INSTITUTE OF AERONAUTICAL ENGINEERING

(Autonomous)

Dundigal, Hyderabad - 500 043

CIVIL ENGINEERING COURSE

DESCRIPTION FORM

Course Title	:	**GEOTECHNICAL ENGINEERING**			
Course Code	:	**A50116**			
Regulation	:	**R15 - JNTUH**			
Course Structure	:	Lectures	Tutorials	Practicals	Credits
		4	-	-	4
Course Coordinator	:	Ms.J.Hymavathi, Ms.B.Navya, Assistant Professor, Civil Engineering Dept.			
Team of Instructors	:	Ms.J.Hymavathi, Ms.B.Navya, Assistant Professor, Civil Engineering Dept.			

I. COURSE OVERVIEW:

It is the branch of civil engineering concerned with the design and construction of foundations, slopes, retaining walls, embankments, tunnels, levees, wharves, landfills and similar facilities; and with the engineering characterization and behavior of the ground and its constituent materialsPlays a key role in all civil engineering projects built on or in the ground. Is vital for the assessment of natural hazards such as earthquakes, liquefaction, sinkholes, rock falls and landslides

II. PREREQUISITE(S):

Level	Credits	Periods/ Week	Prerequisites
UG	4	4	Basic knowledge on building materials

III. MARKS DISTRIBUTION:

Sessional Marks	University End Exam marks	Total marks
Midterm Test There shall be two midterm examinations. Each midterm examination consists of essay paper, objective paper and assignment. The essay paper is for 10 marks of 60 minutes duration and shall contain 4 questions. The student has to answer 2 questions, each carrying 5 marks. The objective paper is for 10 marks of 20 minutes duration. It consists of 10 multiple choice and 10 fill-in-the blank questions, the student has to answer all the questions and each carries half mark. First midterm examination shall be conducted for the first two and half units of syllabus and second midterm examination shall be conducted for the remaining portion. Five marks are earmarked for assignments. There shall be two assignments in every theory course. Assignments are usually issued at the time of commencement of the semester. These are of problem solving in nature with course. Critical thinking. Marks shall be awarded considering the average of two midterm tests in each.	75	100

IV. EVALUATION SCHEME:

S. No	Component	Duration	Marks
1.	I Mid Examination	80 minutes	20
2.	I Assignment	-	5
3.	II Mid Examination	80 minutes	20
4.	II Assignment	-	5
5.	External Examination	3 hours	75

V. COURSE OBJECTIVES:

The objective of the teacher is to impart knowledge and abilities to the students to:

I. Introduce the students to the basic concept of soils
II. Learn the formation and structure of soil
III. Understand the index and engineering properties and standard classifications of soils
IV. Know the permeability of soil and laboratory determination of coefficient of permeability
V. Understand seepage through soils

VI. COURSE OUTCOMES:

After completing this course the student must demonstrate the knowledge and ability to:

1. Understand the basic properties of soil formation and structure.
2. Understand the index properties of soils.
3. Analyse the properties and factors of permeability.
4. Analyse the effective stress and seepage through soils.
5. Demonstrate the properties of flow nets and uses.
6. Evaluate the various stress distribution of soils.
7. Understand the Newmark's influence chart for irregular areas.
8. Understand the effects and factors of compaction.
9. Understand consolidation of soil.
10. Understand shear strength of soil and various methods for determining it.

VII. HOW PROGRAM OUTCOMES ARE ASSESSED:

Program Outcomes		Level	Proficiency assessed by
PO1	**Engineering knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.	H	Assignments, Tutorials, Exams
PO2	**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.	H	Lectures, Assignments, Exams
PO3	**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.	S	Mini Projects
PO4	**Conduct investigations of complex problems**: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.	S	Possible Projects
PO5	**Modern tool usage**: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.	S	Possible Projects
PO6	**The engineer and society**: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.		
PO7	**Environment and sustainability**: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.		
PO8	**Ethics**: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.	S	Discussions
PO9	**Individual and team work**: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.	S	Lectures, Discussions
PO10	**Communication**: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.	S	Lectures, Discussions
PO11	**Life-long learning**: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.		
PO12	**Project management and finance**: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.	S	Discussions and Projects

S – Supportive **H - Highly Related**

VIII. HOW PROGRAM SPECIFIC OUTCOMES ARE ASSESSED:

Program Specific Outcomes		Level	Proficiency assessed by
PSO1	**ENGINEERING KNOWLEDGE:** Graduates shall demonstrate sound knowledge in analysis, design, laboratory investigations and construction aspects of civil engineering infrastructure, along with good	H	Lectures, Assignments
PSO2	**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.	H	Projects
PSO3	**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.	S	Guest Lectures

