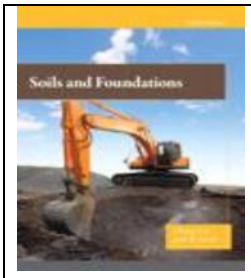	Course Title: GEO TECHNICAL ENGINEERING		
	Credits (L:T:P) : **4:0:0**	Total Contact Hours: **52**	Course Code: **15CE63B**
	Type of Course Delivery: **Lecture and Student activity**	**Credit :4**	Core/ Elective: **Elective**
CIE- 25 Marks			SEE- 100 Marks

Pre-requisites: Knowledge of Materials of Construction and Construction and concrete Technology.

Course Objective:

1. To provide basic knowledge about soil as a medium in civil engineering discipline.
2. To provide the description and classification of soil, Compaction soil and shear strength
3. To get familiarized about field tests conducted on soil, sampling of soil and exploration of soil for conducting tests.
4. To disseminate the idea of ground improvement techniques and stabilization of soils.
5. To understand the concept of foundation in expansive soils.

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

Course Outcome		CL	Linked PO	Teaching Hrs
CO1	Summarize the concept of soil mechanics and properties of soil & their application.	**R/U**	1,2,3	06
CO2	Explain classification of soils , discuss compaction process and shear strength of soil	**R/U**	1,2,3,5,6,10	10
CO3	Conduct the field tests on soil, sampling of soil & knowledge about soil exploration	**R/U**	1,2,3,5,6,7,10	10
CO4	Select various ground improvement techniques & soil stabilization methods	**R/U**	1,2,3,5,6,7,10	10
C05	Discuss the concept of well foundations & pile foundations	**R/U**	1,2,3,6,7,10	10
C06	Indicate the problems faced during laying of foundation in expansive soils	**R/U**	1,2,3,5,6,7,10	06
C07	Manage the suggested or identified problems and solve in teams, in order to improve future problem solving ability and able to present it.	**R/U/Ap/An**	1,2,3,4,5,6,7,8, 9,10	*
		Total sessions		**52**

Legend- R: Remember U: Understand Ap: Application Ay: Analysis C: Creation E: Evaluation

*** Related to Student activity beyond classroom hours.**

Course Delivery: The course will be delivered through lectures and Power point presentations/Videos

Programme outcome Attainment Matrix

Course	Programme Outcome									
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
	Basic knowledge	Discipline knowledge	Experiments and Practice	Engineering Tools	Engineer and society	Environment & Sustainability	Ethics	Individual and Team work	Communication	Life long learning
Geotechnical Engineering	3	3	3	-	3	3	3	-	-	3

Level 3- Highly Addressed, Level 2-Moderately Addressed, Level 1-Low Addressed.

Method is to relate the level of PO with the number of hours devoted to the COs which address the given PO.

If ≥40% of classroom sessions addressing a particular PO, it is considered that PO is addressed at Level 3

If 25 to 40% of classroom sessions addressing a particular PO, it is considered that PO is addressed at Level 2

If 5 to 25% of classroom sessions addressing a particular PO, it is considered that PO is addressed at Level 1

If < 5% of classroom sessions addressing a particular PO, it is considered that PO is considered not-addressed.

UNIT	CONTENT	HOURS
1	**Introduction to Soil Mechanics and Properties of Soils:** **Introduction** – Development of soil Mechanics – Fields of application of Soil Mechanics – Formation of soil, Three phase system of soil. • **Soil properties** – Definitions of Index properties (Water content, Specific gravity, porosity, Degree of saturation, Void ratio, Particle size distribution, Bulk Unit weight of soil, Consistency Limits and relative density) and Engineering properties(Cohesion, Angle of internal friction, Capillarity, Permeability, Elasticity. Compressibility) & Atterberg's limits (shrinkage limit, plastic limit, and liquid limit).	6
2	**Classification, Compaction, shear Strength** **Classification:** Purpose of soil classification, Particle size classification ,IS classification, Highway Research Board classification system, field identification of soils **Compaction of soils**: Definition, Mechanism of compaction, procedures of Standard proctor & Modified proctor tests, factors affecting compaction, Methods of compaction, field compaction equipments. **Shear strength** - concept of Shear strength- List the Methods of determination of Shear strength of soils -concept of sensitivity of soils.	10
3	**Field tests on soil, Soil Exploration & Sampling of soil** **Field tests on soil**- Static Cone Penetration Test, Electrical Resistivity method and Permeability Test. **Soil exploration** - Needs & objectives, guidelines for deciding Number & disposition of trail pits & borings ,depth of exploration, List of methods of soil exploration,	9

