Shri Rawatpura Sarkar University, Raipur, Chhattisgarh

Faculty of Engineering

Shri Rawatpura Sarkar University, Raipur

Examination Scheme & Syllabus

for

M.Tech.(Geotech Engineering)

Semester-II

Outcome Based Education (OBE) and Choice Based Credit System (CBCS)

(Effective from the Session: 2022-23)

Shri Rawatpura Sarkar University, Raipur, Chhattisgarh

Faculty of Engineering

Two Years M.Tech. Programme

Scheme of Teaching and Examination

M.Tech. Second Semester Geotech Engineering

Outcome Based Education (OBE) and Choice Based Credit System (CBCS)

(Effective from the Academic Year 2022-2023)

S.No.	Course Code	Course Title	Hours / Week			Credits	Maximum Marks			Sem End Exam Duration (Hrs)
			L	**T**	**P**		Continuous Evaluation	Sem End Exam	Total	
1	MENGE201T	Theoretical Soil Mechanics	3	1	-	4	30	70	100	3
2	MENGE202T	Dynamics of Soil and Foundation	3	1	-	4	30	70	100	3
3	MENGE203T	Advanced Foundation Engineering-II	3	1	-	4	30	70	100	3
4	MENGE204T	Ground Improvement Techniques	3	1	-	4	30	70	100	3
5	MENGE205T	Elective-II	3	1	-	4	30	70	100	3
6	MENGE206P	Geotechnical Investigation Practice	-	-	2	1	15	35	50	-
7	MENGE207P	Geotechnical Laboratory-II	-	-	2	1	15	35	50	-
	Total Contact Hr Per Week: 24		**Total Credit: 22**				**Grand Total Marks:**		**600**	

L: Lecture T: Tutorial P: Practical

Elective-II

S.NO.	Course Title
1	Earth and Earth Retaining Structure
2	Unsaturated Soil Mechanics
3	Soil Structure Interaction

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<table>
<tr><td>Course Title</td><td colspan="5">Theoretical Soil Mechanics</td></tr>
<tr><td>Course Code</td><td colspan="5">MENGE201T</td></tr>
<tr><td rowspan="2">Course Credits</td><td>L</td><td>T</td><td>P</td><td>TC</td><td></td></tr>
<tr><td>3</td><td>1</td><td>-</td><td>4</td><td></td></tr>
<tr><td>Prerequisites</td><td colspan="5">Geotechnical Engineering-I & II</td></tr>
<tr><td>Course Objectives</td><td colspan="5">This course will enable students to:
Impart the knowledge for computation of settlements and stress in semi-infinite elastic soil medium.</td></tr>
<tr><td>Course Contents</td><td colspan="5">UNIT – I
Introduction – Elasticity and stability problems, concept of stress and strain – plane stress, plane strain and axis symmetric problems – equation of equilibrium and compatibility – stress functions.
UNIT – II
Stresses in elastic half-space medium by external loads –fundamental solutions – Boussinesq, Flamant, Kelvin and Mindlin solution – Applications of fundamental solutions – Anisotropic and non-homogeneous linear continuum – Influence charts – elastic displacement-layered soil-Burmister method.
UNIT – III
Limit equilibrium analysis – perfectly plastic material – stress –strain relationship –stress and displacement field calculations – slip line solutions for undrained and drained loading, arching of soils and theories of arching
UNIT – IV
Limit analysis – principles of virtual work – theorems of plastic collapse – Mechanism for plane plastic collapse –Simple solutions for drained and undrained loading –stability of slopes, cuts and retaining structures. Centrifuge model – Principles and scale effects, practical considerations
UNIT - V
Flow through porous media – Darcy’s law – General equation of flow – steady state condition – solution by flow net – fully saturated conditions; Yielding, Bounding Surfaces.</td></tr>
<tr><td>Course Outcomes</td><td colspan="5">After the completion of course:
Evaluate the theoretical aspects like stresses, limiting stresses etc.
Understand the stability aspects collapse mechanisms, centrifuge modeling.
Estimate the stresses in soils, Flow net and related problems.
Settlements and stress in anisotropic medium and layered deposits due to foundation loads.</td></tr>
</table>

