

**Curriculum  
(Scheme of Examination)  
&  
Syllabus for  
  
M.Tech  
Geotechnical Engineering**

**Batch 2020 onwards**



**SGT University Gurgaon**

## Credit Based Scheme w.e.f. 2020-2021



**Scheme of Examination for M.Tech–Geotechnical Engineering Program**  
**SEMESTER WISE COURSE STRUCTURE**

**First Semester**

S. NO.	Subject Code	Course Title	L	T	P	C	Examination marks		Subject Total
							Ext.	Int.	
1	13160101	Advanced Soil Mechanics	3	0	0	3	60	40	100
2	13160102	Ground Improvement Techniques	3	0	0	3	60	40	100
3	13160103	Research Methodology & IPR	3	0	0	3	60	40	100
4		Elective-I	3	0	0	3	60	40	100
5	13160104	Experimental soil Mechanics Lab	0	0	2	1	40	60	100
6	13160105	Research Methodology & IPR Lab	0	0	2	1	40	60	100
7	13160106	Seminar	0	0	2	1	0	100	100
		<b>Total</b>	<b>12</b>	<b>0</b>	<b>6</b>	<b>15</b>	<b>320</b>	<b>380</b>	<b>700</b>

**Second Semester**

S. NO.	Subject Code	Course Title	L	T	P	C	Examination marks		Subject Total
							Ext.	Int.	
1	13160201	Rock Mechanics	3	0	0	3	60	40	100
2	13160202	Advanced Foundation Engineering	3	0	0	3	60	40	100
3	13160203	Soil Dynamics and Machine Foundations	3	0	0	3	60	40	100
4		Elective II	3	0	0	3	60	40	100
5	13160301	Rock Mechanics Lab	0	0	2	1	40	60	100
6	13160302	Advanced Geotechnical Laboratory	0	0	2	1	40	60	100
7	13160303	Seminar	0	0	2	1	0	100	100
		<b>Total</b>	<b>12</b>	<b>0</b>	<b>6</b>	<b>15</b>	<b>320</b>	<b>380</b>	<b>700</b>



**Scheme of Examination for M.Tech–Geotechnical Engineering Program**  
**SEMESTER WISE COURSE STRUCTURE**

**Third Semester**

S.NO.	Subject Code	Course Title	L	T	P	C	Examination marks		Subject Total
							Ext.	Int.	
1	13160301	Soil strength behavior	3	0	0	3	60	40	100
2	13160302	Earth retaining structures	3	0	0	3	60	40	100
3	13160303	Design of pavements	3	0	0	3	60	40	100
4		Elective – III	3	0	0	3	60	40	100
5	13160304	Computer application in Engineering Lab	0	0	4	2	40	60	100
6	13160305	Identification of Research Problem	0	0	2	-	-	-	-
		<b>Total</b>	<b>12</b>	<b>0</b>	<b>6</b>	<b>14</b>	<b>280</b>	<b>220</b>	<b>500</b>

**Fourth Semester**

S.NO.	Subject Code	Course Title	L	T	P	C	Examination marks		Subject Total
							Ext.	Int.	
1	13160401	Dissertation	0	0	20	20	100	-	100
		<b>Total</b>	<b>0</b>	<b>0</b>	<b>20</b>	<b>20</b>	<b>100</b>	<b>-</b>	<b>100</b>

## List of Program Electives

S. NO.	Subject Code	Course Title	L	T	P	C	Examination marks		Subject Total
							Ext.	Int.	
<b>Elective I</b>									
1	13160126	Earth & Rock fill Dams	3	0	0	3	60	40	100
2	13160127	Computational Methods in Geotechnical Engg	3	0	0	3	60	40	100
3	13160128	Strength and Deformation Behaviour of Soils	3	0	0	3	60	40	100
4	13160129	Advanced Surveying and Cartography	3	0	0	3	60	40	100
<b>Elective II</b>									
1	13160232	Tunneling Technology	3	0	0	3	60	40	100
2	13160233	Advanced Pavement Materials	3	0	0	3	60	40	100
3	13160234	Planning and Design of Low Volume Roads	3	0	0	3	60	40	100
4	13160235	Mechanics of unsaturated soils	3	0	0	3	60	40	100
<b>Elective III</b>									
1	13160322	Construction Methods and Equipment	3	0	0	3	60	40	100
2	13160323	FEM In Geomechanics	3	0	0	3	60	40	100
3	13160324	Climate Change and Sustainable Development	3	0	0	3	60	40	100
4	13160325	Offshore Foundations	3	0	0	3	60	40	100
		<b>Total Credit</b>	<b>09</b>						

# **First Semester**

<b>1. Name of the Department</b>		<b>CIVIL ENGINEERING</b>				
<b>2. Subject Name</b>	<b>Advanced soil Mechanics</b>	<b>L</b>	<b>T</b>	<b>P</b>		
<b>3. Subject Code</b>	13160101	3	0	0		
<b>4. Type of Subject (use tick mark)</b>	<b>Core (√)</b>	<b>PE()</b>		<b>OE()</b>		
<b>5. Pre-requisite (if any)</b>	Nil	<b>Frequency (use tick marks)</b>	Even ( )	Odd (√)	Either Sem (√)	Every Sem ( )
<b>6. Total Number of Lectures, Tutorials, Practical (assuming 14 weeks of one semester)</b>						
<b>Lectures = 36</b>		<b>Tutorials = 00</b>		<b>Practical = 00</b>		
<b>Brief Syllabus:</b> Students will understand the advanced concept of soil mechanics which includes soil properties, effective stresses acting on soil, consolidation behavior of soil and strength characteristics of different types of saturated and unsaturated soil.						
<b>7. Learning objectives:</b>						
1. To study the advanced methods of determination of engineering properties of different soil samples						
2. To lay a firm theoretical background necessary in the design of geotechnical systems						
3. Estimate shear strength, consolidation and effective stress of saturated and partially saturated soils.						
<b>8. Subject Outcomes:</b>						
1. Analyse effective stress for different field conditions.						
2. Calculate settlement of soils using one dimensional and three dimensional consolidation theories.						
3. Estimate shear strength of saturated and partially saturated soils.						
<b>9. Unit wise detailed content</b>						
<b>Unit-1</b>	<b>Number of lectures = 08</b>	<b>Title of the unit: Effective Stress</b>				
<b>Effective Stress:</b> The principle of effective stress, Inter-granular pressure, Pore pressure, capillary pressure, problems						
<b>Unit - 2</b>	<b>Number of lectures = 10</b>	<b>Title of the unit: Consolidation</b>				
<b>Consolidation:</b> Principle of consolidation-compressibility, pressure-void ratio relationships, Terzaghi's one dimensional consolidation parameters, pre-consolidation pressure, Estimation of total Settlement. Two and three dimensional consolidation, Secondary compression						
<b>Unit - 3</b>	<b>Number of lectures = 09</b>	<b>Title of the unit: Shear Strength</b>				
<b>Shear Strength:</b> Basic concepts, Mohr-Coulomb theory; measurement of shear strength, drainage conditions, stress paths, pore pressure parameters.						
<b>Unit - 4</b>	<b>Number of lectures = 09</b>	<b>Title of the unit: Strength of Cohesionless and saturated cohesive Soils</b>				
<b>Strength of Cohesionless Soils:</b> Friction between solid surfaces, Frictional behaviour of minerals, strength of granular soil, Factors affecting strength and deformation, Dilatancy, critical void ratio, Liquefaction.						
<b>Strength of Saturated Cohesive Soils:</b> Effective stress-water content relationship, stress history, structure, strain rate, sensitivity, Thixotropy, Hvorslev's strength parameters.						

**10. Brief Description of self learning / E-learning component**

The students will be encouraged to learn using the SGT e-Learning portal and choose the relevant lectures delivered by subject experts of SGT University.

The link to the E-Learning portal.

<https://elearning.sgtuniversity.ac.in/course-category/>Journal papers; Patents in the respective field.

**11. Books Recommended****Text Books**

1. K. Terzaghi's, "Theoretical Soil Mechanics" - John Wiley & Sons, 1948.
2. R.D. Holtz & W.D. Kovacs, "An Introduction to Geotechnical Engineering" – Prentice – Hall India, 1981.

**Reference books**

1. J. K. Mitchel, "Fundamentals of Soil behaviour" - John Wiley & Sons, 1993.
2. T. W. Lambe & R. V. Whitman, "Soil Mechanics" - Wiley Eastern Ltd.,2000



<b>1. Name of the Department</b>		<b>CIVIL ENGINEERING</b>			
<b>2. Subject Name</b>	<b>Ground Improvement Techniques</b>	<b>L</b>	<b>T</b>	<b>P</b>	
<b>3. Subject Code</b>	13160102	3	0	0	
<b>4. Type of Subject</b>		<b>Core (√)</b>	<b>PE()</b>		<b>OE()</b>
<b>5. Pre-requisite (if any)</b>	Advanced soil mechanics	<b>Frequency (use tick marks)</b>	Even ( )	Odd (√)	Either Sem ( ) Every Sem ( )
<b>6. Total Number of Lectures, Tutorials, Practical</b>					
<b>Lectures = 36</b>		<b>Tutorials = 00</b>	<b>Practical =00</b>		
<b>Brief Syllabus:</b> This course will cover the various methods of ground improvement techniques.					
<b>7. Learning objectives:</b> 1) Understand the mechanical behavior of weak ground 2) To make the foundation strong underlying heavy structures. 3) Study the various admixtures to modify the properties of weak ground by adding in specified amount					
<b>8. Subject Outcomes:</b> At the end of this course the student shall have a knowledge of methods of ground improvement					
<b>9. Unit wise detailed content</b>					
<b>Unit-1</b>	<b>Number of lectures =10</b>	<b>Title of the unit: Introduction – Ground Modification with mechanical modification</b>			
<b>Introduction to Ground Modification:</b> Need and objectives of Ground Improvement, Classification of Ground Modification Techniques – suitability and feasibility, Emerging Trends in ground improvement.  <b>Mechanical Modification:</b> Methods of compaction, Shallow compaction, Deep compaction techniques – Vibro-floatation, Blasting, Dynamic consolidation, precompression and compaction piles, Field compaction control.					
<b>Unit - 2</b>	<b>Number of lectures = 9</b>	<b>Title of the unit: Hydraulic Modification</b>			
<b>Hydraulic Modification :</b> Methods of dewatering – open sumps and ditches, Well-point system, Electro-osmosis, Vacuum dewatering wells; pre-loading without and with sand drains, strip drains and rope drains, Design of vertical drains.					
<b>Unit - 3</b>	<b>Number of lectures =8</b>	<b>Title of the unit: Physical and chemical modification</b>			
<b>Physical and chemical modification :</b> Stabilisation with admixtures like cement, lime, calcium chloride, fly ash and bitumen; Grouting: Categories of grouting, Art of grouting, Grout materials, Grouting techniques and control.					
<b>Unit - 4</b>	<b>Number of lectures = 9</b>	<b>Title of the unit: Reinforced Earth Technology and ground anchor</b>			
<b>Reinforced Earth Technology:</b> Concept of soil reinforcement, Reinforcing materials, Backfill criteria, Art of reinforced earth technology, Design and construction of reinforced earth structures.					

**Ground Anchors:** Types of ground anchors and their suitability, Uplift capacity of anchors

**10. Brief Description of self-learning / E-learning component**

The students will be encouraged to learn using the SGT E-Learning portal and choose the relevant lectures delivered by subject experts of SGT University.

**11. Books Recommended**

**Text books**

1. . Robert M. Koerner “Construction and Geotechnical methods in Foundation Engineering”, Mc.Graw-Hill Pub. Co., New York, 1985.
2. Manfred R. Haussmann, “Engineering principles of ground modification”, Pearson Education Inc. New Delhi, 2008.
3. F. G., Bell, “Engineering Treatment of Soils”, E& FN Spon, New York, 2006.