UNIT	CONTENT	HOURS
	Sampling of soil – Types of samples -undisturbed, disturbed and representative samples, typical Bore log, format of Soil investigation report.	
4	**Ground Engineering** **Ground improvement techniques** – introduction – commonly used methods – pre loading, use of sand drains, densification of soils by vibro floatation, Sand compaction piles, simple stone columns, blasting, heating **Stabilization of soil** – Introduction- Objects of stabilization- Methods of stabilization- grouting methods (Compaction grouting, slurry injection grouting only), soil reinforcement- geogrid and geotextiles.	**11**
5	**Foundations** **Deep foundations**- Introduction – Pile foundation – Uses of piles – Types of piles –selection of piles – Pile driving – Capacity of piles – Pile load test – Floating foundation– pile groups – Settlement of Pile **Well foundation**-Caissons(box & pneumatic caissons), shapes of well foundation, components of well foundation, forces acting on well foundation	**10**
6	**Foundation in expansive soil** Introduction – Identification of expansive soil – Free swell Index Test – Differential free swell test –Swell potential and Swelling pressure- Methods of foundation in expansive soils- replacement of Expansive soils and "CNS(Cohesive Non Swelling)" concept- Under reamed pile foundation.	**6**
	Total	**52**

SUGGESTED ACTIVITIES

The topic should be related to the course in order to enhance his knowledge, practical skill & and lifelong learning, communication, modern tool usage.

1. Collect samples of soil & make a mini project report on their properties.
2. List the various earthwork excavating machines & their usage as per their suitability.
3. Prepare a case study on advanced ground improvement techniques.
4. Collect the soil investigation report for any nearby construction project & prepare a report on it.
5. Visit any nearby site & interact with the engineer how the soil investigation is conducted & make a report on it.
6. Conduct field tests on soil sample of your college & make a report on the tests.
7. Prepare a report on collection of samples of soil.
8. Visit nearby PWD office & collect details of soils of your zone & make a report on it.
9. Conduct seminars on i)Stress distribution of soil ii) Consolidation of soil iii)Reinforcement of soil iv) Stability of slopes v) Soil formation & soil structure vi) Seepage analysis of soil.

NOTE:

1. Students should select any one of the above or other topics relevant to the subject approved by the concerned faculty, individually or in a group of 3 to 5. Students should mandatorily submit a written report and make a presentation on the topic. The task should

not be repeated among students. Report will be evaluated by the faculty as per rubrics. Weightage for 5 marks Internal Assessment shall be as follows:
Unsatisfactory 1, Developing 2, Satisfactory 3, Good 4, Exemplary 5.

2. Reports should be made available along with bluebooks to IA verification officer

Example of model of rubrics / criteria for assessing student activity

Dimension	Students score (Group of five students)				
	STUDENT 1	STUDENT 2	STUDENT 3	STUDENT 4	STUDENT 5
Rubric Scale	Unsatisfactory 1, Developing 2, Satisfactory 3, Good 4, Exemplary5				
1.Literature	3				
2.Fulfill team's roles & duties	2				
3.Conclusion	4				
4.Convensions	5				
Total	14				
Average=(Total /4)	3.5=4				
Note: Concerned faculty (Course coordinator) must devise appropriate rubrics/criteria for assessing Student activity for 5 marks One activity to attain last CO (course outcome) may be given to a group of FIVE students					

Note: Dimension should be chosen related to activity and evaluated by the course faculty.