	• Concept on plastic collapse.
Text Books	1. Foundations of Theoretical Soil Mechanics, Harr, M.E (1966) McGraw Hill, 2. Foundation Engineering Handbook, Winter korn, H.F., and Fang, H.Y(4000) Galgotia, Book source, 4000 3. Theoretical Soil Mechanics- Karl Terzaghi (1943), John Wiley & Sons. 4. Soil Mechanics and Foundations, Muniram Budhu(2007), John Wiley & Sons, Inc.
Reference Books	1. Soil Mechanics, T.W. Lambe and R.V. Whitman (1969). John Wiley & Sons,. 2. Foundations and slopes- Atkinson (1981), McGraw Hill, New Delhi 3. Seepage, Drainage and Flow nets– Cedergren H R(1997).-, John Wiley & Sons 4. The Mechanics Basic concepts and Engineering Applications- Aysen A (4002), AA Balkema Publishers, 4002

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<table>
<tr><td>Course Title</td><td colspan="5">Dynamics of Soil And Foundation</td></tr>
<tr><td>Course Code</td><td colspan="5">MENGE202T</td></tr>
<tr><td rowspan="2">Course Credits</td><td>L</td><td>T</td><td>P</td><td>TC</td><td></td></tr>
<tr><td>3</td><td>1</td><td>-</td><td>4</td><td></td></tr>
<tr><td>Prerequisites</td><td colspan="5">Geotechnical Engineering-I&II</td></tr>
<tr><td>Course Objectives</td><td colspan="5">This course will enable students to:
Study vibration concepts in soils like damping, wave propagation, resonance and effect of modes of vibrations.
Study dynamic soil properties. Determination of dynamic properties by field and laboratory tests
Effect of liquefaction and anti-liquefaction measures.
Study vibration isolation, machine foundation design.</td></tr>
<tr><td>Course Contents</td><td colspan="5">UNIT – I
Fundamentals of Vibration: Definitions, Simple harmonic motion, Response of SDOF systems of Free and Forced vibrations with and without viscous damping, Frequency dependent excitation, Systems under transient loads, Rayleigh’s method of fundamental frequency, Logarithmic decrement, Determination of viscous damping, Transmissibility, Systems with Two and Multiple degrees of freedom, Vibration measuring instruments.
UNIT – II
Wave Propagation and Dynamic Soil Properties: Propagation of seismic waves in soil deposits - Attenuation of stress waves, Stress strain behavior of cyclically loaded soils, Strength of cyclically loaded soils, Dynamic soil properties – Laboratory and field testing techniques, Elastic constants of soils, Correlations for shear modulus and damping ratio in sand, gravels, clays and lightly cemented sand. Liquefaction of soils: An introduction and evaluation using simple methods
UNIT – III
Vibration Analyses: Types, General Requirements, Permissible amplitude, Allowable soil pressure, Modes of vibration of a rigid foundation block, Methods of analysis, Lumped Mass models, elastic half space method, elasto-dynamics, effect of footing shape on vibratory response, dynamic response of embedded block foundation, Vibration isolation
UNIT – IV
Design of Machine Foundations: Analysis and design of block foundations for reciprocating engines, Dynamic analysis and design procedure for a hammer foundation, IS code of practice design procedure for foundations of reciprocating and impact type 10 Hours 23 machines. Vibration isolation and absorption techniques.</td></tr>
</table>

	UNIT – V Machine Foundations on Piles: Introduction, Analysis of piles under vertical vibrations, Analysis of piles under translation and rocking, Analysis of piles under torsion, Design procedure for a pile supported machine foundation.
Course Outcomes	**After the completion of course:** • Develop a mechanism to design the foundations for resisting vibrations and achieve static equilibrium conditions of structures. • Understand the classical geotechnical failures due to liquefaction and mitigate the same. • Design of foundations in large structures like power plants, other industrial buildings etc., for analyzing the vibrating waves which can be isolated and measures for achieving safety of the adjacent foundations. • Predict liquefaction and suggest measures for its mitigation. • Apply the principles of soil dynamics.
Text Books	1. Soil Dynamics and Machine Foundation (4010), Swami Saran, Galgotia Publications Pvt. Ltd. 2. Soil Dynamics(1981)- Prakash, S. McGraw Hill Book Company
Reference Books	1. Foundation for Machines (1998) Prakash, S. and Puri, V. K.: Analysis and Design, John Wiley & sons 2. Vibration Analysis and Foundation Dynamics(1998)-Kameswara Rao, N. S. V., Wheeler Publication Ltd., 3. Vibrations of Soils and Foundations (1970) Richart, F. E. Hall J. R and Woods R. D., Prentice Hall Inc., 4. Principles of Soil Dynamics (4002) Das, B. M., PWS KENT publishing Company, Boston.