**Reference books**

1. P. Purushothama Raj, “ Ground Improvement Techniques” Laxmi Publications (P) Limited, 2006.
2. Jie Han et. al., “Advances in ground Improvement” Allied Pub., 2009.
3. S. Mittal, and J. P. Shukla, “Soil Testing For Engineers”, Khanna Publications, 2003.

<b>1. Name of the Department</b>		CIVIL ENGINEERING				
<b>2. Course Name</b>	Research Methodology and IPR	L	T		P	
<b>3. Course Code</b>	13160103	3	0		0	
<b>4. Type of Course (use tick mark)</b>		Core (√)		PE-()	OE()	
<b>5. Pre-requisite (if any)</b>		<b>6. Frequency (use tick marks)</b>	Even ()	Odd (√)	Either Sem ()	Every Sem ()
<b>7. Total Number of Lectures, Tutorials, Practical (assuming 14 weeks of one semester)</b>						
Lectures = 32		Tutorials = 00		Practical = 0		
<b>8. Brief Syllabus:</b>						
The aim of the course is to make students understand the importance of Research Paper Writing. Also, it covers all the concepts which involved in writing the Research Paper.						
<b>9. Learning objectives:</b>						
The objectives of the course are:						
<ol style="list-style-type: none"> <li>1. The students are able to recognize the steps involved in doing research work.</li> <li>2. The students will be able to collect data using various media and using the best possible sample available.</li> <li>3. The students would learn to propose their Hypothesis and build models for the problem.</li> <li>4. The students would be able to correctly document their findings in the form of a report.</li> </ol>						
<b>10. Course Outcomes:</b>						
After completion of this course, the student will be able to:						
<ol style="list-style-type: none"> <li>1. Recognize the various steps involved in research.</li> <li>2. Collect data from samples, Examine and Analyze the data.</li> <li>3. Develop models for problems.</li> <li>4. Explain the entire process in the form of a report.</li> </ol>						
<b>11. Unit wise detailed content</b>						
Unit-1	Number of lectures = 08	Title of the unit: Introduction				
Research - Types, Research process and steps, Hypothesis, Research Proposal and aspects. Research Design- Need, Problem Definition, Variables, Research Design concepts, Literature survey and review, Research design process, Errors in research. Research Modeling- Types of models, model building and stages, Data consideration.						
Unit - 2	Number of lectures = 08	Title of the unit: Sampling				
Sampling and data collection- Techniques of sampling, Random, Stratified, Systematic, Multistage-sampling, Primary and secondary sources of data. Design of questionnaire.						
Unit - 3	Number of lectures = 08	Title of the unit: Data Collection and Experiments				
Design of Experiments- Objectives, strategies, Factorial experimental design, designing engineering experiments, basic principles-replication, randomization, blocking, guidelines for design of experiments.						
Unit - 4	Number of lectures = 08	Title of the unit: Models and Hypothesis & Report writing				
Single factor experiment- Hypothesis testing, analysis of Variance component (ANOVA) for fixed effect model; Total, treatment and error of squares, Degrees of freedom, Confidence interval; ANOVA for random effect model, estimation of variance components, Model adequacy checking. Structure and components of Scientific Reports, Types of Report, Technical Reports and Thesis; Different steps in the preparation – Layout, structure and Language of typical reports; Illustrations and tables, Bibliography, Referencing and foot notes.						

**12. Brief Description of self learning / E-learning component**

<https://research-methodology.net/research-methodology/>

<https://gradcoach.com/what-is-research-methodology/>

**13. Books Recommended****Text Book:**

1. Research Methodology – Methods and Techniques – C.R. Kothari, New Age International, New Delhi, 2004.

**Reference Book:**

1. Design and Analysis of Experiments – Douglas C. Montgomery, Wiley India, 8th Edition, 2012.
2. Practical Research: Planning Design – Paul D. Leddy, London, 1980.

1. Name of the Department		CIVIL ENGINEERING				
2. Subject Name	Experimental soil Mechanics Lab	L	T		P	
3. Subject Code	13160104	0	0		2	
4. Type of Subject		Core (√)	PE()		OE()	
5. Pre-requisite (if any)	Soil Mechanics	Frequency (use tick marks)	Even ()	Odd (√)	Either Sem ()	Every Sem ()
6. Total Number of Lectures, Tutorials, Practical, Assuming 14 weeks in semester						
Lectures = 00		Tutorials = 00		Practical =28		
7. Learning objectives:						
1. To understand the properties of soil.						
2. To evaluate the and determine the properties of soil used in foundation and pavement design.						
Outcomes:						
On completion of this course, the students will be able to						
1. Understand the properties and behavior of various soil used in construction						
2. student able to understand Requirements of design as per their Indian standard specified value						
3. Study and evaluate strength and consolidation behavior of various soils						
8. Lab Content						
Sr. No.	Title					CO covered
1	Water Content, specific gravity,					1,2
2	Liquid Limit, Plastic Limit,					1,2
3	Core cutter test for density determination					1,2
4	Compaction test					1,2
5	Permeability test					1,2
6	Constant head & falling head methods					1,2
7	Determination of density Sand replacement method					1,2
8	Estimation of settlement					2,3
9	Compression index parameter					2,3
10	Rate of settlement, coefficient of consolidation, Swell Pressure					2,3
11	Triaxial Compression Test - Unconsolidated					2,3
12	Undrained Tests, Consolidated Undrained Tests with Pore pressure measurement,					2,3

1. Name of the Department		CIVIL ENGINEERING				
2. Subject Name	Research Methodology and IPR Lab	L	T		P	
3. Subject Code	13160105	0	0		2	
4. Type of Subject		Core (√)	PE()		OE()	
5. Pre-requisite (if any)	Research Methodology and IPR	Frequency (use tick marks)	Even ()	Odd (√)	Either Sem ()	Every Sem ()
6. Total Number of Lectures, Tutorials, Practical, Assuming 14 weeks in semester						
Lectures = 00		Tutorials = 00		Practical =28		
<p><b>1. Learning objectives:</b>  The objectives of the course are:</p> <ol style="list-style-type: none"> <li>The students are able to recognize the steps involved in Identifying research problem.</li> <li>The students will be able to collect data using various media and using the best possible sample available.</li> <li>The students would learn to propose their Hypothesis and build models for the problem.</li> <li>The students would be able to correctly document their findings in the form of a report.</li> </ol>						
<p><b>Outcomes:</b>  On completion of this course, the students will be able to</p> <ol style="list-style-type: none"> <li>Choose the topic for writing research paper.</li> <li>Develop models for problems.</li> <li>The students would learn to write the research paper.</li> </ol>						
<b>7. Lab Content</b>						
Sr. No.	Title					CO covered
1	How to choose topic for research					1,2
2	How to collect data for the particular research problem					1,2
3	Writing Abstract					1,2
4	Writing Literature review					1,2
5	Explaining and writing methodology					1,2
6	How to analyze the data collected					1,2
7	Presentation of analysis and findings					1,2
8	How to write result and conclusion					2,3
9	References in research article					2,3

1 Name of the Department		CIVIL ENGINEERING				
2 Subject Name	Seminar	L	T		P	
3 Subject Code	13160106	0	0		2	
4 Type of Subject (use tick mark)		Core (√)			OE()	
5 Pre-requisite (if any)	Nil	1. Frequency (use tick marks)	Even (√)	Odd ()	Either Sem ()	Every Sem ()
6 Total Number of Lectures, Tutorials, Practical						
Lectures = 00		Tutorials =00		Practical =28		
<p><b>Detailed Syllabus:</b> The student can choose any topic, pertaining to Geotechnical Engineering. Topic should be a relevant and currently researched one. Students are advised to refer articles published in current journals for choosing their seminar topics. Student should review minimum of 5 to 6 research papers relevant to the topic chosen, in addition to standard textbooks, handbooks, etc. Students are required to prepare a seminar report, in the standard format and give presentation to the Seminar Assessment Committee (SAC) in the presence of their classmates. the engineering properties and behaviour of different types of rocks.</p>						
<p><b>8 Subject Outcomes:</b></p> <ol style="list-style-type: none"> <li>1. Present different topics in engineering practice.</li> <li>2. Comprehend technical reports.</li> <li>3. Interpret the analysis of case studies.</li> <li>4. Present topics of relevance to a group of professionals.</li> </ol>						

# **Second Semester**



<b>1. Name of the Department</b>		<b>CIVIL ENGINEERING</b>					
<b>2. Subject Name</b>	<b>Rock Mechanics</b>	<b>L</b>	<b>T</b>		<b>P</b>		
<b>3. Subject Code</b>	13160201	3	0		0		
<b>4. Type of Subject</b>		<b>Core (√)</b>		<b>PE()</b>		<b>OE()</b>	
<b>5. Pre-requisite (if any)</b>		<b>Frequency (use tick marks)</b>		Even (√)	Odd ()	Either Sem (√)	Every Sem ()
<b>6. Total Number of Lectures, Tutorials, Practical</b>							
<b>Lectures = 37</b>		<b>Tutorials = 00</b>			<b>Practical = 00</b>		
<b>Brief Syllabus:</b> Rock mechanics includes the testing methods of rock ,rock mass classification, in-situ testing and methods to improve the engineering properties of rock mass							
<b>7. Learning objectives:</b> 1 To study and analyze the laboratory and field testing for a given project / construction 2 To analyze the appropriate methods to improve stability of rock mass							
<b>8. Subject Outcomes:</b> On completion of this course, the students will be able to 1 Estimate foundation capacity of rock mass. 2. Design of tunnel excavation and support systems.							
<b>9. Unit wise detailed content</b>							
<b>Unit-1</b>	<b>Number of lectures =10</b>	<b>Title of the unit: Introduction and Laboratory Testing methods</b>					
<b>Introduction:</b> Development of rock mechanics, problems of rock mechanics, applications and scope of rock mechanics.  <b>Laboratory Testing methods study:</b> Rock sampling, Determination of density, Porosity and Water absorption, Uniaxial Compressive strength, Determination of elastic parameters, Tensile strength, Shear Strength, Flexural strength, Strength criterion in rocks, Swelling and slake durability, permeability, point load strength, Dynamic methods of testing, Factors affecting strength of rocks.							
<b>Unit - 2</b>	<b>Number of lectures = 08</b>	<b>Title of the unit: Rock Mass Classification</b>					
<b>Rock Mass Classification:</b> Classification by Rock Quality Designation, Rock structure Rating, Geomechanics and NGI classification systems.							
<b>Unit – 3</b>	<b>Number of lectures =10</b>	<b>Title of the unit: In – situ testing and Methods of Improving Rock Mass properties</b>					
<b>In – situ testing :</b> Necessity and Requirements of in – situ tests – Types of in – situ tests – Flat jack Technique – Hydraulic Fracturing Technique, pressure Tunnel Test, Plate Load Test, Shear Strength Test, Radial Jack Test, Goodman Jack Test and Dilatometer Test. <b>Methods of Improving Rock Mass properties:</b> Rock Reinforcement, Rock bolting.Mechanism of Rock bolting,Types of rock bolts. Pressure grouting – grout curtains and consolidation grouting.							
<b>Unit - 4</b>	<b>Number of lectures = 09</b>	<b>Title of the unit: Stability of Rock Slopes and foundation on rock</b>					
<b>Stability of Rock Slopes:</b> Causes of landslides, Modes of failure, Methods of analysis, Prevention and control of rock slope failure, Instrumentation for Monitoring and Maintenance of Landslides.  <b>Foundations on Rock:</b> Shallow foundations, Pile and well foundations, Basement excavation, Foundation construction, Allowable bearing pressure.							

**10. Brief Description of self learning / E-learning component**

The students will be encouraged to learn using the SGT e-Learning portal and choose the relevant lectures delivered by subject experts of SGT University.

The link to the E-Learning portal.

<https://elearning.sgtuniversity.ac.in/course-category/>Journal papers; Patents in the respective field.