Dimension	Rubric Scale				
	1 Unsatisfactory	2 Developing	3 Satisfactory	4 Good	5 Exemplary
1.Literature	Has not included relevant info	Has included few relevant info	Has included some relevant info	Has included many relevant info	Has included all relevant info needed
2. Fulfill team's roles & duties	Does not perform any duties assigned	Performs very little duties	Performs partial duties	Performs nearly all duties	Performs all duties of assigned team roles
3.Communication	Poor	Less Effective	Partially effective	Effective	Most Effective
4.Convensions	Frequent Error	More Error	Some Error	Occasional Error	No Error

Course Assessment and Evaluation Scheme:

	What		To whom	When/Where (Frequency in the course)		Max Marks	Evidence collected	Course outcomes
Direct	CIE	IA	Students	Thrice	test	Test 1	20	Blue books	CO1,CO2

				(Average of three tests)	Test 2			CO3,CO4
					Test 3			CO5,CO6
				Student Activities		05	Written Report	CO1 to CO7
	SEE	End Exam		End of the course		100	Answer scripts at BTE	CO1,CO2,CO3,CO4,CO5,CO6
Indirect Assessment	Student Feedback on course		Students	Middle of the course			Feedback forms	CO1,CO2 &CO 3 Delivery of course
	End of Course Survey			End of the course			Questionnaires	CO1 to CO7 Effectiveness of Delivery of instructions & Assessment Methods

***CIE** – Continuous Internal Evaluation ***SEE** – Semester End Examination

Note: I.A. test shall be conducted for 20 marks. Average marks of three tests shall be rounded off to the next higher digit.

Note to IA verifier*: *The following documents to be verified by CIE verifier at the end of semester

1. Blue books (20 marks)
2. Student suggested activities report for 5 marks evaluated through appropriate rubrics.
3. Student feedback on course regarding Effectiveness of Delivery of instructions & Assessment Methods

Weightage of Marks and blue print of marks for SEE

Unit	Major Topics	Hours Allotted	Questions to be set for SEE – Cognitive Levels R	U	Ap	Marks weightage	weightage (%)	A*	B*
1	Introduction to Soil Mechanics and Properties of Soils	06	16.66% **5**	33.33% **10**	0.00% **0**	15	10.34	1	1
2	Classification, Compaction & shear strength	10	16.66% **10**	16.66% **20**	0.00% **0**	30	20.68	2	2
3	Field tests on soil, Soil Exploration & Sampling of soil	10	13.00% **05**	28.57% **25**	0.00% **0**	30	20.68	2	2
4	Ground Engineering	10	25.00% **05**	25.00% **20**	0.00% **0**	25	17.25	1	2
5	Earth work, Earth moving equipment & Deep foundations	10	25.00% **10**	25.00% **20**	0.00% **0**	30	20.68	2	2
6	Foundation in expansive soil	06	50.00% **5**	50.00% **10**	0.00% **0**	15	10.37	1	1
	Total	52	**27.60%** **40**	**72.4%** **105**	**0%** **0**	145	100	9	10

Legend- R; Remember U: Understand Ap: Application Ay: Analysis C: Creation E: Evaluation

A*-SEE questions to be set for (05 marks) in Part – A
B*- SEE questions to be set for (10 marks) in Part – B
Questions for CIE and SEE will be designed to evaluate the various educational components such as:

1	Remembering and Understanding	70%
2	Applying the knowledge acquired from the course	20%
3	Analysis	10%
4	Evaluation	0%
5	Creating new knowledge	0%

Model Question Paper for CIE :

Test/Date and Time	Semester/year	Course/Course Code	Max Marks
Ex: I test/6 th week of sem 10-11 Am	VI	**GEO-TECH ENGINEERING**	**20**
	Year: 2015-16	**Course code:15CE63B**	

Name of Course coordinator : **Course Outcome : 1,2**
Note: Answer all questions

	Question	**M**	**CL**	**CO**	**PO**
1	Discuss briefly the various applications of soil mechanics. Or With sketch Explain three phase system of soil.	**05**	**U**	**1,2**	**1,2,3 ,5,6, 10**
2	Define i) Specific gravity ii)Particle size distribution iii) Bulk Unit weight of soil, iv)Consistency Limits v)relative density	**05**	**R**	**1,2**	**1,2,3 ,5,6, 10**
3	Explain Highway Research Board classification of soil. Or Write a short note on field identification of soils.	**05**	**R**	**1,2**	**1,2,3 ,5,6, 10**
4	Discuss the effect of compaction on soil properties (or) Differentiate between Standard & modified proctor test.	**05**	**U**	**1,2**	**1,2,3 ,5,6, 10**

Note: Internal Choice may be given in each CO at the same cognitive level (CL).