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<table>
<tr><td>Course Title</td><td colspan="5">Advanced Foundation Engineering-II</td></tr>
<tr><td>Course Code</td><td colspan="5">MENGE203T</td></tr>
<tr><td rowspan="2">Course Credits</td><td>L</td><td>T</td><td>P</td><td>TC</td><td></td></tr>
<tr><td>3</td><td>1</td><td>-</td><td>4</td><td></td></tr>
<tr><td>Prerequisites</td><td colspan="5">Geotechnical Technical-I & II</td></tr>
<tr><td>Course Objectives</td><td colspan="5">This course will enable students to:
Know the design of deep foundation.
Type of deep foundations will be provided for different structures.
Understand the special foundations.</td></tr>
<tr><td>Course Contents</td><td colspan="5">UNIT – I
Single Pile: Vertically loaded piles, Static capacity- α, β and λ Methods, Dynamic formulae; Wave Equation Analyses; Point Bearing Resistance with SPT and CPT Results; Bearing Resistance of Piles on Rock; Settlement; Pile Load Test; Uplift Resistance; Laterally Loaded Piles -Ultimate Lateral Resistance; Negative Skin Friction; Batter Piles; Under Reamed Piles; Mini and Micro Piles.
UNIT – II
Buckling of Fully and Partially Embedded Piles; Ultimate Capacity of Pile Groups in Compression, Pullout & Lateral Load; Efficiency; Settlements of Pile Groups; Interaction of Axially & Laterally Loaded Pile Groups.
UNIT – III
Well Foundation: Design and construction. Bearing capacity, settlement and lateral resistance. Tilts and shifts. Drilled shaft: construction procedures, Design considerations, load carrying capacity and settlement analysis.
UNIT – IV
Drilled Shaft: Construction procedures, Design Considerations, Load Carrying Capacity and settlement analysis. Design of Sheet pile foundations: Analysis of anchored sheet piles and cantilever sheet piles Lateral supports in open cuts Numerical problems
UNIT – V
Special Topics of Foundation Engineering Foundations on Collapsible Soils: Origin and occurrence, Identification, Sampling and Testing, Preventive and Remedial measures. Foundations on Expansive Soils: The nature, origin and occurrence, Identifying, testing and evaluating expansive soils, typical structural distress patterns and Preventive design & construction measures.</td></tr>
</table>

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Course Outcomes	**After the completion of course:** • Identify a suitable foundation system for a structure. • Evaluate the importance of raft foundation and principles of design for buildings and tower structures. • Analyze and design pile foundations. • Examine and discuss various machine foundations. • Analyze and design Sheet piles and cofferdams. • Design the sheet piles and under reamed piles in expansive soils.
Text Books	1. Principles of Foundation Engineering, B. M Das, Thomson Brooks/Cole 2. Foundation Analysis and Design J. E. Bowles, , McGraw-Hill Book Company 3. Design of Foundation Systems : Principles & Practices, N.P. Kurien, Narosa, New Delhi 1992 4. Foundation Engineering Hand Book, H. F. Winterkorn and H Y Fang, Galgotia Book source
Reference Books	1. Dynamic of Bases and Foundation, Barken, D.D. 2. Engineering and Thornolour Foundation Peek Hansen 3. Engineering Leaconards 4. Bowles " Foundation Design" 5. Vibration of Soils - Foundations."Rechartetal