**11. Books Recommended****Text books**

1. Central Board of Irrigation and Power - Manual on Rock Mechanics, 1988.
2. R. E. Goodman, "Introduction to Rock Mechanics" John Wiley & Sons, New York, 1989.

**Reference Books:-**

1. Wakter Wittke, "Rock Mechanics" Springer Verlag, New York, 1990.
2. Kiyoo Mogi "Experimental Rock Mechanics" Taylor & Francis Group, UK, 2007.
3. T. Ramamurthy, "Engineerng in Rocks for slopes, foundations and tunnels", PHI Learning Pvt. Limited, 2010.

<b>8. Name of the Department</b>		<b>CIVIL ENGINEERING</b>			
<b>9. Subject Name</b>	<b>Advanced Foundation Engineering</b>	<b>L</b>	<b>T</b>	<b>P</b>	
<b>10. Subject Code</b>	13160202	3	0	0	
<b>11. Type of Subject (use tick mark)</b>		<b>Core (√)</b>	<b>PE()</b>		<b>OE()</b>
<b>12. Pre-requisite (if any)</b>	Basics of foundation engineering	<b>Frequency (use tick marks)</b>	Even (√)	Odd ()	Either Sem (√) Every Sem ()
<b>13. Total Number of Lectures, Tutorials, Practical (assuming 14 weeks of one semester)</b>					
<b>Lectures = 37</b>		<b>Tutorials = 00</b>	<b>Practical = 00</b>		
<b>Brief Syllabus:</b> In this course, the students will know the importance of foundation engineering, bearing capacity of soil and study the characteristics and design of various foundations					
<b>14. Learning objectives:</b> 1. To study the different types of foundations based on site conditions. 2. To Analyze and suggest remedial measures against foundation failures.					
<b>15. Subject Outcomes:</b> 1. Analyze bearing capacity and settlement of foundations. 2. Design shallow and deep foundations.					
<b>16. Unit wise detailed content</b>					
<b>Unit-1</b>	<b>Number of lectures = 08</b>	<b>Title of the unit: Bearing Capacity</b>			
<b>Art of Foundation engineering: Bearing Capacity</b> - Theories of Terzaghi, Meyerhof, Brinch Hansen, and Skempton, Penetration tests, Plate load tests, Factors; Settlement Analysis - Stresses in soil, Immediate and consolidation settlement, control of excessive settlement					
<b>Unit - 2</b>	<b>Number of lectures = 08</b>	<b>Title of the unit: Shallow Foundations</b>			
<b>Shallow Foundations:</b> Foundation classification; Choice of foundations; Isolated foundations – individual and combined foundations, Raft foundations - Necessity; Types of rafts; Bearing capacity and settlement of rafts – Beams on elastic foundations					
<b>Unit - 3</b>	<b>Number of lectures = 11</b>	<b>Title of the unit: Pile Foundations and well foundations</b>			
<b>Pile Foundations:</b> Classification and Uses, Carrying capacity of Single pile, Pile load tests, cyclic pile load test, pull out resistance, laterally loaded Piles; Pile groups - Group efficiency, Settlement of single pile and pile groups, Negative skin friction, sharing of loads					
<b>Well Foundations:</b> Caissons – Types, advantages and disadvantages, Shapes and component parts, Grip length, Bearing capacity and settlement, Forces acting, Sinking of wells, Rectification of Tilts and Shifts, Lateral stability - Terzaghi's method and IRC method					
<b>Unit - 4</b>	<b>Number of lectures = 09</b>	<b>Title of the unit: Foundation Failure</b>			
<b>Foundation Failures :</b> Types and causes of failures, Remedial measures, Shoring and Underpinning					

**17. Brief Description of self learning / E-learning component**

The students will be encouraged to learn using the SGT e-Learning portal and choose the relevant lectures delivered by subject experts of SGT University.

The link to the E-Learning portal.

<https://elearning.sgtuniversity.ac.in/course-category/>Journal papers; Patents in the respective field.

**18. Books Recommended****Text Books**

- 1 J. E. Bowles, "Foundation Analysis & Design", Mc.Graw Hill Book Co.
2. W. C. Teng, "Foundation Design", Prentice Hall of India Ltd.

**Referance books**

1. Tomlinson, "Foundation Design and Construction", ELBS, Longman Group Ltd.
2. Winterkorn and Fang, "Foundation Engineering Hand Book", Van Nostrand Reinhold Co, New York.

<b>1. Name of the Department</b>		<b>CIVIL ENGINEERING</b>			
<b>2. Subject Name</b>	<b>Soil Dynamics and Machine Foundation</b>	<b>L</b>	<b>T</b>	<b>P</b>	
<b>3. Subject Code</b>	13160203	3	0	0	
<b>4. Type of Subject</b>		<b>Core (√)</b>	<b>PE()</b>		<b>OE()</b>
<b>5. Pre-requisite (if any)</b>		<b>Frequency (use tick marks)</b>	Even (√)	Odd ()	Either Sem (√)    Every Sem ()
<b>6. Total Number of Lectures, Tutorials, Practical</b>					
<b>Lectures = 36</b>		<b>Tutorials = 00</b>		<b>Practical = 00</b>	
<b>7. Learning objectives:</b>					
1.To analyze and design behaviour of a machine foundation resting on the surface, embedded foundation and foundations on piles by elastic half space concept.					
2. To analyze and design vibration isolation systems					
<b>Subject Outcomes:</b> On completion of this course, the students will be able to					
1.Calculate the dynamic properties of soils using laboratory and field tests					
2. Apply theory of vibrations to solve dynamic soil problems					
<b>8. Unit wise detailed content</b>					
<b>Unit-1</b>	<b>Number of lectures = 09</b>	<b>Title of the unit: Theory of vibrations</b>			
<b>Theory of vibrations: Introduction</b> – Soil behavior under dynamic loads, Vibration of single and two degree freedom system, Vibration of six and multi degree freedom system, Mass spring analogy - Barkan's Theory					
<b>Unit – 2</b>	<b>Number of lectures = 08</b>	<b>Title of the unit: Vibration Isolation</b>			
<b>Vibration Isolation:</b> Introduction, Active and passive isolation, Methods of vibration isolation					
<b>Unit – 3</b>	<b>Number of lectures = 09</b>	<b>Title of the unit: Machine Foundations</b>			
<b>Machine Foundations:</b> General principles of machine foundation design, Types of machines and foundations, General requirements of machine foundation, Permissible amplitudes and stresses					
<b>Unit – 4</b>	<b>Number of lectures = 8</b>	<b>Title of the unit: Public Works Account</b>			
Tender and acceptance of tender, Earnest money, security money, retention money, measurement book, cash book, preparation, examination and payment of bills, first and final bills, administrative sanction, technical sanction.					
<b>9. Brief Description of self learning / E-learning component</b>					
The students will be encouraged to learn using the SGT e-Learning portal and choose the relevant lectures delivered by subject experts of SGT University.					
The link to the E-Learning portal.					
<a href="https://elearning.sgtuniversity.ac.in/course-category/">https://elearning.sgtuniversity.ac.in/course-category/</a> Journal papers; Patents in the respective field.					
<b>10. Books Recommended (3 Text Books + 2-3 Reference Books)</b>					
<b>Text Books</b>					
1. Bharath Bhusan Prasad, “Soil Dynamics and Earthquake Engineering”, PHI, New Delhi, 2009.					
2. S. Prakash, “Soil Dynamics”, McGraw Hill Book Co., New York, 1999					
<b>Reference Books</b>					

1. S. Prakash and V. K. Puri, "Analysis and Design of Machine Foundations", McGraw Hill Book Co., New York, 1993
2. P. Sreenivasulu and C. V. Vidyanathan, "Hand Book of Machine Foundation", Tata McGraw Hill, New Delhi, 1981

1. Name of the Department		CIVIL ENGINEERING				
8. Subject Name	Advanced Geotechnical Laboratory	L	T		P	
9. Subject Code	13160205	0	0		2	
10. Type of Subject		Core (√)	PE()		OE()	
11. Pre-requisite (if any)		Frequency (use tick marks)	Even ()	Odd (√)	Either Sem ()	Every Sem ()
12. Total Number of Lectures, Tutorials, Practical						
Lectures = 00		Tutorials = 00		Practical =28		
13. Learning objectives:						
1. To understand the properties of soil. 2. To evaluate the and determine the properties of soil used in foundation and pavement design.						
14. Lab content						
Sr. No.	Title					CO covered
	Test includes to determine the bearing capacity of soil.  California bearing Ratio test (CBR) for soft soil ,Medium hard soil and stiff and hard soil sample  Dynamic cone penetation test (DCPT) for different types of soil sample  Static cone penetration test (SPT) for different types of soil  Plate load tests for soft ,medium and hard soil sample					1,2,3

<b>1 Name of the Department</b>		<b>CIVIL ENGINEERING</b>				
<b>2 Subject Name</b>	<b>Rock Mechanics Lab</b>	<b>L</b>	<b>T</b>		<b>P</b>	
<b>3 Subject Code</b>	13160204	0	0		2	
<b>4 Type of Subject (use tick mark)</b>		Core (√)		OE()		
<b>5 Pre-requisite (if any)</b>	Nil	<b>2. Frequency (use tick marks)</b>		Even (√)	Odd ()	Either Sem () Every Sem ()
<b>6 Total Number of Lectures, Tutorials, Practical (assuming 14 weeks of one semester)</b>						
Lectures = 00		Tutorials =00		Practical =28		
<b>7 Learning objectives:</b> To study the engineering properties and behaviour of different types of rocks						
<b>8 Subject Outcomes:</b> 1. Determine compressive strength of rock specimens 2. Find the tensile strength of rock specimens 3. Find the durability of rock						
<b>9 Unit wise detailed content</b>						
<b>Preparation of rock core samples;</b>						
1) Specific Gravity,						
2) Porosity						
3) Water Absorption of rock sample.						
<b>Fundamental Laboratory tests;</b>						
4) Uniaxial						
5) Point load and Brazilian tests						
6) Determination of uniaxial compressive strength						
7) Young's Modulus and tensile strength;						
8) Triaxial compression tests						



1 Name of the Department		CIVIL ENGINEERING				
2 Subject Name	Seminar	L	T		P	
3 Subject Code	13160206	0	0		2	
4 Type of Subject (use tick mark)		Core (√)			OE()	
5 Pre-requisite (if any)	Nil	1. Frequency (use tick marks)	Even (√)	Odd ()	Either Sem ()	Every Sem ()
6 Total Number of Lectures, Tutorials, Practical						
Lectures = 00		Tutorials =00		Practical =28		
<p><b>Detailed Syllabus:</b> The student can choose any topic, pertaining to Geotechnical Engineering. Topic should be a relevant and currently researched one. Students are advised to refer articles published in current journals for choosing their seminar topics. Student should review minimum of 5 to 6 research papers relevant to the topic chosen, in addition to standard textbooks, handbooks, etc. Students are required to prepare a seminar report, in the standard format and give presentation to the Seminar Assessment Committee (SAC) in the presence of their classmates.</p>						
<p><b>8 Subject Outcomes:</b></p> <ol style="list-style-type: none"> <li>1. Present different topics in engineering practice.</li> <li>2. Comprehend technical reports.</li> <li>3. Interpret the analysis of case studies.</li> <li>4. Present topics of relevance to a group of professionals.</li> </ol>						