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IX. SYLLABUS:

UNIT I

INTRODUCTION: Soil formation, Clay Mineralogy and Soil structure, Moisture Content, Weight –Volume Relationships, Relative Density

INDEX PROPERTIES OF SOILS: Grain size analysis, Sieve analysis, Principle of hydrometer method, Consistency limits and indices, I.S. Classification of soils

UNIT II

PERMEABILITY: Soil Water, Capillary Rise, Flow Of Water Through Soils, Darcy's Law, Permeability, Factors Affecting Permeability, Laboratory Determination Of Coefficient Of Permeability, Permeability Of Layered Soils, In-Situ Permeability Tests (Pumping In & Pumping Out Test)

EFFECTIVE STRESS &SEEPAGE THROUGH SOILS: Total, Neutral and Effective Stress, Quick Sand Condition, Seepage through Soils, Flow nets: Characteristics And Uses.

UNIT III

STRESS DISTRIBUTION IN SOILS: Boussinesq's And Westergaard's Theories For Point Load , Uniformly Loaded Circular And Rectangular Areas, Pressure Bulb, Variation Of Vertical Stress Under Point Load Along Vertical And Horizontal Plane, Newark's Influence Chart For Irregular Areas.

COMPACTION: Mechanism Of Compaction, Factors Affecting Compaction, Effects Of Compaction On Soil Properties, Field Compaction Equipment And Compaction Quality Control.

UNIT IV

CONSOLIDATION: Types Of Compressibility, Immediate Settlement, Primary Consolidation And Secondary Consolidation, Stress History Of Clay, E-P And E-Logp Curves, Normally Consolidated Soil, Over And Under Consolidated Soil, Pre-Consolidation Pressure And Its Determination, Terzaghi's 1d

Consolidation Theory, Coefficient Of Consolidation :Square Root Time And Logarithm Of Time Fitting Methods, Computation Of Total Settlement And Time Rate Of Settlement.

UNIT V

SHEAR STRENGTH OF SOILS: Importance Of Shear Strength, Mohr And Coulomb Failure Theories, Types Of Laboratory Tests For Strength Parameters, Strength Tests Based On Drainage Conditions, Strength Envelops, Shear Strength Of Sands, Dilatancy, Critical Void Ratio, Liquefaction, Shear Strength Of Clays.

Textbooks:

1. Principles of geotechnical engineering by Braja M.Das, Cengage learning publishers.
2. Soil mechanics and foundation engineering by VNS Murthy, CBS publishers and distributors
3. Basic and applied soil mechanics by Gopal Ranjan & ASR Rao, New Age international Pvt. Ltd, New Delhi.

Reference Books:

1. Geotechnical engineering by C. Venkataramiah, New Age International Pvt. Ltd, (2002)
2. Geotechnical engineering hand book by Das –JRoss Publishing.
3. Geotechnical engineering principles and practices by Cuduto, PHI International
4. Geotechnical engineering by Manoj Dutta & Gulati S.K – Tata Mc Grawhill publishers New Delhi .
5. Soil mechanics and foundation engineering by K.R .Arora , standard publishers and distributors , Delhi.
6. Soil mechanics and foundation by B.C. Punmia , Ashok Kumar Jain And Arun Kumar Jain, Laxmi publications Pvt . Ltd , New Delhi

X. COURSE PLAN:

At the end of the course, the students are able to achieve the following course learning outcomes:

Lecture No.	Topics to be covered	Course Learning Outcomes	References
1-2	**Introduction** to geotechnical engineering, properties of soils	**Understand** how the properties of soil formation	**T1:1.1**
3	Formation of soil and soil structures	**Learn** how the soil structures are formed	**T1:1.4**
4	Clay mineralogy and adsorbed water	**Understand** how the clayey soils are formed	**T:6.6**
5-6	Mass volume relationship	**Understand** the relationships of mass volume	**T1:3.1**
7	Relative density	**Learn** how the relative density is formed	**T3:3.15**
8-9	**INDEX PROPERTIES OF SOILS:** grain sizes analysis	**Understand** the properties of soil	**T1:3.3**
10-11	Sieve and hydrometer method of analysis	**Understand** the hydrometer method was used	**T1:3.8**
12-13	Consistency limit and indices of soil	**Analyse** the limits of soil	**T1:3.9**
14	I.S classification of soils	**Understand** how the I.S classification of soils is done	**T1:4.3**
15-16	**PERMEABILITY** - soil water –capillary rise	**Understand** what is permeability	**T1:5.9**
17-18	Flow of water through soil	**Understand** how the water flows through soil	**T1:5.4**
19-20	Darcy's law	**Understand** Darcy's law	**T1:5.4.1**