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<table>
<tr><td>Course Title</td><td colspan="5">Ground Improvement Techniques</td></tr>
<tr><td>Course Code</td><td colspan="5">MENGE204T</td></tr>
<tr><td rowspan="2">Course Credits</td><td>L</td><td>T</td><td>P</td><td>TC</td><td></td></tr>
<tr><td>3</td><td>1</td><td>-</td><td>4</td><td></td></tr>
<tr><td>Prerequisites</td><td colspan="5">Geotechnical Engineering-I & II</td></tr>
<tr><td>Course Objectives</td><td colspan="5">This course will enable students to:
Identify the soil type of soil from a job site or in a professional setting, determine that soil’s properties based on types.
Explore the scientific principles used to describe the major engineering properties of soil, and the engineering testing methods used to quantify these properties.
Explore the site improvement techniques.</td></tr>
<tr><td>Course Contents</td><td colspan="5">UNIT–I
Introduction: Need of Ground Improvement: Different methods of Ground improvement, General Principal of Compaction: Mechanics, field procedure, quality control in field. Ground Improvement in Granular Soil: In place densification by (i) Vibrofloatation (ii)Compaction pile (iii) Vibro Compaction Piles (iv) Dynamic Compaction (v) Blasting
UNIT-II
Ground Improvement in Cohesive Soil: Compressibility, vertical and radial consolidation, preloading methods. Types of Drains, Design of vertical Drains, construction techniques. Stone Column: Function Design principles, load carrying capacity, construction techniques, settlement of stone column foundation. Drainage: soil and filter permeability, filter criteria, drainage layout and pumping system. Principles, sand drains, pore pressure distribution, electro-osmotic and chemical osmotic consolidation. Numerical problems.
UNIT-III
Ground Improvement by Grouting and Soil Reinforcement: Grouting in soil, types of grout, desirable characteristics, grouting pressure, grouting methods. Soil Reinforcement: Mechanism, Types of reinforcing elements, reinforcement-soil interaction, Reinforcement of soil beneath the roads, foundation. Geosynthetics and their application.
UNIT –IV
Soil Stabilization: Lime Stabilization-Base exchange mechanism, Pozzolanic reaction, lime-soil interaction, line columns, Design of Foundation on lime</td></tr>
</table>

	columns. Cement stabilization: Mechanism, amount, age and curing. Fly-ash - Lime Stabilization, Soil Bitumen Stabilization. **UNIT- V** Sampling and in-situ field tests: types of samples, samplers, preservation, shipment and storage of samples, bore log, pore pressure measurements, core recovery, rock strength, rock quality designation in-situ field testing and laboratory investigation of soils and rock (including advanced equipment), instrumentation, data acquisition and measurement techniques: SPT, SCPT, DCPT, pressure meter, dilatometer, permeability, plate load test, lateral pressure test. Numerical problems.
Course Outcomes	**After the completion of course:** • Explore and understand the behavior of soils using index, compaction and engineering properties for the design of foundations • Adopt suitable ground improvement techniques to alter the geotechnical properties to suit any type of foundations based on the load coming from the super structure on to the foundation and soil. • Gain thorough knowledge about the design of pile foundations. • Understand the importance of deep foundation in civil engineering construction field and they could able to select appropriate pile system based on the site conditions. • Do pile capacity (static, dynamic, lateral and group capacity) analysis as per code and they will understand the complete physics of pile and pile group failure mode under various circumstances.
Text Books	1. Engineering Principles of Ground Modifications – Hausmann, McGraw Hill. 2. Foundation Analysis and Design – J E Bowles, Tata McGraw Hill. 3. Subsurface Exploration and Sampling of Soils for Civil Engineering Purposes – Hvorslev M J, 4. Ground Improvement Techniques by P. Purushotham Raj. 5. Foundation Engineering by S P Brahma
Reference Books	1. Soil Mechanics, T.W. Lambe and R.V. Whitman. John Wiley & Sons, 1969. 2. Geotechnical Engineering- Donold P Coduto Phi Learning Private Limited, New Delhi 3. Geotechnical Engineering- Shashi K. Gulathi & Manoj Datta. (4009), Tata McGraw Hill. 4. Soil Mechanics and Foundation Engg.- Muni Budhu (4010), 3rd Edition, John Wiely & Sons 5. Soil Mechanics for Road Engineers – HMSO.

