SRI VENKATESWARA UNIVERSITY: TIRUPATI

SRI VENKATESWARA UNIVERSITY COLLEGE OF ENGINEERING

DEPARTMENT OF CIVIL ENGINEERING

Course

M.Tech CIVIL ENGINEERING

(GEOTECHNICAL ENGINEERING)

Choice Based Credit System (CBCS)

Academic Year 2017-2018

Vision:

Vision of the Civil Engineering Department is to produce globally competitive and committed Civil Engineers with ethical values to cater to the needs of the society and strive for sustainable development through research and innovation.

Mission:

To impart quality education with the support of state-of-art Infrastructure and Faculty.

To inculcate inquisitiveness, infuse training and research for the societal development.

To address growing needs of sustainable infrastructure development.

To provide technical advice and support to the industry.

To provide awareness of global economic problems and contribute to Nation building.

To provide entrepreneurial skills for the upliftment of the country.

PROGRAMME EDUCATIONAL OBJECTIVES (PEO)

a. To provide students with the fundamental, technical knowledge and skills in mathematics, sciences and engineering to recognize, analyze and solve complex problems in the areas of Structural, Geotechnical, Hydraulics and Water Resources, Transportation and Environmental engineering.

b. To provide students with individual working skills and practical experience and to fulfill their professional duties and communicate effectively in teamwork, ethical thinking, technical leadership, and lifelong learning.

c. To make the students responsible professionals to work in various positions in industry or government and/or succeed in graduate or other professional organizations.

d. To train the students to become engineers, managers, scientists, researchers and innovators and make substantial contributions to the society.

e. To guide the students to use modern tools to solve complex engineering problems

f. To make the students to strive for the improvement of the quality of life and improve the standard of living by providing environmental sustainability.

PROGRAMME OBJECTIVES

1. To make students learn the principles of soil and rock mechanics. Understand different problems Associated with geotechnical engineering. Explain how to select design soil/rock parameters for Design purpose based on the subsurface exploration. Develop Analysis and Design procedure for Various geotechnical structures.
2. Students should gain competency in the design of shallow/deep foundations, earth retaining Structures, embankment and earthen dams, underground structures. Can assess stability of slopes and apply preventive measures for stability.

PROGRAMME OUTCOMES (POs)

1. Students will learn soil and rock behavior. Students will be able to perform various laboratory and in-situ tests on soil/rock to find out design parameters.

2. Students can design shallow/deep foundations, earth retaining structures, embankment and earthen dams, tunnel support systems for given site conditions.
3. Student can compute factor of safety to assess stability of slopes and apply preventive measures for stability.
4. Student can develop numerical models to estimate response of various geotechnical structures under different loadings.

PROGRAM SPECIFIC OUTCOMES (PSOs)

1. To prepare programme graduates with foundation knowledge to perform analysis and design various geotechnical structures for work on site and quality control systems.
2. T o provide programme graduates with entrepreneur skills to take up individual projects or work in teams in the field of geotechnical engineering and in multidisciplinary environments.
3. To inculcate in programme graduates an interest towards research work in the relevant domain or appropriate domains for providing sustainable solutions to the Civil EngineeringProblems

S.V.U. COLLEGE OF ENGINEERING (Autonomous):: TIRUPATI
DEPARTMENT OF CIVIL ENGINEERING
Scheme of Instruction for Choice Based Credit System (With effect from the academic year 2016-17)
M.Tech. (Geotechnical Engineering)