21-22	Permeability and factors effecting laboratory determination of coefficient of permeability	**Understand** how permeability of soil is determined	**T1:5.6**
23-24	Permeability of layered systems	**Identify** how the layers are formed in permeability	**T1:5.8**
25-26	**SEEPAGE THROUGH SOILS** –total, neutral and effective stresses quick sand conditions	**Undersatand** the concept of seepage through soils	**T1:6.9 to 6.10**
27	Seepage through soils	**Understand** the seepage through soils	**T1:6.5**
28-29-30	Flow nets, characteristics and uses	**Understand** the effect of flownets and uses	**T1:6.3 to6.3**
31	**COMPACTION-** mechanism of compaction	**Understand** what is mechanism	**T1:7.22**
32-33	Factors effecting compaction of soils properties	**Discover** various factors of compaction of soils	**T1:7.22**
34-35	Effect of compaction on soil properties	**Discuss** the factors affecting the compaction of soil	**T1:12.3.2**
36-37	Field compaction equipment	**Understand** field compaction	**T1:12.6.1**
38	Compaction control	**Understand** the concept of	**T1:12.6.2**
39-40	**CONSOLIDATION** –Stress history of	**Understand** the consolidation	**T:**
41-42	e-p and e- log p curves	**Understand** how the e vs p & log-p curves	**T:**
43-44	Magnitude and rates of 1-D consolidation	**Recognise** the magnitude of 1 – D consolidation	**T1:7.2.1**
45-46	Terzaghi's theory	**Understand** Terzaghi's theory	**T1:7.4**
47-48-49	**STRESS DISTRIBUTION IN SOILS –** Boussinesq's theory for point loads and areas	**Understand** the concept of Boussinesq's theory for different Shapes of area	**T1:10.2.1**
50-51-52	Westergaard's theory for point loads and area of different shapes	**Understand** the concept of Westergaard's theory of different shapes	**T1:10.2.4**
53-54	Newmark's influences chart	**Develop** Newmark's influence	**T1:10.7**
55-56-57	**SHEAR STRENGTH OF SOILS** –Mohr and	**Discuss** the shear strength of soils	**T1:8.4.2**
58-59-60	Types of laboratory strength test	**Understand** the laboratory	**T1:8.8**
61-62	Strength test based on drainage conditions	**Discuss** the drainage conditions based on strength test	**T1:8.12.2**
63-64	Shear strength of sands	**Understand** the shear strength of sands	**T1:8.11.3**
65-66	Critical void ratio of clay	**Discuss** Critical void ratio of	**T1:8.11.2**
67-68	Liquefaction and shear strength of clay	**Discuss** the liquefaction and shear strength of clay	**T1:8.12**
69-70	Strength test based on drainage conditions	**Discuss** the drainage conditions based on strength test	**T1:8.12.2**

XI. MAPPING COURSE OBJECTIVES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES:

Course Objectives	Program Outcomes												Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
I	S	H											H		S
II	H	S											H	S	
III				H			S						H	S	
IV											S		S	H	
V			H	S						S			S	H	S

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

Course Outcomes	Program Outcomes												Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	H	S	S	S	S	S	S	S	S	S	S	S	H	S	S
2	H	S	S	S	S	S	S	S	S	S	S	S	H	S	S
3	H	S	S	S	S	S	S	S	S	S	S	S	H	S	S
4	H	S	S	S	S	S	S	S	S	S	S	S	H	S	S
5	H	S	S	S	S	S	S	S	S	S	S	S	H	S	S
6	H	S	S	S	S	S	S	S	S	S	S	S	H	S	S
7	H	S	S	S	S	S	S	S	S	S	S	S	H	S	S
8	H	S	S	S	S	S	S	S	S	S	S	S	H	S	S
9	H	S	S	S	S	S	S	S	S	S	S	S	H	S	S
10	H	S	S	S	S	H	H	H	H	H	H	H	H	S	S

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Prepared by: Ms.J.Hymavathi, Ms. B. Navya, Assistant Professor, CE

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