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<table>
<tr><td>Course Title</td><td colspan="5">Earth And Earth Retaining Structures</td></tr>
<tr><td>Course Code</td><td colspan="5">MENGE205T (Elective-II)</td></tr>
<tr><td rowspan="2">Course Credits</td><td>L</td><td>T</td><td>P</td><td>TC</td><td></td></tr>
<tr><td>3</td><td>1</td><td>-</td><td>4</td><td></td></tr>
<tr><td>Prerequisites</td><td colspan="5">Geotechnical Engineering-II</td></tr>
<tr><td>Course Objectives</td><td colspan="5">This course will enable students to:
• Study the geostatic stresses, shear strength of soils.
• Study the static earth pressure for retaining walls, slope stability etc</td></tr>
<tr><td>Course Contents</td><td colspan="5">UNIT–I
Earth Pressure: Introduction, Rankine’s theory and Coulomb’s wedge theory, Numerical problems, Culmann’s and Rebhann’s graphical methods for determination of active and passive earth pressures, earth pressure calculations for line load and/or uniform strip load acting on the ground surface.
UNIT-II
Retaining walls: Types of retaining walls, Failure of retaining walls by sliding, overturning and bearing. Stability and principles of the design of retaining walls – Gravity retaining walls, cantilever retaining walls, counter fort retaining walls, modes of failure of retaining walls, drainage from the backfill.
UNIT-III
Bulk heads: Cantilever sheet pile walls - Types of sheet pile walls, free cantilever sheet pile, cantilever sheet pile in cohesion less soils and in clay.
Bulk heads: Anchored cantilever sheet pile walls - Anchored sheet pile with free earth support in cohesion less and cohesive soil. Bulk heads with fixed earth support method.
UNIT–IV
Braced cuts: Introduction, lateral earth pressure on sheeting, different types of sheeting and bracing systems, design of various components of bracings.
UNIT- V
Coffer dams and Cellular coffer dams: Introduction, types of coffer dams, design of cellular coffer dams on rock by Tennes Valley Authority (TVA) method, safety against sliding, slipping, overturning, vertical shear and stability against bursting.</td></tr>
<tr><td>Course Outcomes</td><td colspan="5">After the completion of course:
• Analyze the field problems and encountering various failures due to shear geostatic stress etc.
• Design and analyze the retaining structures for earth pressures.
• Design and analyze suitable slope stability, understand the seepage in soils for</td></tr>
</table>

	design of complicated structures. • Quantify the lateral earth pressures associated with different earth retaining systems. • Gain knowledge on analysis and design of retaining structures. • Evaluate the stability of retaining structures under regular and earthquake forces.
Text Books	1. Foundation analysis and design - J E Bowles, McGraw Hill, NY 2. Soil Mechanics in Engineering Practice – Karl Terzaghi and R B Peck (1967), John Wiley and Sons, NY 3. Analysis and Design of Foundations and Retaining Structures –S Prakash (1979), Sarita Prakashana, Meerut
Reference Books	1. Soil Mechanics and Foundation Engineering – S K Garg, Khanna Publications 2. Geotechnical Engineering – C Venkataramaiah, New Age International Publishers

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<table>
<tr><td>Course Title</td><td colspan="5">Unsaturated Soil Mechanics</td></tr>
<tr><td>Course Code</td><td colspan="5">MENGE205T (Elective-II)</td></tr>
<tr><td rowspan="2">Course Credits</td><td>L</td><td>T</td><td>P</td><td>TC</td><td></td></tr>
<tr><td>3</td><td>1</td><td>-</td><td>4</td><td></td></tr>
<tr><td>Prerequisites</td><td colspan="5">Geotechnical Engineering-I&II</td></tr>
<tr><td>Course Objectives</td><td colspan="5">This course will enable students to:
Understand concept of shear stress and its importance.
Know the behaviour hydraulic conductivity of the soil.
Know the importance of soil-water interaction in applied soil engineering</td></tr>
<tr><td>Course Contents</td><td colspan="5">UNIT–I
Introduction to Unsaturated Soil Mechanics: Types of problems, typical profiles of unsaturated, tropical and residual soil, expansive and collapsing type of soils. Origin and formation, identification and classification of expansive and collapsing soils, Contractile skin.
Collapse and Heave: Collapse potential and swell potential, importance and their determination by different laboratory methods, Heave prediction based on oedometer tests, suction tests and empirical procedures, heave and collapse settlement.
UNIT – II
Soil Suction: Metric and osmotic suction, total suction, theory of soil suction, measurement by direct and indirect methods –Tensiometers, Axis translation technique, Pressure plate apparatus, Filter paper method, Psychrometers, Squeezing technique of measuring osmotic suction
Flow through unsaturated soils – flow laws, Darcy’s law for unsaturated soils, coefficient of permeability with respect to water phase and air phase, air diffusion, measurement of permeability and air coefficient of permeability.
UNIT–III
Phase properties and relations for unsaturated soils: Properties of individual phases, interaction of air and water, volume-mass relations, changes in volume-mass properties, densities of mixtures subjected to compression of the air phase, piston porous stone analogy, effective stress concepts and stress state variables for unsaturated soils, equilibrium analysis for unsaturated soils: total or overall equilibrium, independent phase equilibrium – water phase, air phase, contractile skin(meniscus)
UNIT– IV
Design alternatives for structures on expansive soils: Structural foundation alternatives, treatment of expansive soils – general considerations and guidelines, surcharge loading, pre-wetting, use of admixtures, electrochemical soil treatment, moisture control and soil stabilization, treatment alternatives for highways and airfield pavements.</td></tr>
</table>