M. Tech (GEOTECHNICAL ENGINEERING) – I SEMESTER												
Course No.	**Name of the Course**	**L**	**T**	**P**	**S**	**Credits**	**I Test**	**II Test**	**Conti-nuous Assess-ment**	**End Semester Examination**		**Total Marks**
										Hrs.	**Marks**	
CEMAC 501	Advanced Engineering Mathematics	3	1	--	--	4	20	20	--	3	60	100
CEGTC 502	Basic Geomechanics and Soil Behaviour	3	1	--	--	4	20	20	--	3	60	100
CEGTC 503	Soil Dynamics & Machine Foundations	3	1	--	--	4	20	20	--	3	60	100
CEGTC 504	Experimental Geomechanics	3	1	--	--	4	20	20	--	3	60	100
CEGTE 505	Elective – I	3	1	--	--	4	20	20	--	3	60	100
CEGTE 506	Elective – II	3	1	--	--	4	20	20	--	3	60	100
CEGTP 507	Geotechnical Engg. (Practical)	--	--	3	--	2	--	--	40	3	60	100
CEGTS508	Seminar –I	--	--	--	2	1	--	--	--	--	100	100
	Total	18	6	3	2	**27**	120	120	40	21	520	800

M. Tech (GEOTECHNICAL ENGINEERING) – II												
CEGTC 601	Advanced Foundation Engineering	3	1	--	--	4	20	20	--	3	60	100
CEGTC 602	Ground Improvement Techniques	3	1	--	--	4	20	20	--	3	60	100
CEGTC 603	Earth and Earth Retaining Structures	3	1	--	--	4	20	20	--	3	60	100
CEGTC 604	Numerical Methods in Geotechnical Engineering	3	1	--	--	4	20	20	--	3	60	100
CEGTE 605	Elective – III	3	1	--	--	4	20	20	--	3	60	100
CEGTE 606	Elective – IV	3	1	--	--	4	20	20	--	3	60	100
CEGTS 607	Computing Techniques (Practical)	--	--	3	--	2	--	--	40	3	60	100
CEGTS 608	Seminar – I	--	--	--	2	1	--	--	--	--	100	100
CEGTV 609	Comprehensive Viva-Voce – I	--	--	--	--	2	--	--	--	--	100	100
	Total	18	6	3	2	**29**	120	120	40	21	620	900

M. Tech (GEOTECHNICAL ENGINEERING) – III&IV SEMESTERS									
Course Code	Course Title	Scheme of Instruction (Hours/Week)				No. of Credits	Scheme of Evaluation		
		Lecture	Tutorial	Practical	Total		Sessional Marks	Semester End Examination Marks	Total
CEGTD701	Dissertation work (As listed in regulations)	--	--	--	--			60	100
*Dissertation work to be initiated in the third semester itself.									

GEOTECHNICAL ENGINEERING

GTPC01 ADVANCED SOIL MECHANICS

CEMAC 501 ADVANCED ENGINEERING MATHEMATICS

L + T / week : 3+1 Hrs | Sessional Marks : 20+20

University Exam : 3 Hrs | End Exam Marks : 60

Course Objectives

The students completing this course are expected to understand -

1. Partial Differential Equations
2. Special Functions
3. Statistics
4. Complex Variables & Laplace Transforms
5. Numerical Methods

UNIT – I

PARTIAL DIFFERENTIAL EQUATIONS

Formation by elimination of arbitrary constants and arbitrary functions – Solutions of equations by the methods of separation of variables in case of simple boundary conditions pertaining to (i) one dimensional wave equation and (ii) two dimensional wave equation satisfied by vibrating membrane (No numerical problems).

UNIT – II

SPECIAL FUNCTIONS

Gamma and Beta functions Bessel – function – Legendre polynomials – Recurrence relations for $J_m(x)$ and $P_n(x)$. Orthogonality of Legendre Polynomials – Rodrigues formula.

UNIT – III

STATISTICS

Emperical distributions – Log-normal-Binomial, poisson, gamma, extreme value and uniform distributions – Estimation of parameters by method of moments and maximum likely hood methods – Multiple correlation and regression.

UNIT – IV
COMPLEX VARIABLES & LAPLACE TRANSFORMS
Complex variables – Cauchy – Reimann equations – Laplace equation – Conformal transformations including Joukowski's and Schwaz and Christoffel transformations.Laplace transformation of Impulse function (Dirac-Delta function) and its applications to differential equation.