**Reading:**

1. Geotechnical Engineering Journals, Conference Proceedings
2. Research Articles /Reports available on Internet

# **Third Semester**

<b>1 Name of the Department</b>		<b>CIVIL ENGINEERING</b>				
<b>2 Subject Name</b>	<b>Soil Strength Behaviour</b>	<b>L</b>	<b>T</b>		<b>P</b>	
<b>3 Subject Code</b>	13160301	3	0		0	
<b>4 Type of Subject (use tick mark)</b>		<b>Core (√)</b>	<b>PE()</b>		<b>OE()</b>	
<b>5 Pre-requisite (if any)</b>	Nil	<b>1. Frequency (use tick marks)</b>	Even ()	Odd (√)	Either Sem (√)	Every Sem ()
<b>6 Total Number of Lectures, Tutorials, Practical (assuming 14 weeks of one semester)</b>						
<b>Lectures = 37</b>		<b>Tutorials = 00</b>		<b>Practical = 00</b>		
<b>Brief Syllabus:</b> This Course will introduce the knowledge about soil formation and mineralogy, soil fabric and its measurement, clay-water interaction, effective granular and total stress, volume change, shear strength and deformation behavior.						
<b>7 Learning objectives:</b> 1. Define possible reasons for the observed phenomenon under scientific investigations for solving engineering problems. 2. Identify soil fabric by direct and indirect measuring methods						
<b>8 Subject Outcomes:</b> On completion of this course the students will be able to know 1. Recognize the importance of soil mineralogy and mechanisms of formation on engineering behaviour of soils 2. Identify basic mechanism behind the physical and engineering properties of soils						
<b>9 Unit wise detailed content</b>						
<b>Unit-1</b>	<b>Number of lectures = 9</b>	<b>Title of the unit: Soil formation and mineralogy</b>				
<b>Soil formation and mineralogy:</b> Origin of clay minerals, sediment erosion, transport and deposition; clay mineral types and their importance in geotechnical engineering; gravel, sand and silt particles; Determination of soil composition, X-Ray diffraction, Scanning Electron Microscope						
<b>Unit - 2</b>	<b>Number of lectures = 10</b>	<b>Title of the unit: Soil fabric and its measurement</b>				
<b>Soil fabric and its measurement:</b> Fabrics and fabric elements, contact force characterization, voids and their distribution, pore size distribution analysis, methods of fabric characterization						
<b>Unit - 3</b>	<b>Number of lectures = 08</b>	<b>Title of the unit: Clay-water interactions</b>				
<b>Clay-water interactions:</b> Mechanisms of soil-water interaction, properties of adsorbed water; clay-water-electrolyte system, diffuse double layer theory; cation exchange, Soilchemical interactions						
<b>Unit - 4</b>	<b>Number of lectures = 09</b>	<b>Title of the unit : Volume change, shear strength and deformation behavior</b>				
<b>Volume change, shear strength and deformation behavior:</b> General volume change behaviour of soils, physical interactions, fabric, structure and volume change; General characteristics of strength and deformation, fabric, structure and strength; friction and physical interactions among soil particles						

**10 Brief Description of self-learning / E-learning component**

The students will be encouraged to learn using the SGT E-Learning portal and choose the relevant lectures delivered by subject experts of SGT University.

**11 Books Recommended****Text Books**

1. L. D., Baver, "Soil Physics", Asia Publishing House, 1960.
2. Malcom D. Bolton, "A Guide to Soil Mechanics", University Press (India) Pvt. Ltd., 2003.

**Reference books**

1. J. K., Mitchell, "Fundamentals of Soil Behavior", John Wiley & Sons Inc., 1993.
2. Nyle C. Brady and Ray R. Weil, "The Nature and Properties of Soils", Pearson Education Inc., 2002

<b>2 Subject Name</b>	<b>Earth retaining structures</b>	<b>L</b>	<b>T</b>	<b>P</b>		
<b>3 Subject Code</b>	13160302	3	0	0		
<b>4 Type of Subject (use tick mark)</b>		<b>Core (√)</b>	<b>PE()</b>	<b>OE()</b>		
<b>5 Pre-requisite (if any)</b>	Nil	<b>1. Frequency (use tick marks)</b>	Even ()	Odd (√)	Either Sem (√)	Every Sem ()
<b>6 Total Number of Lectures, Tutorials, Practical</b>						
<b>Lectures = 36</b>		<b>Tutorials = 00</b>		<b>Practical =00</b>		
<b>Brief Syllabus:</b> Earth retaining structures include the brief of earth pressure and theories, types of earth retaining structures, retaining wall and its design, sheet piles and bulkheads in granular and cohesive soils						
<b>7 Learning objectives:</b> 1. To calculate earth pressure on various earth retaining structures such as gravity retaining walls, sheet pile, bulkheads, bracing/struts and coffer dams						
<b>8 Subject Outcomes:</b> By the end of the course students will be able to 1. Design a relevant earth retaining structure for given soil condition 2. Design of sheet pile with and without anchors.						
<b>9 Unit wise detailed content</b>						
<b>Unit-1</b>	<b>Number of lectures = 09</b>	<b>Title of the unit: Introduction to earth pressure and theories</b>				
<b>Introduction to earth pressure</b> – basic concepts – active, passive and at rest earth pressures  <b>Rankine's and Coulomb's earth pressure theories</b> – concepts and drawbacks – earth pressure models – graphical methods and their interpretations						
<b>Unit - 2</b>	<b>Number of lectures = 10</b>	<b>Title of the unit: Types of earth retaining structures</b>				
<b>Types of earth retaining structures</b> – classifications – specifications						
<b>Unit - 3</b>	<b>Number of lectures = 08</b>	<b>Title of the unit: Retaining walls</b>				
<b>Retaining walls</b> – types – Design specifications and pressure distribution variations						
<b>Unit - 4</b>	<b>Number of lectures = 08</b>	<b>Title of the unit: Sheet Piles and Bulkheads in Granular and Cohesive Soils</b>				
<b>Sheet Piles and Bulkheads in Granular and Cohesive Soils</b> - Materials Used for Sheet Piles – Free Earth and Fixed earth Support Methods, coffer dam						
<b>10 Brief Description of self learning / E-learning component</b> The students will be encouraged to learn using the SGT e-Learning portal and choose the relevant lectures delivered by subject experts of SGT University. The link to the E-Learning portal. <a href="https://elearning.sgtuniversity.ac.in/course-category/">https://elearning.sgtuniversity.ac.in/course-category/</a> Journal papers; Patents in the respective field.						

## **11Books Recommended**

### **Text Books**

1. . E. Bowels, “Foundation Analysis and Design”, Mc Graw Hill Companies, 1997
2. B. M. Das, “Foundation engineering”, Cengage Learning, 2007

### **Referance books**

1. Gulhati, K. Shashi and M. Datta, “Geotechnical engineering”, Mc.Graw Hill book company, 2005

1 Name of the Department		CIVIL ENGINEERING				
2 Subject Name	Design of pavements	L	T		P	
3 Subject Code	13160303	3	0		0	
4 Type of Subject (use tick mark)		Core (√)	PE()		OE()	
5 Pre-requisite (if any)	Nil	1. Frequency (use tick marks)	Even ()	Odd (√)	Either Sem (√)	Every Sem ()
6 Total Number of Lectures, Tutorials, Practical (assuming 14 weeks of one semester)						
Lectures = 36		Tutorials =		Practical		
<b>Brief Syllabus:</b>						
Pavement design includes the pavement properties and types, design of flexible and rigid pavement, pavement evaluation and rehabilitation and stabilization of soil for road construction						
<b>7 Learning objectives:</b>						
1. To teach the concepts of traffic studies, traffic facilities and their regulations and management. 2. To understand the methods for efficient management of traffic in urban roads.						
<b>8 Subject Outcomes:</b>						
On completion of this course, the students will be able to 1. Perform traffic studies. 2. Know importance of traffic management. 3. Identify the specification of traffic facilities.						
<b>9 Unit wise detailed content</b>						
Unit-1	Number of lectures = 10	Title of the unit: Basic Concepts of Pavement				
<b>Basic Concepts</b>						
Pavements types – Approaches to pavement design – vehicle and traffic considerations – behaviour of road materials under repeated loading – Stresses and deflections in layered systems.						
Unit – 2	Number of lectures = 11	Title of the unit: Flexible Pavement				
<b>Flexible Pavement</b>						
Material characterization for analytical pavement design – CBR and stabilometer tests – Resilient modulus – Fatigue subsystem – failure criteria for bituminous pavements – IRC design guidelines.						
Unit – 3	Number of lectures = 10	Title of the unit: Rigid Pavement				
<b>Rigid Pavement</b>						
Design procedures for rigid pavement – IRC guidelines – Airfield pavements. Highway pavement – CRC pavements.						
Unit – 4	Number of lectures = 05	Title of the unit: Stabilization of Soils For Road Constructions				
<b>Stabilization of Soils for Road Constructions</b>						
The need for a stabilized soil – Design criteria and choice of stabilizers – Testing and field control – Stabilisation in India for rural roads – Use of geofabrics in unpaved road construction. Case studies.						
<b>10 Brief Description of self-learning / E-learning component</b>						
The students will be encouraged to learn using the SGT E-Learning portal and choose the relevant lectures delivered by subject experts of SGT University.						

## **11 Books Recommended**

### **Text Books**

1. Wright, P.H., Highway Engineers, John Wiley & Sons, Inc., New York, 1996
2. Khanna S.K and Justo C.E.G, Highway Engineering, New Chand and Brothers, Roorkee, 1998
3. Croney, D., Design and Performance of Road Pavements, HMO Stationary Office, 1979.

### **Reference books**

1. Design and Specification of Rural Roads (Manual), Ministry of rural roads, Government of India, New Delhi, 2001
2. Yoder R.J and Witchak M.W., Principles of Pavement Design, John Wiley, 2000.
3. Guidelines for the Design of Flexible Pavements, IRC:37 - 2001, The Indian roads Congress, New Delhi.
4. Guideline for the Design of Rigid Pavements for Highways, IRC:58-1998, The Indian Roads Congress, New Delhi.



<b>1 Name of the Department</b>		<b>CIVIL ENGINEERING</b>				
<b>2 Subject Name</b>	<b>Computer application in engineering Lab</b>	<b>L</b>	<b>T</b>		<b>P</b>	
<b>3 Subject Code</b>	13160304	0	0		2	
<b>4 Type of Subject (use tick mark)</b>		Core (√)		OE()		
<b>5 Pre-requisite (if any)</b>	Nil	<b>1. Frequency (use tick marks)</b>		Even ()	Odd (√)	Either Sem () Every Sem ()
<b>6 Total Number of Lectures, Tutorials, Practical</b>						
<b>Lectures = 00</b>		<b>Tutorials =00</b>		<b>Practical =00</b>		
<b>Detailed Syllabus:</b> ETABS for the Analysis and Design of various foundation Components of Civil Engineering						
<b>8 Course Outcomes:</b> Complete understanding of foundation systems						
<b>Detailed Content</b>						
1-Analysis and design of concrete footing						
2-Steel footing						
3-Raft foundation						
4-Pile cap						
5-Pile foundation						
6-Analysis of footing when soil soft						
7-Analysis of footing when soil soft						
8-Analysis of footing when soil soft						
9 – Composite footing						
10- Reinforcement Detailing of foundations						

<b>1 Name of the Department</b>		<b>CIVIL ENGINEERING</b>				
<b>2 Subject Name</b>	<b>Identification of Research Problem</b>	<b>L</b>	<b>T</b>		<b>P</b>	
<b>3 Subject Code</b>	13160305	0	0		4	
<b>4 Type of Subject (use tick mark)</b>		<b>Core (√)</b>		<b>OE()</b>		
<b>5 Pre-requisite (if any)</b>	Nil	<b>2. Frequency (use tick marks)</b>		Even ()	Odd (√)	Either Sem () Every Sem ()
<b>6 Total Number of Lectures, Tutorials, Practical</b>						
<b>Lectures = 00</b>		<b>Tutorials =00</b>		<b>Practical =48</b>		
<p><b>Detailed Syllabus:</b> Students are required to search, collect and review various research articles published in chosen area of research and identifying research Problems. A student must analyze research related problems, based on geotechnical engineering research area.</p>						
<p><b>8 Course Outcomes:</b></p> <ol style="list-style-type: none"> <li>1. Identify topics in thrust areas of Geotechnical engineering.</li> <li>2. Take up critical review of literature on the chosen topic.</li> <li>3. Carry out independent research work on the topic by experimental / analytical approaches.</li> <li>4. Document and present the results of research problems</li> </ol>						