	UNIT– V **Shear Strength:** History of shear strength, failure envelope for unsaturated soils, and use of effective stress parameters to define shear strength, Mohr-coulomb and stress point's envelopes, triaxial tests on unsaturated soils, CD tests, constant water content tests, CU tests with pore pressure measurements, undrained tests, multistage testing, measurement of shear strength parameters.
Course Outcomes	**After the completion of course:** • Understand the concept of unsaturated soils and change in the behavior of the soil properties. • Understand the contractual skin mechanism of partially saturate soils in the design of foundations by knowing the soil water interaction i.e. Soil is a four phase system. Comparative study of basic properties in case of three and four phase system in soils. • Design the effective methods for foundations and structures. • Apply theory of elasticity and plasticity to characterize the stress-strain behaviour of soils. • Formulate basic elasto-plastic model based on unsaturated soil mechanics like cam-clay.
Text Books	1. Soil Mechanics for Unsaturated Soils – DG Fredlund and H Rahardjo, Wiley Inter science Publication, John Wiley & Sons, NY 2. Unsaturated Soil Mechanics – Ning Lu and William J Likos, John Wiley & Sons, INC
Reference Books	1. Mechanics of Residual Soils – G E Blight, A A Balkema Publishers, USA 2. Expansive Soils – Problems & Practice in Foundations and Pavement Engineering – John D Nelson and Debora J Miller, John Wiley & Sons, NY

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<table>
<tr><td>Course Title</td><td colspan="5">Soil Structure Interaction</td></tr>
<tr><td>Course Code</td><td colspan="5">MENGE205T (Elective-II)</td></tr>
<tr><td rowspan="2">Course Credits</td><td>L</td><td>T</td><td>P</td><td>TC</td><td></td></tr>
<tr><td>3</td><td>1</td><td>-</td><td>4</td><td></td></tr>
<tr><td>Prerequisites</td><td colspan="5">Geotechnical Engineering-I&II</td></tr>
<tr><td>Course Objectives</td><td colspan="5">This course will enable students to:
Make students understand soil structure.
Understand stress-strain characteristics of soils.
The mechanism of failure, the factors that affects the shear strength
Structural behaviour with soils.</td></tr>
<tr><td>Course Contents</td><td colspan="5">UNIT–I
Soil-Foundation Interaction: Introduction to soil-foundation interaction problems, Soil behavior, Foundation behavior, Interface behavior, Scope of soil foundation interaction analysis, soil response models, Winkler, Elastic continuum, Two parameter elastic models, Elastic plastic behavior, and Time dependent behavior.
UNIT – II
Beam on Elastic Foundation- Soil Models: Infinite beam, Two parameters, Isotropic elastic half space, Analysis of beams of finite length, Classification of finite beams in relation to their stiffness. Plate on Elastic Medium: Thin and thick plates, Analysis of finite plates, Numerical analysis of finite plates, simple solutions.
UNIT–III
Plates on Elastic Continuum: Thin and thick rafts, Analysis of finite plates, Numerical analysis of finite plates
UNIT– IV
Elastic Analysis of Pile: Elastic analysis of single pile, Theoretical solutions for settlement and load distributions, Analysis of pile group, Interaction analysis, Load distribution in groups with rigid cap.
UNIT– V
Laterally Loaded Pile: Load deflection prediction for laterally loaded piles, Sub-grade reaction and elastic analysis, Interaction analysis, Pile-raft system, Solutions through influence charts. An introduction to soil-foundation interaction under dynamic loads.</td></tr>
<tr><td>Course Outcomes</td><td colspan="5">After the completion of course:
Understand soil foundation interaction and its importance.
Familiar with model analysis, Winkler model for soil structure interaction analysis.</td></tr>
</table>

