INSTITUTE OF AERONAUTICAL ENGINEERING

(Autonomous)
Dundigal, Hyderabad -500 043

CIVIL ENGINEERING

COURSE DESCRIPTOR

Course Title	GEOTECHNICAL ENGINEERING LABORATORY				
Course Code	ACE105				
Programme	B. Tech				
Semester	IV	CE			
Course Type	Core				
Regulation	IARE - R16				
Course Structure	**Theory**			**Practical**	
	Lectures	**Tutorials**	**Credits**	**Laboratory**	**Credits**
	3	1	4	3	2
Chief Coordinator	Mrs. J. Hymavathi, Assistant Professor, CE				
Course Faculty	Mr. Y. Ravi Kumar, Assistant Professor, CE Mrs. J. Hymavathi, Assistant Professor, CE				

I. COURSE OVERVIEW:

This course aims to find out index & engineering properties of soil. The index properties such as grain size, liquid limit and plastic limit can be found out using sieve analysis, liquid limit and plastic limit tests respectively. Field density of the soil is found out by core cutter and sand replacement methods. Engineering properties of soil such as permeability, compressibility, shear strength, California bearing ratio of the soil is also found out by their respective tests.

II. COURSE PRE-REQUISITES:

Level	Course Code	Semester	Prerequisites	Credits
UG	ACE006	IV	Geotechnical Engineering	4

III. MARKS DISTRIBUTION:

Subject	SEE Examination	CIA Examination	Total Marks
Geotechnical Engineering Laboratory	70 Marks	30Marks	100

IV. DELIVERY / INSTRUCTIONAL METHODOLOGIES:

✔	Chalk & Talk	✘	Quiz	✘	Assignments	✘	MOOCs
✔	LCD / PPT	✘	Seminars	✘	Mini Project	✔	Videos
✘	Open Ended Experiments						

V. EVALUATION METHODOLOGY:

Each laboratory will be evaluated for a total of 100 marks consisting of 30 marks for internal assessment and 70 marks for semester end lab examination. Out of 30 marks of internal assessment, continuous lab assessment will be done for 20 marks for the day to day performance and 10 marks for the final internal lab assessment.

Semester End Examination (SEE): The semester end lab examination for 70 marks shall be conducted by two examiners, one of them being Internal Examiner and the other being External Examiner, both nominated by the Principal from the panel of experts recommended by Chairman, BOS.

The emphasis on the experiments is broadly based on the following criteria:

20 %	To test the preparedness for the experiment.
20 %	To test the performance in the laboratory.
20 %	To test the calculations and graphs related to the concern experiment.
20 %	To test the results and the error analysis of the experiment.
20 %	To test the subject knowledge through viva – voce.

Continuous Internal Assessment (CIA):
CIA is conducted for a total of 30 marks (Table 1), with 20 marks for continuous lab assessment during day to day performance, 10 marks for final internal lab assessment.

Table 1: Assessment pattern for CIA

Component	**Laboratory**		**Total Marks**
Type of Assessment	Day to day performance	Final internal lab assessment	
CIA Marks	20	10	30

Continuous Internal Examination (CIE):
One CIE exams shall be conducted at the end of the 16th week of the semester. The CIE exam is conducted for 10 marks of 3 hours duration.

Preparation	**Performance**	**Calculations and Graph**	**Results and Error Analysis**	**Viva**	**Total**
2	2	2	2	2	10

VI. HOW PROGRAM OUTCOMES ARE ASSESSED:

Program Outcomes (POs)		Strength	Proficiency assessed by
PO 1	**Engineering knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.	1	Calculations of the observations & Viva
PO 2	**Problem analysis**: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.	2	Exam & Viva
PO 3	**Design/development of solutions:** Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.	2	Results & Viva
PO9	**Individual and team work:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.	1	Experiment Conducted

3 = High; 2 = Medium; 1 = Low

VII. HOW PROGRAM SPECIFIC OUTCOMES ARE ASSESSED:

Program Specific Outcomes (PSOs)		Strength	Proficiency assessed by
PSO 1	**Engineering Knowledge:** Graduates shall demonstrate sound knowledge in analysis, design, laboratory investigations and construction aspects of civil engineering infrastructure, along with good foundation in mathematics, basic sciences and technical communication.	2	Exams & Viva
PSO 2	**Broadness and Diversity:** Graduates will have a broad understanding of economical, environmental, societal, health and safety factors involved in infrastructural development, and shall demonstrate ability to function within multidisciplinary teams with competence in modern tool usage.	-	
PSO 3	**Self-Learning and Service:** Graduates will be motivated for continuous self-learning in engineering practice and/or pursue research in advanced areas of civil engineering in order to offer engineering services to the society, ethically and responsibly.	-	

3 = High; 2 = Medium; 1 = Low

VIII. COURSE OBJECTIVES (COs):

The course should enable the students to:	
I	Classify the soil based on index properties of soil
II	Find the field bulk and dry density of cohesion-less and cohesive soils
III	Find the coefficient of permeability of coarse grained and fine grained soils & compressibility characteristics of soil
IV	Evaluate the shear strength parameters of soil.