TEXT BOOKS

1 **References:**

1. A text book of Soil Mechanics & Foundation Engineering – VNS Murthy, Dhanpat Rai & Sons 1682,, Nai sark, Delhi.
2. A text book of Soil Mechanics & Foundation Engineering – B.N.D Narasimha Rao
3. Construction and Foundation Engineering – Dr. Janardhana Jha and S. K. Sinha.
4. Geo technical Engineering by Prof.T.N.Ramamurthy , Prof.T.G.SITHARAM
5. Problems in soil mechanics – B. C. Punmia.
6. A Text book of soil mechanics- Dr. B. C. Punmia.
7. Problems in soil mechanics – Shamsher Prakash.
8. Foundation Design in Engg. Practice – Nayak.

9. Soil Mechanics in Engineering practice – Tenzagi & Peck.
10. Soil Mechanics by K R Arora.
11. Soil Mechanics and foundation Engineering -- Joseph. E. Bowles
12. Basic Soil Mechanics & Foundations Paperback – January 1, 2011 by Alam Singh (Author)
13. Foundation Engineering- P C Varghese, PHI learning, 2009.
14. Geotechnical Engineering- Dr C Venkataramaiha, New Age Publications,2009
15. Soil Mechanics and foundation Engineering- S K Garga, Khanna publications, 2003.

Websites:

16. http://nptel.ac.in/courses/105104034/
17. http://nptel.ac.in/courses/105104131/
18. http://nptel.ac.in/courses/105104135/
19. https://www.youtube.com/watch?v=cRAEZTOCBm0
20. https://www.youtube.com/watch?v=C42m52LKgX8
21. https://www.youtube.com/watch?v=o0Kyihefy2A&list=PLWbF2j_Smxk1VgPtPsQwQDlLLDnzA5moT
22. https://www.youtube.com/watch?v=vjGNwhvODGk
23. https://www.youtube.com/watch?v=BQ2w6A23ElQ
24. https://www.youtube.com/watch?v=4h8vqN6nOa4
25. https://www.youtube.com/watch?v=bh7TieIxrWE
26. https://www.youtube.com/watch?v=IPGAJCdVjUQ&list=PLFH132nBHpEZP-eTIcAcK0_A1qXKhCKxV
27. https://www.youtube.com/watch?v=kNllvz-0oF4
28. https://www.youtube.com/watch?v=e2aEEUvmLIM

Model Question Paper
Diploma in Civil Engineering
6TH semester
Course title: **GEO TECHNICAL ENGINEERING**

Time: 3Hrs. **Max. marks: 100**

Part –A

Answer any six questions each carries 5 marks

1. Define the following
   i) Cohesion ii) Angle of internal friction iii) Capillarity iv) Permeability v)Elasticity
2. Explain classification of soil.
3. Discuss the effect of compaction on soil properties.
4. What are the needs of soil exploration program?
5. Distinguish between disturbed sample & undisturbed sample.
6. Explain sand compaction piles used for ground improvement.
7. Write a short note on types of piles.
8. What are the forces acting on well foundation.
9. Explain i) Swell potential ii) Swell pressure

Part –B

Answer any seven each question carries 10 marks

1. a) Explain three phase system of soil with a neat sketch.
   b) Write a short note on Atterberg limits of soil.
2. Explain Standard proctor test.
3. a) Explain the mechanism of compaction
   b) Explain sensitivity of soils.
4. Explain Static Cone Penetration Test soil.
5. a) Explain depth of exploration..
   b) Distinguish between disturbed sample & undisturbed sample.
6. a) Explain the need of ground improvement techniques
   b) Explain how pre-loading technique is useful in improving the properties of the soil.
7. a) Discuss the objects of soil stabilization.
   b) Write a short note on soil reinforcement.
8. Explain pile load test.
9. Describe the various components of a pneumatic caisson with a neat sketch
10. Explain the test procedure to determine free swell Index for expansive soil.