	• Exposed to beams and plates on elastic foundation. • Carry out elastic analysis of pile, soil-pile interaction analysis, and dynamic soil-pile interaction. • Better understand the concepts of laterally loaded pile.
Text Books	1. Foundation analysis and design - J E Bowles, McGraw Hill, NY 2. Soil Mechanics in Engineering Practice – Karl Terzaghi and R B Peck (1967), John Wiley and Sons, NY 3. Analysis and Design of Foundations and Retaining Structures –S Prakash (1979), Sarita Prakashana, meerut
Reference Books	1. Soil Mechanics and Foundation Engineering – S K Garg, Khanna Publications 2. Geotechnical Engineering – C Venkataramaiah, New Age International Publishers

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Course Title	**Geotechnical Investigation Practice**				
Course Code	**MENGE206P**				
Course Credits	**L**	**T**	**P**	**TC**	
	-	**-**	**2**	**1**	
Prerequisites	**Geotechnical Engineering-I&II**				
Course Objectives	**This course will enable students to:** • Student able to get the practical knowledge of various techniques • Will perform various test with different methods.				
Course Contents	**List of Experiments** 1. Field Investigation by Auger Boring 2. Bored Pile installation in field 3. Plate load test 4. SPT test 5. Static Cone Penetration test 6. Dynamic cone Penetration test 7. Soil test Reports.				
Course Outcomes	**After the completion of course:** • Student will be able to perform Plate Load Test, SPT Test, and Shear test. • Able to determination of CBR of a soil specimen. • Able to perform static cone penetration test.				
Text Books	1. Physical and Geotechnical Properties of Soils, 2nd Edition J.E. Bowles, McGraw Hill, New York. 2. Engineering Soil Testing, Shamsher Prakash, (1979) "Nemichand, New Delhi. 3. Engineering Properties of soil and their measurements, Joesph E Bowles, McGraw hill				
Reference Books	1. Geotechnical Laboratory Measurements, John T. Germaine, Amy V. Germaine, (2009) John Wiely 2. Soil Testing for Engineers, William Lambe, (2003) MIT.				

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<table>
<tr><td>Course Title</td><td colspan="5">Geotechnical Laboratory-II</td></tr>
<tr><td>Course Code</td><td colspan="5">MENGE207P</td></tr>
<tr><td rowspan="2">Course Credits</td><td>L</td><td>T</td><td>P</td><td>TC</td><td></td></tr>
<tr><td>-</td><td>-</td><td>2</td><td>1</td><td></td></tr>
<tr><td>Prerequisites</td><td colspan="5">Geotechnical Engineering-I & II</td></tr>
<tr><td>Course Objectives</td><td colspan="5">This course will enable students to:
• Make students to learn principles and design of experiments (DOE).
• Investigate the performance of various Soils</td></tr>
<tr><td>Course Contents</td><td colspan="5">LIST OF EXPERIMENTS
1. Determination of Relative density.
2. Determination of Different Geotextile Properties
a) Thickness test
b) Sieve test
c) Tensile strength test
d) Tear resistance test
e) Puncture test
f) Cone drop test
g) Determination of pH and organic solids</td></tr>
<tr><td>Course Outcomes</td><td colspan="5">After the completion of course:
• Achieve Knowledge of Design and development of experimental skills.
• Understand the principles of design of experiments.</td></tr>
<tr><td>Text Books</td><td colspan="5">1. Physical and Geotechnical Properties of Soils, 2nd Edition J.E. Bowles, McGraw Hill, New York.
2. Engineering Soil Testing, Shamsher Prakash, (1979) Nemichand, New Delhi.
3. Engineering Properties of soil and their measurements, Joesph E Bowles, McGraw hill</td></tr>
<tr><td>Reference Books</td><td colspan="5">1. Geotechnical Laboratory Measurements, John T. Germaine, Amy V. Germaine, (2009) John Wiely
2. Soil Testing for Engineers, William Lambe, (2003) MIT</td></tr>
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