IX. COURSE LEARNING OUTCOMES (CLOs):

CLO Code	CLO's	At the end of the course, the student will have the ability to:	PO's Mapped	Strength of Mapping
ACE105.01	CLO 1	Calculate water content of the soil	PO 1	1
ACE105.02	CLO 2	Determine the Specific Gravity of the soil	PO 1	1
ACE105.03	CLO 3	Classify the Coarse grained soils based on sieve analysis test & grain size distribution curve	PO 2	2
ACE105.04	CLO 4	Determine the liquid limit of fine grained soils & plot flow curve for a given soil	PO 3, PO2, PO 9	1
ACE105.05	CLO 5	Determine the plastic limit of fine grained soils	PO 3, PO2, PO 9	1
ACE105.06	CLO 6	Classify the fine grained soils based on plasticity index and liquid limit of soil	PO 2	2
ACE105.07	CLO 7	Determine the field bulk and dry density of cohesive soils by Core Cutter method	PO 1, PO3, PO 9	2
ACE105.08	CLO 8	Determine the field bulk and dry density of cohesion-less soils by Sand Replacement method	PO 1, PO3, PO 9	2
ACE105.09	CLO 9	Determine the permeability of coarse grained soil by constant head permeability test	PO 1, PO 2, PO 3	2
ACE105.10	CLO 10	Determine the permeability of fine grained soil by falling head permeability test.	PO 1, PO 2, PO 3	2
ACE105.11	CLO 11	Determine unconfined compressive strength of soil	PO 1, PO 3	2
ACE105.12	CLO 12	Determine California bearing ratio of the soil	PO 1, PO 3, PO 9	2
ACE105.13	CLO 13	Determine maximum dry density and optimum moisture content of the soil by standard proctor test.	PO 1, PO 3, PO 9	1
ACE105.14	CLO 14	Determine the shear strength parameters of soil by direct shear test	PO 1, PO 2, PO 3, PO 9	2
ACE105.15	CLO 15	Determine the un-drained shear strength of soft clays	PO 1, PO 2, PO 3, PO 9	2
ACE105.16	CLO 16	Determine the coefficient of Consolidation of the soil by consolidation test	PO 1, PO 2, PO 3	2
ACE105.17	CLO 17	Determine coefficient of volume compressibility by consolidation test	PO 1, PO 2, PO 3	2
ACE105.18	CLO 18	Determine the un-drained shear strength parameters of soil by tri-axial shear test	PO 3, PO 9	2
ACE105.19	CLO 19	Determine the drained shear strength parameters of soil by tri-axial shear test	PO 3, PO 9	2
ACE105.20	CLO 20	Determine the SPT N value of the soil by standard Penetration Test.	PO 3, PO 9	3

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X. MAPPING COURSE LEARNING OUTCOMES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES:

Course Learning Outcomes (CLOs)	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CLO 1	2												1		

Course Learning Outcomes (CLOs)	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CLO 2	2												1		
CLO 3		2											2		
CLO 4		2	1										2		
CLO 5		2	1										2		
CLO 6		3											2		
CLO 7	2	3											3		
CLO 8	2	3											3		
CLO 9	1	2	3										3		
CLO 10	1	2	3										3		
CLO 11	2		3										2		
CLO 12	2		3						2				2		
CLO 13	1		2						2				2		
CLO 14	2	2	3						1				3		
CLO 15	2	2	3						1				3		
CLO 16	2	1	3										3		
CLO 17	2	1	3										3		
CLO 18			3						2				3		
CLO 19			3						2				3		
CLO 20			3						3				3		

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XI. ASSESSMENT METHODOLOGIES – DIRECT

CIE Exams	PO 1, PO 2 PO 3	SEE Exams	PO 1, PO 2 PO 3	Assignments	-	Seminars	-
Laboratory Practices	PO 1, PO 2 PO 3, PO 9	Student Viva	PO 1, PO 2 PO 3	Mini Project	-	Certification	-

XII. ASSESSMENT METHODOLOGIES - INDIRECT

✔	Early Semester Feedback	✔	End Semester OBE Feedback
✘	Assessment of Mini Projects by Experts		