# **Fourth Semester**

<b>1 Name of the Department</b>		<b>CIVIL ENGINEERING</b>				
<b>2 Subject Name</b>	Dissertation	<b>L</b>	<b>T</b>		<b>P</b>	
<b>3 Subject Code</b>	13160401	0	0		36	
<b>4 Type of Subject (use tick mark)</b>		Core (√)			OE()	
<b>5 Pre-requisite (if any)</b>	Nil	<b>3. Frequency (use tick marks)</b>	Even (√)	Odd ()	Either Sem ()	Every Sem ()
<b>6 Total Number of Lectures, Tutorials, Practical</b>						
<b>Lectures = 00</b>		<b>Tutorials =00</b>		<b>Practical</b>		
<p><b>Detailed Syllabus:</b> Students are required to search, collect and review various research articles published in chosen area of research. A student must select a topic for his dissertation, based on his/her interest. A student shall be required to submit a dissertation report on the research work carried out by him/her.</p>						
<p><b>8 Course Outcomes:</b></p> <ol style="list-style-type: none"> <li>1. Identify topics in the areas of Geotechnical engineering.</li> <li>2. Take up critical review of literature on the chosen topic.</li> <li>3. Carry out independent research work on the topic by experimental / analytical approaches.</li> <li>4. Document and present the results of research work.</li> </ol>						

**Reading:**

1. Journal Publications
2. Conference/ Seminar Proceedings
3. Handbooks/ Research Digests
4. Research articles on internet

# **Elective I**

<b>1. Name of the Department</b>		<b>CIVIL ENGINEERING</b>				
<b>2. Subject Name</b>	<b>Earth and Rock-fill Dam</b>	<b>L</b>	<b>T</b>	<b>P</b>		
<b>3. Subject Code</b>	13160126	3	0	0		
<b>4. Type of Subject</b>		<b>Core ()</b>	<b>PE-I (√)</b>		<b>OE()</b>	
<b>5. Pre-requisite (if any)</b>		<b>6. Frequency (use tick marks)</b>	Even (	Odd (√))	Either Sem () Every Sem ()	
<b>7. Total Number of Lectures, Tutorials, Practical</b>						
<b>Lectures = 37</b>		<b>Tutorials = 00</b>		<b>Practical = 00</b>		
<b>8. Learning objectives:</b>						
1. To analyze seepage through a given earth/rockfill dam section and select effective seepage control measures for the prevailing site conditions.						
2. To study and analyze stability of slopes and evaluate the failure criteria.						
<b>Subject Outcomes:</b> On completion of this course, the students will be able to						
1. Select a suitable site, materials and equipment for construction of earth/rockfill dams						
2. Design earth and rock fill dams.						
<b>9. Unit wise detailed content</b>						
<b>Unit-1</b>	<b>Number of lectures = 07</b>	<b>Title of the unit: Introduction of dams</b>				
<b>Introduction :</b> Classification of dams- Selection of Site-Basic design requirements Preliminary section.						
<b>Unit – 2</b>	<b>Number of lectures = 10</b>	<b>Title of the unit: Seepage through dam section and foundation</b>				
<b>Seepage through dam section and control :</b> fundamentals of seepage flow, flow nets, seepage through dam section and foundation, seepage control filters, Impervious core, drainage.						
<b>Control of seepage through foundation:</b> types of foundations trench cutoff, upstream impervious blanket, horizontal drainage blanket , relief wells, drainage trenches, cut-off walls, downstream loading berm.						
<b>Unit – 3</b>	<b>Number of lectures = 10</b>	<b>Title of the unit: Foundation treatment and Stability analysis</b>				
<b>Foundation treatment:</b> treatment of pervious, impervious and rock foundations, core contact treatment, grouting, foundation excavation.						
<b>Stability analysis:</b> critical slip surfaces, test conditions, strength parameters, pore pressures, stability analysis-method of slices						
<b>Unit – 4</b>	<b>Number of lectures = 10</b>	<b>Title of the unit: Construction and failure in dams</b>				
<b>Construction of earth dams:</b> construction equipment, procedures for pervious, semi pervious, impervious and rock fill sections, construction supervision.						
<b>Failures and damages of earth dams:</b> nature of failures – piping, settlement cracks, slides, earthquake & miscellaneous damages –case studies.						
<b>10. Brief Description of self learning / E-learning component</b>						

The students will be encouraged to learn using the SGT e-Learning portal and choose the relevant lectures delivered by subject experts of SGT University.

The link to the E-Learning portal.

<https://elearning.sgtuniversity.ac.in/course-category/>Journal papers; Patents in the respective field.

### **11. Books Recommended**

#### **Text Books**

1. Sherard, et.al., "EARTH AND ROCK DAMS", John Wiley Inc., 1963.
2. H. D. Sharma, "Embankment dams", Oxford and IBH Publishing Co., 1991

#### **Reference Books**

1. Bharath Singh and R. S. Varshney, "engineering for embankment dams" A. A. Balekema publications, 1995.

<b>1 Name of the Department</b>		<b>CIVIL ENGINEERING</b>				
<b>2 Subject Name</b>	<b>Computational Methods in Geotechnical Engineering</b>	<b>L</b>	<b>T</b>		<b>P</b>	
<b>3 Subject Code</b>	13160127	3	0		0	
<b>4 Type of Subject (use tick mark)</b>		<b>Core ()</b>	<b>PE-1(√)</b>		<b>OE()</b>	
<b>5 Pre-requisite (if any)</b>	Nil	<b>Frequency (use tick marks)</b>	Even ()	Odd (√)	Either Sem (√)	Every Sem ()
<b>6 Total Number of Lectures, Tutorials, Practical (assuming 14 weeks of one semester)</b>						
<b>Lectures = 36</b>		<b>Tutorials = 0</b>		<b>Practical =00</b>		
<b>Brief Syllabus:</b> This course imparts the student's knowledge of solution of non-linear equations, solution of ODE using numerical techniques.						
<b>7 Learning objectives:</b> To develop the understanding of computational methods in geotechnical engineering.						
<b>8 Subject Outcomes:</b> Upon completion of the study of the subject, the student should be able to 1. Solve linear and non-linear equations using numerical techniques. 2. Apply the basic concepts of tensor algebra and calculus in continuum mechanics problems 3. Apply finite difference and finite element method for analyzing behavior of geotechnical structures 4. Apply the basic concepts of critical state soil mechanics for constitutive modeling in Geomechanics						
<b>9 Unit wise detailed content</b>						
<b>Unit-1</b>	<b>Number of lectures = 08</b>	<b>Title of the unit: Solution of Non-linear Equations</b>				
Solution of Non-linear Equations: Bisection, False Position, Newton-Raphson, Successive approximation method, Iterative methods.						
<b>Unit – 2</b>	<b>Number of lectures =09</b>	<b>Title of the unit: Solution of set of Linear Equations</b>				
Solution of set of Linear Equations: Jacobi's method, Gauss Seidal method, Successive over relaxation method.						
<b>Unit – 3</b>	<b>Number of lectures = 10</b>	<b>Title of the unit: Solution of ODE using numerical techniques:</b>				
Solution of ODE using numerical techniques: Initial value problems and boundary value problems; Taylor series method, Picard's method, Euler's method, Runge-Kutta method The continuum theory of Soil Mechanics, methodology of continuum mechanics, introduction to tensor algebra and tensor calculus, deformation and strain, traction and stress						
<b>Unit – 4</b>	<b>Number of lectures = 09</b>	<b>Title of the unit: Finite Difference Method</b>				
Finite Difference Method: Boundary value and Initial value problems – Disichlet conditions, Neumann conditions; ordinary and partial differential equations; Nonlinear problems Introduction to Finite Element Method: Formulation of weak form, interpolation functions  Constitutive modelling of soil: Critical state soil mechanics; Elastic-plastic constitutive models; Original Cam-Clay model and Modified Cam-Clay model						
<b>10 Brief Description of self-learning / E-learning component</b> The students will be encouraged to learn using the SGT E-Learning portal and choose the relevant lectures delivered by subject experts of SGT University.						



## **11 Books Recommended**

### **Text Books**

1. S. Chandrakant., Desai and John T. Christian, “Numerical Methods in Geotechnical Engineering”, Mc. Graw Hill Book Company, 1977.
2. M.K. Jain, S.R.K. Iyengar and R.K. Jain, “Numerical Methods for Scientific and Engineering computations”, Third edition, New Age International (P) Ltd. Publishers, New Delhi. 2010.

### **Referance books**

1. D.J. Naylor and G.N. Pande, “Finite Elements in Geotechnical Engineering”, Pineridge Press Ltd., UK. 1981
2. Sam Helwany, “Applied Soil Mechanics with ABAQUS Applications”, John Wiley & sons, Inc, USA, 2007.
3. Alexander Puzrin, "Constitutive Modelling in Geomechanics: Introduction", Springer, 2012

<b>1. Name of the Department</b>		<b>CIVIL ENGINEERING</b>			
<b>2. Subject Name</b>	<b>Strength and Deformation Behavior of soil</b>	<b>L</b>	<b>T</b>	<b>P</b>	
<b>3. Subject Code</b>	13160128	3	0	0	
<b>4. Type of Subject</b>		<b>Core ()</b>	<b>PE-I(√)</b>		<b>OE()</b>
<b>5. Pre-requisite (if any)</b>		<b>Frequency (use tick marks)</b>	Even ( )	Odd (√)	Either Sem ( ) Every Sem ( )
<b>6. Total Number of Lectures, Tutorials, Practical</b>					
<b>Lectures = 36</b>		<b>Tutorials = 00</b>	<b>Practical =00</b>		
<b>7. Brief Syllabus:</b> This subject includes the strength characteristics and different types of fine and coarse soils and their deformation behavior					
<b>Learning objectives:</b>					
1. To understand the strength behavior of soils.					
2. To know the different concepts for the analysis of failure behavior of soil.					
3. To identify the failure pattern of soil					
<b>Subject Outcomes:</b> On completion of this course, the students will be able to					
1. Identify the method of shear strength determination.					
2. Understand the importance of various shear parameter and deformation behavior of various soils.					
<b>8. Unit wise detailed content</b>					
<b>Unit-1</b>	<b>Number of lectures = 09</b>	<b>Title of the unit:</b> <b>Shear strength of cohesion less soils</b>			
<b>Shear strength of cohesion less soils:</b> Shear strength of granular soils - Direct shear - Triaxial Testing- Drained and undrained Stress strain behaviour - Dilation, contraction and critical states - Liquefaction on saturated sands. Factors influencing stress-strain shear strength.					
<b>Unit - 2</b>	<b>Number of lectures = 09</b>	<b>Title of the unit:</b> <b>Shear strength of cohesive soils</b>			
<b>Shear strength of cohesive soils:</b> Shear strength of clays - Stress-strain behaviour - Triaxial testing and stress path plotting - pore pressure parameter of Skempton and Henkel - Total stress and effective stress approach - shear strength of partially saturated clay in terms of stress state variables. Factors influencing stress strain shear strength.					
<b>Unit - 3</b>	<b>Number of lectures = 08</b>	<b>Title of the unit:</b> <b>Yield criterion</b>			
<b>Yield criterion:</b> Concepts of yield and failure in soils- yield criteria of von Mises, Tresca and their extended form, their applicability to soils - Detailed discussion of Mohr. - Coulomb failure criterion					
<b>Unit - 4</b>	<b>Number of lectures = 10</b>	<b>Title of the unit:</b> <b>Stress - strain laws for soils</b>			
<b>Stress - strain laws for soils:</b> Stress-strain laws for soils - hyperbolic law - Linear visco-elastic and Elasto -plastic laws - yield functions, hardening law, flow rules and plastic strain computation - Rheological models of Kelvin, Maxwell and Burger and Burger as applied to soils.					
<b>9. Brief Description of self learning / E-learning component</b>					
The students will be encouraged to learn using the SGT e-Learning portal and choose the relevant lectures delivered by subject experts of SGT University.					
The link to the E-Learning portal. <a href="https://elearning.sgtuniversity.ac.in/course-category/">https://elearning.sgtuniversity.ac.in/course-category/</a> Journal papers; Patents in the respective field.					
<b>10. Books Recommended</b>					

**Text Books**

1. Hotlz, R.D and Kovacs, W.D., Introduction Geotechnical Engineering, Prentice-Hall, 1981
2. Braja, M, Das., Advanced soil mechanics, McGraw Hill, 1997.
3. Lambe, T.W. and Whitman R.V. Soil Mechanics in S.I. Units John Wiley, 1979.