MODEL QUESTION BANK

CO I : Understand concept of soil mechanics & different properties of soil & their application.

Cognitive level –Remember

1. Define Soil mechanics?
2. Discuss briefly the various applications of soil mechanics.
3. With the help of three phase diagram define the following
   i) Voids ratio (ii) Porosity (iii) Degree of saturation (iv) Water content
4. Define i) Specific gravity ii)Particle size distribution iii) Bulk Unit weight of soil, iv)Consistency Limits v) relative density
5. Define i) Cohesion ii) Angle of internal friction iii) Capillarity iv) Permeability v) Elasticity vi) Compressibility

Cognitive level -Understand

1. Explain briefly the formation of soil.
2. Explain three phase system of soil.
3. Explain Engineering properties of soil.
4. Write a short note on Atterberg's limits of soil.

CO II : Apply understand the classification of soils ,compaction of soil & shear strength of soil.

Cognitive level –Remember

1. Explain classification of soil.

2. Explain IS classification of soil.
3. Explain Highway Research Board classification of soil.
4. Explain the mechanism of compaction.
5. Explain Standard proctor test.
6. Write a short note Modified proctor test.
7. Differentiate between Standard & modified proctor test.
8. Explain sensitivity of soils.

Cognitive level -Understand

1. What is the purpose of soil classification?
2. List the different types of classification of soil.
3. Write a short note on field identification of soils.
4. Define compaction?
5. Discuss the effect of compaction on soil properties.
6. What are the factors affecting Compaction.
7. Write short note field compaction equipments.
8. What is shear strength of soil?
9. List the different methods of determination of shear strength of soils.

CO III : Conduct the field tests on soil, sampling of soil & knowledge about soil exploration

Cognitive level –Remember

1. What are the needs of soil exploration program?
2. Explain the guidelines for deciding Number & disposition of trail pits & borings .
3. List the methods of soil exploration
4. Discuss the different types soil samples.
5. Sketch a typical bore log and describe its features.

Cognitive level -Understand

1. Explain Static Cone Penetration Test soil.
2. Discuss Electrical Resistivity method.
3. Explain the conduction of Permeability Test of soil.
4. Explain depth of exploration.
5. Distinguish between disturbed sample & undisturbed sample.
6. What are the salient features of a good soil investigation report.
7. Discuss the objectives of Soil exploration.

CO IV : Apply the knowledge of ground improvement techniques & stabilization of soils

Cognitive level - Remember

1. Explain the need of ground improvement techniques.
2. Discuss the objects of soil stabilization.
3. Explain briefly Compaction & slurry injection method of grouting.
4. Write a short note on soil reinforcement.

Cognitive level -Understand

1. Explain how pre-loading technique is useful in improving the properties of the soil.
2. Explain sand drains for improving properties of the soil.
3. Explain Vibro flotation technique for insitu densification of soil.
4. Explain stone columns used for improving the properties of soil.
5. Explain sand compaction piles used for ground improvement.
6. Explain blasting method of improving the properties of soil.
7. Explain heating method of improving the properties of soil.
8. Explain geo grids & geo textiles used in soil reinforcement.

CO V : Understand the different earth well foundation & pile foundations

1. Write a short note on types of piles.
2. Discuss briefly the capacity of piles.
3. Write a short note on pile groups.
4. What do you understand about settlement of pile?
5. Describe the various components of a pneumatic caisson with a neat sketch
6. Sketch & list out the components of well foundation.
7. What are the different shapes of well foundation?
8. What are the forces acting on well foundation?

Cognitive level -Understand

1. Explain pile foundation
2. Explain pile driving.
3. Explain pile load test.
4. Explain briefly the floating foundation
5. Describe the construction procedure of Box caisson.
6. Describe the forces acting on a well foundation.
7. Discuss the uses of piles.

CO VI : Understand the foundation in expansive soils

Cognitive level –Remember

1. Define i) Swell potential ii) Swell pressure
2. Discuss CNS Concept in expansive soils.

Cognitive level -Understand

1. Explain the test procedure to determine free swell Index for expansive soil.
2. Explain the differential test.
3. Explain the method of foundation of replacement of Expansive soils
4. Write a short note under reamed pile foundation.