel.ac.in/courses/105105104
4. https://onlinecourses.nptel.ac.in/noc23_ce84/preview

VIII. MATERIALS ONLINE:

1. Course Outline Description
2. Lecture notes
3. PowerPoint presentation
4 Definitions and Terminology
5. Tutorial Question Bank
6. Case Studies
7. Real life Examples
8. Complex Engineering Problems
9. Tech Talk Topics
10. Concept Video Topics
11. Open-ended Exercises
12. Assignments
13. Model Question Paper – I
14. Model Question Paper – II
15. GATE Question Bank
16. Previous Question Papers and Solutions