**Reference Books**

1. Atkinson J.H. and BrandsbyP.L. Introduction to critical state soil mechanics McGraw Hill, 1978.
2. Wood, D.M., Soil behaviour and Critical State Soil Mechanics, Cambridge University Press, New York, 1990.
3. Bazant, Z.P., Mechanics of Geo-materials, Rocks, Concrete and Soil, John Willey and Sons, Chilchester, 1985.
4. Graham Barnes, Soil Mechanics Principles and Practices, Macmillan Press Ltd., London, ISBN 0-333-77776x - 2002.
5. Shear Strength of Liquefied Soils, Final Proceedings of the workshop, National Science Foundation, Urbane, Illinois, July 1998.

<b>1. Name of the Department</b>		<b>CIVIL ENGINEERING</b>				
<b>2. Subject Name</b>	<b>Advanced Surveying and Cartography</b>	<b>L</b>	<b>T</b>		<b>P</b>	
<b>3. Subject Code</b>	13160129	3	0		0	
<b>4. Type of Subject (use tick mark)</b>		<b>Core ()</b>	<b>PE-II(√)</b>		<b>OE()</b>	
<b>5. Pre-requisite (if any)</b>	nil	<b>Frequency (use tick marks)</b>	Even ()	Odd (√)	Either Sem ()	Every Sem ()
<b>6. Total Number of Lectures, Tutorials, Practical (assuming 14 weeks of one semester)</b>						
<b>Lectures = 37</b>		<b>Tutorials = 00</b>		<b>Practical</b>		
<b>Brief Syllabus:</b> Students will learn the concept of advanced Surveying						
<b>7. Learning objectives:</b> 1. To teach the students about the <b>Triangulation and Trilateration</b> 2. To enable the students to understand the <b>Photogrammetry and Remote Sensing</b>						
<b>8. Subject Outcomes:</b> On completion of this course, the students will be able to 1. Understand the concept of advanced surveying 2. Understanding the concept of field survey and field astronomy.						
<b>9. Unit wise detailed content</b>						
<b>Unit-1</b>	<b>Number of lectures = 10</b>	<b>Title of the unit: Triangulation ,Trilateration and Adjustment Computations</b>				
<b>Triangulation and Trilateration :</b> Necessity of Control Surveying, Principle of Triangulation and Trilateration classification of Triangulation Systems Station Marks, Towers and Signals, Satellite station, Intersected and Resected points, Reconnaissance, Intervisibility of stations, Angular Measurement, Base line measurement and its extension  <b>Adjustment Computations:</b> Treatment of random errors, Normal law of errors, Most Probable Value, Weight of observations, Propagation of errors and variances, Principle of Least Squares, Observations and correlative Normal Equations, Adjustment of triangulation figures and level nets.						
<b>Unit - 2</b>	<b>Number of lectures = 11</b>	<b>Title of the unit: Curves and project survey</b>				
<b>Curves:</b> Classification of curves, Elements of Simple Circular, Transition and Vertical curves, Theory and methods of setting out circular, transition and vertical curves, special field problems.  <b>Project Surveys:</b> General requirements and specifications for Engineering project surveys, Reconnaissance, Preliminary and Location surveys for highways, railways and canals, Correlation of surface and underground surveys in case of culverts, Bridges and Tunnels; Principles and practice of hydrographic surveys, Layout of culverts, canals, bridges and buildings.						
<b>Unit - 3</b>	<b>Number of lectures = 10</b>	<b>Title of the unit: Field Astronomy:</b>				

**Field Astronomy:** Astronomical terms, co-ordinate systems, Spherical trigonometry, Astronomical triangle, Relationship between coordinates.

**Unit – 4**

**Number of lectures = 05**

**Title of the unit:  
Photogrammetry ,Remote Sensing,GPS and GIS**

**Photogrammetry and Remote Sensing:** Photogrammetry-Introduction, Scale of photograph, Tilt and height displacement, Stereoscopic vision and stereoscopes, Techniques of photo-interpretation, Principles of remote sensing, Electro Magnetic Radiation (EMR), energy interaction with atmosphere and earth features, spectral signatures, Remote sensing satellites and their data products, methods of interpretation of remotely sensed data.

**GPS and GIS:**Global Positioning System (GPS)-Introduction, principle, and applications of GPS in different fields of Surveying, Geographic Information System (GIS) – Introduction, Geographical concepts and terminology, Applications of GIS

#### **10. Brief Description of self learning / E-learning component**

The students will be encouraged to learn using the SGT e-Learning portal and choose the relevant lectures delivered by subject experts of SGT University.

The link to the E-Learning portal.

<https://elearning.sgtuniversity.ac.in/course-category/>Journal papers; Patents in the respective field.

#### **11. Books Recommended**

##### **Text Books**

- 1 Agor, R., “Surveying”, Vol. II & III, Khanna Publications, Delhi, 1995.
2. Arora, K.R., “Surveying”, Vol. II & III, Standard Book House, Delhi. Bannister, A. And Baker, R., “Solving Problems in 3 Surveying, “Longman Scintific Technical, U.K., 1994. .
5. Punmia, B.C., “Surveying”, Vol.II & III Laxmi Publications,New Delhi.

##### **Referance books**

1. Duggal S.K., Surveying Vol. I & II TMH Basak, Surveying TMH. Kanetkar, Surveying Chandra, A.M. “Plane Surveying”, New Age International Publisher,
2. Cromley .R. G, “Digital Cartography”. Prentice-Hall of India, New Delhi, 1992.
3. Dent, B. D., “Cartography – Thematic Map Design”,. 5th” Edition, W C B McGraw-Hill, Boston, 1999.
4. Rampal .K.K, “Mapping and Compilation”. Concept Publishing Co.,New Delhi, 1993.

# **Elective II**

<b>1. Name of the Department</b>		<b>CIVIL ENGINEERING</b>				
<b>2. Subject Name</b>	<b>Tunnel Technology</b>	<b>L</b>	<b>T</b>	<b>P</b>		
<b>3. Subject Code</b>	13160232	3	0	0		
<b>4. Type of Subject</b>		<b>Core ()</b>	<b>PE-II(√)</b>		<b>OE()</b>	
<b>5. Pre-requisite (if any)</b>	nil	<b>Frequency (use tick marks)</b>	Even()	Odd (√)	Either Sem ()	Every Sem ()
<b>6. Total Number of Lectures, Tutorials, Practical</b>						
<b>Lectures = 37</b>		<b>Tutorials =00</b>		<b>Practical = 00</b>		
<b>7. Brief Syllabus:</b> Understanding the methods of tunnel driving, tunnel on different types of rocks , tunneling methods and numerical analysis of tunneling.						
<b>8. Learning objectives:</b>						
1. To select the specific method of tunnel driving for a given ground condition						
2. To identify possible difficulties in different ground conditions.						
<b>Subject Outcomes:</b> On completion of this course, the student will be able to						
1. Design tunnel excavation methods.						
2. Select suitable tunnel support systems and its design.						
<b>9. Unit wise detailed content</b>						
<b>Unit-1</b>	<b>Number of lectures = 09</b>	<b>Title of the unit: Tunnels in Soils and Rocks</b>				
<b>Tunnels in Soils and Rocks:</b> Benefits of tunnelling, Tunnels for different purposes, Site investigation and geophysical methods adopted for tunneling purposes, Rock rating and classification, Instrumentation on tunnels						
<b>Unit - 2</b>	<b>Number of lectures = 09</b>	<b>Title of the unit: Tunnelling methods</b>				
<b>Tunnelling methods:</b> Drill and blast method, Tunnel boring machine, NATM, Shield tunnelling, Earth pressure method, Application of compressed air						
<b>Unit - 3</b>	<b>Number of lectures = 10</b>	<b>Title of the unit: Tunnel lining and supports</b>				
<b>Tunnel lining and supports:</b> Different types of support measures adopted in tunnelling, Analysis of stresses on the tunnel lining, Design of tunnel lining and support measures						
<b>Unit - 4</b>	<b>Number of lectures = 09</b>	<b>Title of the unit: Tunneling Mechanics</b>				
<b>Tunnelling Mechanics:</b> Behaviour of soils and rocks, Stress and deformation fields around tunnels, Analytical equations used and derivations, Stability problems in tunnels						
<b>10. Brief Description of self learning / E-learning component</b>						
The students will be encouraged to learn using the SGT e-Learning portal and choose the relevant lectures delivered by subject experts of SGT University.						
The link to the E-Learning portal.						
<a href="https://elearning.sgtuniversity.ac.in/course-category/">https://elearning.sgtuniversity.ac.in/course-category/</a> Journal papers; Patents in the respective field.						

## **11. Books Recommended**

### **1 Text Books**

1. D. Kolymbas, "Tunnelling and Tunnel Mechanics", A rational approach to tunnelling, Springer, 2005

### **Reference Books**

1. B. Singh and R. K. Goel, "Tunelling through weak rocks", Elsevier, 2006



<b>1. Name of the Department</b>		<b>CIVIL ENGINEERING</b>				
<b>2. Subject Name</b>	<b>Advanced Pavement Material</b>	<b>L</b>	<b>T</b>		<b>P</b>	
<b>3. Subject Code</b>	13160233	3	0		0	
<b>4. Type of Subject</b>		<b>Core ()</b>	<b>PE-II(√)</b>		<b>OE()</b>	
<b>5. Pre-requisite (if any)</b>	nil	<b>Frequency (use tick marks)</b>	Even ()	Odd (√)	Either Sem ()	Every Sem ()
<b>6. Total Number of Lectures, Tutorials, Practical</b>						
<b>Lectures = 36</b>		<b>Tutorials = 00</b>		<b>Practical =00</b>		
<b>7. Learning objectives:</b>						
1. To understand the properties of different paving materials						
2. To study the behavior of bituminous binder and modified binder as per their use in pavement layer						
<b>Subject Outcomes:</b> On completion of this course, the students will be able to						
1. Understand the behavior of various material used in construction of pavement design						
2. student able to understand Requirements of paving concrete, design of mixes						
<b>8. Unit wise detailed content</b>						
<b>Unit-1</b>	<b>Number of lectures = 08</b>	<b>Title of the unit: Introduction</b>				
<b>Introduction</b> -Subgrade functions, Importance of subgrade soil properties on pavement performance. Identification and significance of soil characteristics, Soil classification, Effect of water on swelling and shrinkage, Cohesion and Plasticity						
<b>Unit – 2</b>	<b>Number of lectures = 09</b>	<b>Title of the unit: Road making aggregates</b>				
<b>Road making aggregates</b> – Classification, Properties of aggregates, design of aggregate gradation, texture, polishing and skid resistance						
<b>Unit – 3</b>	<b>Number of lectures = 09</b>	<b>Title of the unit: Bituminous road binders</b>				
<b>Bituminous road binders</b> – Straight- run bitumen, emulsions, Cutback and modified binders. Rheology of bituminous binders						
<b>Unit – 4</b>	<b>Number of lectures = 10</b>	<b>Title of the unit: modified binders and Requirements of paving concrete, design of mixes</b>				
<b>modified binders</b> – Adhesion and stripping, penetration index, viscosity, temperature susceptibility of viscosity. Additives and their suitability, Fillers. Design of Bituminous mixes – Marshall method and super paves procedure.						
<b>Requirements of paving concrete, design of mixes</b> – IRC, absolute volume, Vibrated Concrete mix design, design of DLC and SFRC mixes, Soilstabilization techniques. CBR Test						
<b>9. Brief Description of self learning / E-learning component</b>						
The students will be encouraged to learn using the SGT e-Learning portal and choose the relevant lectures delivered by subject experts of SGT University.						
The link to the E-Learning portal.						
<a href="https://elearning.sgtuniversity.ac.in/course-category/">https://elearning.sgtuniversity.ac.in/course-category/</a> Journal papers; Patents in the respective field.						
<b>10. Books Recommended</b>						