XIII. SYLLABUS

LIST OF EXPERIMENTS	
Week-1	**MOISTURE CONTENT**
To determine the natural moisture content of the given soil sample.	
Week-2	**SPECIFIC GRAVITY**
Determine the specific gravity of soil fraction passing 4.75 mm I.S sieve by density bottle.	
Week-3	**ATTERBERG'S LIMITS**
To determine liquid limit, plastic limit, shrinkage limit, classify the soil and to find flow index and toughness index	
Week-4	**RELATIVE DENSITY**
To determine the relative density of given coarse grained material	
Week-5	**FIELD DENSITY- CORE CUTTER AND SAND REPLACEMENT METHOD**
To determine the mass density of soils by core cutter method and replacement method	
Week-6	**GRAIN SIZE ANALYSIS**
To classify the coarse grained soils based on sieve analysis	
Week-7	**PERMEABILITY OF SOIL: CONSTANT AND VARIABLE HEAD TEST**
To determine coefficient of permeability of given soil sample at desired density by a suitable method.	
Week-8	**COMPACTION TEST**
To determine the optimum moisture content and maximum dry density of a soil by proctor test.	
Week-9	**CBR TEST**
To determine the California bearing ratio by conducting a load penetration test in the laboratory.	
Week-10	**CONSOLIDATION TEST**
To determine the settlements due to primary consolidation of soil by conducting one dimensional test.	
Week-11	**UNCONFINED COMPRESSION TEST**
To determine the unconfined compressive strength of cohesive soil sample and its sensitivity	
Week-12	**TRIAXIAL COMPRESSION TEST**
To determine shear strength parameter i.e. angle of shearing resistance and cohesion of a given soil sample	
Week-13	**DIRECT SHEAR TEST**
To determine shear strength parameters of the given soil sample at known density and moisture content by direct shear test.	

Week-14	VANE SHEAR TEST
To determine the shear strength of clay specimen.	
Week-15	**STANDARD PENETRATION TEST**
To measure the resistance to penetration of a sampling spoon in soil under dynamic loading	
Reference Books:	

1. Braja M. Das, "Soil Mechanics Laboratory Manual", Engineering Press at OUP, 2001.
2. Michael E. Kalinski, "Soil Mechanics Lab Manual", John Wiley & Sons, 2006.
3. Head,"Manual of Soil Lab Testing: Effect. Stress Tests", CBS Publishers, 1997.

XIV. COURSE PLAN:

The course plan is meant as a guideline. Probably there may be changes.

Week No.	Topics to be covered	Course Learning Outcomes (CLOs)	Reference
1	To determine the natural moisture content of the given soil sample.	CLO 1	R1 1.2
2	Determine the specific gravity of soil fraction passing 4.75 mm I.S sieve by density bottle.	CLO 2	R1 1.3
3	To determine liquid limit, plastic limit, shrinkage limit, classify the soil and to find flow index and toughness index	CLO 4, CLO 5, CLO 6	R1 2.2
4	To determine the relative density of given coarse grained material	CLO 4	R1 2.6
5	To determine the mass density of soils by core cutter method and replacement method	CLO 7, CLO 8	R1 2.4
6	To classify the coarse grained soils based on sieve analysis	CLO 3	R1 2.6
7	To determine coefficient of permeability of given soil sample at desired density by a suitable method.	CLO 9, CLO 10	R1 3.4
8	To determine the optimum moisture content and maximum dry density of a soil by proctor test.	CLO 13	R1 5.6
9	To determine the California bearing ratio by conducting a load penetration test in the laboratory.	CLO 12	R1 6.2
10	To determine the settlements due to primary consolidation of soil by conducting one dimensional test.	CLO 16, CLO 17	R1 9.2
11	To determine the unconfined compressive strength of cohesive soil sample and its sensitivity	CLO 11	R1 7.1
12	To determine shear strength parameter i.e. angle of shearing resistance and cohesion of a given soil sample	CLO 18, CLO 19	R1 10.2
13	To determine shear strength parameters of the given soil sample at known density and moisture content by direct shear test.	CLO 14	R1 10.4
14	To determine the shear strength of clay specimen.	CLO 15	R1 10.6
15	To measure the resistance to penetration of a sampling spoon in soil under dynamic loading	CLO 20	R1 12.5

XV. GAPS IN THE SYLLABUS - TO MEET INDUSTRY / PROFESSION REQUIREMENTS:

S No	Description	Proposed actions	Relevance with POs	Relevance with PSOs
1	Sketch flow nets and calculate seepage, exit gradient etc.,	Seminars/Guest Lectures/NPTEL	PO 3, PO 4	PSO 1
2	Fields tests to determine the shear strength of soils	Seminars/NPTEL	PO 4	PSO 1
3	Fields tests to determine the Permeability of soils	Seminars/NPTEL	PO 4	PSO 1

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