**Text Books**

1. Papagiannakis A. T., Masad Eyad, "Pavement design and materials", John Wiley & Sons.

**Reference Books**

1. Athanassios Nikolaides, "Highway Engineering: Pavements, Materials and Control of Quality", CRC Press.

<b>1. Name of the Department</b>		<b>CIVIL ENGINEERING</b>				
<b>2. Subject Name</b>	<b>Planning and Design of Low Volume Roads</b>	<b>L</b>	<b>T</b>		<b>P</b>	
<b>3. Subject Code</b>	13160234	3	0		0	
<b>4. Type of Subject</b>		<b>Core ()</b>	<b>PE-II(√)</b>		<b>OE()</b>	
<b>5. Pre-requisite (if any)</b>	Nil	<b>Frequency (use tick marks)</b>	Even ( )	Odd (√)	Either Sem (√)	Every Sem ( )
<b>6. Total Number of Lectures, Tutorials, Practical</b>						
<b>Lectures = 36</b>		<b>Tutorials = 00</b>		<b>Practical = 00</b>		
<b>Brief Syllabus:</b>						
Planning and Design of Low Volume Roads is a prominent aspect of surface transport and deals with planning, design, construction, operation and maintenance of all types of low volume roads. design of Highway Engineering.						
<b>7. Learning objectives:</b>						
1. To impart the knowledge in Highway Geometrics, materials, construction methods and design of different type of pavements along with design of base course and sub-base course.						
<b>8. Subject Outcomes:</b>						
1. Design various geometric elements of low volume road.						
2. Understand the various types of materials used in road construction along with conducting specified test on the materials as per BSI code for their suitability.						
3. Perform structural design of pavements.						
4. Know various road constructions techniques and its maintenance						
<b>9. Unit wise detailed content</b>						
<b>Unit-1</b>	<b>Number of lectures =08</b>	<b>Title of the unit: Planning of Low volume roads</b>				
<b>Planning of Low volume roads:</b> Introduction to planning of low volume roads, concepts of network planning, selection of roadway alignment, factors affecting rout selection, engineering surveys for new road location.						
<b>Unit – 2</b>	<b>Number of lectures = 8</b>	<b>Title of the unit: Geometric design parameters</b>				
<b>Geometric design parameters:</b> basic principles of geometric design, design of horizontal alignment, curves, super elevation, design of vertical alignment, summit curve, and vally curve standard of design of low volume road.						
<b>Unit – 3</b>	<b>Number of lectures =10</b>	<b>Title of the unit: Material</b>				
<b>Materials:</b> Road materials for pavement construction, soil-subgrade, road aggregate, binder, test on soil, test on aggregates and test on bitumen, bituminous mix design, marshal stability method for mix design.						
<b>Unit - 4</b>	<b>Number of lectures = 10</b>	<b>Title of the unit: Pavement design and road construction</b>				
<b>Design of pavement:</b> Factors affecting pavement design function of pavement components, design of flexible pavement by GI method, CBR method, burmister layer. Design of rigid pavement by using IRC method.						

**Road construction:** Specifications of material and construction of sub grade, subbase, base and surface layer, construction of non bituminous road, construction of bituminous roads, equipment required for construction, maintenance of low volume roads

**10. Brief Description of self learning / E-learning component**

The students will be encouraged to learn using the SGT e-Learning portal and choose the relevant lectures delivered by subject experts of SGT University.

The link to the E-Learning portal.

<https://elearning.sgtuniversity.ac.in/course-category/>Journal papers; Patents in the respective field.

**11. Books Recommended**

**Text books**

1. A. Veeraragavan, S.K Khanna and C.E.G. Justo, Highway Engineering, Nem Chand & Brothers, 2014.
2. Bruton, M. J., Introduction to Transportation Planning, UCL press, London, UK, 1992.
3. Ethiopian Roads Authority, Design Manual for Low Volume Roads

**Reference books**

1. Gordon Keller & James Sherar, Low-Volume Roads Engineering: Best Management Practices – Field Guide, USDA Forest Service/USAID, 2003. 27
2. Roger L. Brockenbrough, Highway Engineering Handbook

<b>1 Name of the Department</b>		<b>CIVIL ENGINEERING</b>				
<b>2 Subject Name</b>	<b>Mechanics of unsaturated soils</b>	<b>L</b>	<b>T</b>		<b>P</b>	
<b>3 Subject Code</b>	13160235	3	0		0	
<b>4 Type of Subject (use tick mark)</b>		<b>Core ()</b>	<b>PE-II(√)</b>		<b>OE()</b>	
<b>5 Pre-requisite (if any)</b>	Nil	<b>Frequency (use tick marks)</b>	Even ()	Odd (√)	Either Sem (√)	Every Sem ()
<b>6 Total Number of Lectures, Tutorials, Practical (assuming 14 weeks of one semester)</b>						
<b>Lectures = 36</b>		<b>Tutorials =</b>	<b>Practical</b>			
<b>Brief Syllabus:</b>						
This course contains the state of unsaturated soil, Physics of soil water system, stress state variable and shear strength, steady and transient flow						
<b>7 Learning objectives:</b>						
1. Study mechanics involve in unsaturated soil and soil water system						
2. Mechanism of soil water system with different flow conditions						
<b>8. Subject Outcomes:</b>						
On completion of this course, the students will be able to						
1. Identify the characteristics of unsaturated soil.						
2. Analyses stress state variable, shear strength characteristics and steady and transient flow in soil.						
<b>9 Unit wise detailed content</b>						
<b>Unit-1</b>	<b>Number of lectures = 8</b>	<b>Title of the unit: State of unsaturated soil</b>				
<b>State of unsaturated soil</b>						
Definition – Interdisciplinary nature of unsaturated soil – soil classification – Nature and practice – stress profiles, stress state variables - material variables –constitutive law – suction potential of soil water						
<b>Unit - 2</b>	<b>Number of lectures = 9</b>	<b>Title of the unit: Physics of soil water system</b>				
<b>Physics of soil water system</b>						
Physical properties of Air and water – partial pressure and relative Humidity Density of moist air – surface Tension – cavitations of water. Solubility of Air in water – Air –water solid interface – vapor pressure lowering – soil water characteristic-curve. Capillary tube model – contacting sphere model. Young Laplace equation – Height of capillary rise – Rate of capillary rise – capillary pore size distribution – theoretical basis – determination – laboratory method.						
<b>Unit - 3</b>	<b>Number of lectures = 9</b>	<b>Title of the unit: Stress state variables and shear strength</b>				
<b>Stress state variables and shear strength</b>						
Effective-stress – stress between two spherical particles – Hysteresis in SWCC –stress parameter, stress tensor – stress control by Axis Translation – analytical representation of stress – volume change characteristics. Extended Mohr – Coulomb criterion – shear strength parameters – Interpretation of Direct shear test results and Tri axial test results – unified representation of failure envelope – Influence of suction in earth pressure distribution.						
<b>Unit - 4</b>	<b>Number of lectures = 08</b>	<b>Title of the unit: Steady and transient flows</b>				

**Steady and transient flows**

Driving mechanism – Permeability and Hydraulic conductivity – capillary barriers –steady infiltration and evaporation – Vapor flow – Air diffusion in water. Principles for pore liquid flow – Rate of infiltration, Transient suction and moisture profiles. Principles for Pore Gas flow – Barometric pumping Analysis. models.

**10 Brief Description of self-learning / E-learning component** The students will be encouraged to learn using the SGT E-Learning portal and choose the relevant lectures delivered by subject experts of SGT University.

**11 Books Recommended****Text Books**

1. Fredlund, D.G. and Rahardjo, H. Soil Mechanics for unsaturated soils, John Wiley & Sons, INC, New York.2003.
2. Ning Lu and William, J. Likes, Unsaturated Soil Mechanics, John Wiley &sons, INC. New Jersey, 2004

**Referance books**

1. Ng Charles, W.W., Menzies Bruce, Advanced unsaturated Soil Mechanism and Engineering, Taylor & Francis Group, 2007.
2. Ning Lu, Laureano R. Hoyes and Lakshmi Reddi, Advances in unsaturated soil, seepage and Environmental Geotechnics, ASCE., Geotechnical special publication No.148.

# **Elective-III**

<b>1. Name of the Department</b>		<b>CIVIL ENGINEERING</b>			
<b>2. Subject Name</b>	<b>Construction Methods and Equipments</b>	<b>L</b>	<b>T</b>	<b>P</b>	
<b>3. Subject Code</b>	13160322	3	0	0	
<b>4. Type of Subject</b>		<b>Core ()</b>	<b>PE-III(√)</b>		<b>OE()</b>
<b>5. Pre-requisite (if any)</b>		<b>Frequency (use tick marks)</b>	Even (√)	Odd ()	Either Sem (√) Every Sem ()
<b>6. Total Number of Lectures, Tutorials, Practical</b>					
<b>Lectures = 37</b>		<b>Tutorials = 00</b>		<b>Practical = 00</b>	
<b>7. Learning objectives:</b>					
1. To create an awareness in Engineers about construction methods and equipment's 2. To understand the modern materials used in modern construction					
<b>Subject Outcomes:</b> On completion of this course, the students will be able to					
1. Understand the significance of construction methods involve in modern construction techniques 2. Students understand the technology of uses of modern material and equipment.					
<b>2. Unit wise detailed content</b>					
<b>Unit-1</b>	<b>Number of lectures = 10</b>	<b>Title of the unit: Modern Construction Materials</b>			
<b>Modern Construction Materials</b> (Study Of Advance Building Materials like, aluminium, glass, fabric, various types of finishes & treatments, Construction chemicals – sealants, engineering grouts, mortars , admixtures and adhesives					
<b>Unit – 2</b>	<b>Number of lectures = 09</b>	<b>Title of the unit: Construction Methods</b>			
<b>Construction Methods</b> -Precast Flat Panel System, 3d Volumetric Construction, Tunnel Boring Methods, Precast Foundations .Fabrication Of Pre Cast And Pre Stressed Components, Reinforcing Steel: Types, Bending, Placing, Splicing And Spacing, Tendons- Soil Improvement - Mechanical, Thermal And Chemical.					
<b>Unit – 3</b>	<b>Number of lectures = 11</b>	<b>Title of the unit: Construction Equipment</b>			
<b>Construction Equipment</b> -Equipment for Excavating, Dredging, Trenching, Tunneling, Drilling, Blasting-Equipment for compaction-Erection Equipment- Types of pumps used in construction-Equipment for Dewatering and Grouting-Foundation and Pile Driving Equipment , Forklifts and related Equipment-Portable Material -Conveyors-Hauling Equipment					
<b>Unit – 4</b>	<b>Number of lectures = 10</b>	<b>Title of the unit: Polymers in Civil Engineering</b>			
Polymers in Civil Engineering-Structural Plastics And Composites- Polymer Membranes Coatings-Adhesives, Non - Weathering Materials-Flooring And Facade Materials- Glazed Brick, Photo Catalytic Cement, Acid Etched Copper And Composite Fiber Metals-Metals And Special Alloys Of Steel - Water Jet Cut Stainless Steel, Mill Slab Steel, Tension Rods Assemblies And Cast Iron, Heat Treatment In Steels, Tendons.					
<b>3. Brief Description of self-learning / E-learning component</b>					



The students will be encouraged to learn using the SGT E-Learning portal and choose the relevant lectures delivered by subject experts of SGT University.

#### **4. Books Recommended**

##### **Text Books**

1. Shan Somayaji, " Civil Engineering Materials ", 2nd Edititon , Prentice Hall Inc., 2001.
2. Mamlouk, M.S. and Zaniewski, J.P., " Materials for Civil and Construction Engineers ", Prentice Hall Inc., 1999.
3. Derucher, K.Korfiatis. G. and Ezeldin, S., " Materials for Civil and Highway Engineers ", Prentice Hall Inc., 1999. 4th Edition

##### **Reference Books**

- 1 Peurifoy, R.L., Ledbetter, W.B.and Schexnayder, C., "Construction Planning, Equipment and Methods ",  
5th Edition, McGraw Hill, Singapore, 1995. 5. Sharma S.C. "Construction Equipment and Management ", Khanna Publishers New Delhi, 1988.
2. Deodhar, S.V. "Construction Equipment and Job Planning ", Khanna Publishers, New Delhi, 1988.
3. Dr. Mahesh Varma, "Construction Equipment and its Planning and Application ", Metro-politan Book Company, New Delhi-, 1983.

<b>8. Name of the Department</b>		<b>CIVIL ENGINEERING</b>			
<b>9. Subject Name</b>	FEM In Geomechanics	<b>L</b>	<b>T</b>	<b>P</b>	
<b>10. Subject Code</b>	13160323	3	0	0	
<b>11. Type of Subject</b>		<b>Core ()</b>	<b>PE-III(√)</b>		<b>OE()</b>
<b>12. Pre-requisite (if any)</b>		<b>Frequency (use tick marks)</b>	Even (√)	Odd ()	Either Sem (√) Every Sem ()
<b>13. Total Number of Lectures, Tutorials, Practical</b>					
<b>Lectures = 40</b>		<b>Tutorials = 00</b>	<b>Practical = 00</b>		
<b>14. Learning objectives:</b>					
1. To study about stress deformation analysis					
2. To understand the principle of discretization and displacement formulation, settlement analysis					
<b>Subject Outcomes:</b> On completion of this course, the students will be able to					
1. Understand the mechanism of stress deformation					
2. Students understand the technology Finite Element Method in Geoscience.					
<b>5. Unit wise detailed content</b>					
<b>Unit-1</b>	<b>Number of lectures = 09</b>	<b>Title of the unit: Stress-deformation analysis</b>			
Stress-deformation analysis: One dimensional, two dimensional and three-dimensional formulations					
<b>Unit – 2</b>	<b>Number of lectures = 09</b>	<b>Title of the unit: Discretization of a Continuum</b>			
Discretization of a Continuum, Elements, Strains, Stresses, Constitutive, Relations, Hooke's Law, Formulation of Stiffness Matrix, Boundary Conditions, Solution Algorithms					
<b>Unit – 3</b>	<b>Number of lectures = 08</b>	<b>Title of the unit: Principles of discretization</b>			
Principles of discretization, element stiffness and mass formulation based on direct, variational and weighted residual techniques and displacements approach, Shape functions and numerical integrations, convergence.					
<b>Unit – 4</b>	<b>Number of lectures = 10</b>	<b>Title of the unit: Displacement formulation, Settlement Analysis:</b>			
Displacement formulation for rectangular, triangular and iso-parametric elements for two dimensional and axisymmetric stress analysis. Settlement Analysis: 2-D elastic solutions for homogeneous, isotropic medium, Steady Seepage Analysis: Finite element solutions of Laplace's equation, Consolidation Analysis: Terzaghi consolidation problem, Choice of Soil Properties for Finite Element Analysis					
<b>6. Brief Description of self-learning / E-learning component</b>					
The students will be encouraged to learn using the SGT E-Learning portal and choose the relevant lectures delivered by subject experts of SGT University.					
<b>7. Books Recommended</b>					
<b>Text Books</b>					
1. Zienkiewicz O.C. and Taylor R.L., Finite element methods (Vol I & Vol II), McGraw Hill					
<b>Reference Books</b>					
1. Bathe K.J., Finite element procedures, PHI Ltd.					
2. Potts D.M. and Zdravkovic L., Finite Element Analysis in Geotechnical Engineering, Thomas Telford					

<b>1 Name of the Department</b>		<b>CIVIL ENGINEERING</b>			
<b>2 Subject Name</b>	<b>Climate Change and Sustainable Development</b>	<b>L</b>	<b>T</b>		<b>P</b>
<b>3 Subject Code</b>	13160324	3	0		0
<b>4 Type of Subject (use tick mark)</b>		<b>Core ()</b>	<b>PE-III(√)</b>		<b>OE()</b>
<b>5 Pre-requisite (if any)</b>	Nil	<b>1. Frequency (use tick marks)</b>	Even (√)	Odd ()	Either Sem (√) Every Sem ()
<b>6 Total Number of Lectures, Tutorials, Practical (assuming 14 weeks of one semester)</b>					
<b>Lectures = 36</b>		<b>Tutorials =00</b>		<b>Practical =00</b>	
<b>Brief Syllabus:</b> Climate change and sustainable development includes the study of climate system, observed changes in climate and causes, impacts of climate changes, climate change adaptation					
<b>7 Learning objectives:</b> 1. To study the concepts of climate changes and clean technology and energy concepts					
<b>8 Subject Outcomes:</b> On completion of this course, the students will be able to 1. To understand the climate change system and observed changes and its causes 2. Impacts of climate change and mitigation measures					
<b>9 Unit wise detailed content</b>					
<b>Unit-1</b>	<b>Number of lectures = 9</b>	<b>Title of the unit: Earth's Climate System</b>			
<b>Earth's Climate System:</b> Introduction-Climate in the spotlight - The Earth's Climate Machine – Climate Classification - Global Wind Systems – Trade Winds and the Hadley Cell – The Westerlies - Cloud Formation and Monsoon Rains – Storms and Hurricanes – The Hydrological Cycle – Global Ocean Circulation – El Nino and its Effect - Solar Radiation –The Earth's Natural Green House Effect – Green House Gases and Global Warming – Carbon Cycle.					
<b>Unit - 2</b>	<b>Number of lectures = 9</b>	<b>Title of the unit: Observed Changes and its Causes</b>			
<b>Observed Changes And Its Causes:</b> Observation of Climate Change – Changes in patterns of temperature, precipitation and sea level rise – Observed effects of Climate Changes – Patterns of Large Scale Variability – Drivers of Climate Change					
<b>Unit - 3</b>	<b>Number of lectures = 9</b>	<b>Title of the unit: Impacts of Climate Change</b>			
<b>Impacts Of Climate Change:</b> Impacts of Climate Change on various sectors – Agriculture, Forestry and Ecosystem – Water Resources – Human Health – Industry, Settlement and Society – Methods and Scenarios – Projected Impacts for Different Regions– Uncertainties in the Projected Impacts of Climate Change – Risk of Irreversible Changes.					
<b>Unit - 4</b>	<b>Number of lectures = 09</b>	<b>Title of the unit: Climate Change Adaptation and Mitigation Measures</b>			

**Climate Change Adaptation and Mitigation Measures:** Adaptation Strategy/Options in various sectors – Water – Agriculture -- Infrastructure and Settlement including coastal zones – Human Health – Tourism – Transport – Energy – Key Mitigation Technologies and Practices

**10 Brief Description of self learning / E-learning component**

The students will be encouraged to learn using the SGT e-Learning portal and choose the relevant lectures delivered by subject experts of SGT University.

The link to the E-Learning portal.

<https://elearning.sgtuniversity.ac.in/course-category/>Journal papers; Patents in the respective field.

**11 Text Book**

1. Anil Markandya , Climate Change and Sustainable Development: Prospects for Developing Countries, Routledge, 2002

2. Heal, G. M., Interpreting Sustainability, in Sustainability: Dynamics and Uncertainty, Kluwer Academic Publ., 1998

3. Jepma, C.J., and Munasinghe, M., Climate Change Policy – Facts, Issues and Analysis, Cambridge University Press, 1998

**Reference Books**

1. Munasinghe, M., Sustainable Energy Development: Issues and Policy in Energy, Environment and Economy: Asian Perspective, Kleindorfer P. R. et. al (ed.), Edward Elgar, 1996

2. Dash Sushil Kumar, “Climate Change – An Indian Perspective”, Cambridge University Press India Pvt. Ltd, 2007

<b>1. Name of the Department</b>		<b>CIVIL ENGINEERING</b>				
<b>2. Subject Name</b>	<b>Offshore Foundations</b>	<b>L</b>	<b>T</b>		<b>P</b>	
<b>3. Subject Code</b>	13160325	3	0		0	
<b>4. Type of Subject</b>		<b>Core ()</b>	<b>PE-IV(√)</b>		<b>OE()</b>	
<b>5. Pre-requisite (if any)</b>	nil	<b>Frequency (use tick marks)</b>	Even (√)	Odd ()	Either Sem (√) Every Sem ()	
<b>6. Total Number of Lectures, Tutorials, Practical</b>						
<b>Lectures = 36</b>		<b>Tutorials =00</b>		<b>Practical = 00</b>		
<b>7. Brief Syllabus</b>						
Student will study the challenges of an offshore engineering design, main components of an offshore site investigation.						
<b>8. Learning objectives:</b>						
1. To introduce the concepts of offshore engineering and types of offshore foundation						
2. The student is exposed to the use the urban storm water models for better storm water management.						
<b>Subject Outcomes:</b>						
At the completion of the course the student should be able to						
1. Apply appropriate techniques for planning, and designing of as offshore foundation						
<b>9. Unit wise detailed content</b>						
<b>Unit-1</b>	<b>Number of lectures = 10</b>	<b>Title of the unit: Challenges of offshore engineering design</b>				
Identify and describe key challenges of offshore engineering design; describe the aspects of the marine environment that feed into offshore engineering design						
<b>Unit - 2</b>	<b>Number of lectures = 10</b>	<b>Title of the unit: Main Component of an offshore site investigation</b>				
Describe the main components of an offshore site investigation; Interpret selected geotechnical site investigation data						
<b>Unit - 3</b>	<b>Number of lectures = 08</b>	<b>Title of the unit: Types of offshore foundation</b>				
Identify the main types of offshore foundation systems and describe the drivers during foundation design, Perform selected foundation design calculations to illustrate the interplaying mechanisms						
<b>Unit - 4</b>	<b>Number of lectures = 08</b>	<b>Title of the unit: Geotechnical pipeline design aspects</b>				
Identify key aspects of geotechnical pipeline design and perform selected design calculations to illustrate the interplaying mechanisms, determine the loads acting on the offshore structures						
<b>10. Brief Description of self learning / E-learning component</b>						
The students will be encouraged to learn using the SGT e-Learning portal and choose the relevant lectures delivered by subject experts of SGT University.						
The link to the E-Learning portal. <a href="https://elearning.sgtuniversity.ac.in/course-category/">https://elearning.sgtuniversity.ac.in/course-category/</a> Journal papers; Patents in the respective field.						

## **1. Books Recommended**

### **Text Books**

1. Ben C. Gerwick, "Construction of Marine and Offshore Structures", CRC Press, 1999.
2. B. Gou, S. Song, J. Chacko and A. Ghalambor, "Offshore Pipelines", GPP Publishers, 2006.

### **Reference Books**

1. S. K. Hakrabarti, "Handook of Offshore Engineering", Elsevier, 2005.
2. M. J. Tomlinson, "Pile Design and Construction", E and F Spon, 1994