UNIT – V
NUMERICAL METHODS
Numerical solutions of partial differential equations – Laplace and poisson equations by ieration method, heat equation by Schmidt method.

Reference Books :
1.Dr. B.S. Grewal, Higher Engineering Mathematics.
2.S.C. Guptha, V.K. Kapur Foundations of Mathematics Statistics.

Course outcomes

The expected outcomes are:

1. This part extends out ability to analyze Partial differential equations.
2. The students become familiar with the special functions of differential equations to engineering problems.
3. The student becomes conversant with the fundamentals of Statistics.
4. The student becomes familiar with the Complex numbers and elementary functions of complex variable and is able to understand the basics of Laplace transforms and their applications.
5. The student gets familiarity in using mathematical tools such as directional derivatives and divergence play significant roles in many applications.

PO&PSO / CO	PO1	PO2	PO3	PO4		PSO1	PSO2	PSO3
CO1	2							
CO2		3		3			2	
CO3								
CO4								2
CO5				2			2	2

***1: Low Correlated, 2: Moderately Correlated, 3: Highly Correlated**

CEGTC 502 BASIC GEOMECHANICS AND SOIL BEHAVIOUR

L + T / week : 3+1 Hrs Sessional Marks : 20+20

University Exam : 3 Hrs End Exam Marks : 60

Course Objectives
The course imparts knowledge about

1.Process involved in soil formation and expected soil conditions in a given geologic settings.
2.Basics of soil mineralogy to determine soil properties and predict soil Behaviour.
3.The Principles of Clay-Water Electrolyte System
4.Soil fabric & structure and methods of determination
5.The mechanism behind volume change behaviour in soils and Strength behaviour of soils.

UNIT – I

SOIL FORMATION & SOIL DEPOSITS Formation, composition and classification of soils. Nature of mineral fractions of soils – Residual, Terrestrial and marine deposits – Post depositional changes.

UNIT – II

SOIL MINERALOGY & CLAY-WATER ELECTROLYTE SYSTEM

Origin, structure, classification and identification of clay minerals. Interactions and electrical forces in clay - Water - electrolyte systems. Effective stress concept.

UNIT – III

FABRIC & STRUCTURE

Soil structure and fabric. Fabric measurement. Fabric stability and its relevance to engineering behaviour of soils. Sensitivity and its causes.

UNIT – IV

VOLUME CHANGE BEHAVIOUR OF SOILS

Physical interactions in volume change – Fabric, structure and volume change – Cohesive and cohesionless soils – Osmotic pressure concept – Compression and swelling.

UNIT – V

STRENGTH BEHAVIOUR OF SOILS

Strength and deformation of granular and cohesive soils and related tests – Fabric structure and strength – Residual stresses. Influence of stress history anysotropy on strength. Pore pressure development – Strength theories.

Reference Books

1. Fundamental behaviour of soil by J. Mitchel
2. Soil Mechanics by Lambe and Whitman
3. Principles of Soil Mechanics by R.F.Scott.
4. Soil Properties and behaviour by Yong and Warkentin.

Course outcomes

The expected outcomes are:
1. Predict the expected soil conditions in given geologic settings.
2. Be able to determine material properties and predict soil behaviour.
3. Be able to estimate and understand the nature of subsurface stress.
4. Assessment of soil deformation parameters and settlement magnitude and rate of settlement.
5. Estimation of strength parameters of soil.

PO&PSO / CO	PO1	PO2	PO3	PO4		PSO1	PSO2	PSO3
CO1						2		2
CO2	3	2	2	2		2	2	2
CO3			3					2
CO4			2	2				
CO5	2	2	2			2		2

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CEGTC 503 SOIL DYNAMICS AND MACHINE FOUNDATION

L + T / week : 3+1 Hrs | Sessional Marks : 20+20

University Exam : 3 Hrs | End Exam Marks : 60

Course Objectives

To understand vibration theory

- To enable the students to realize the importance wave propagation

To make the students aware of the dynamic soil properties

To enable the students to become aware of analysis and design of machine foundations

To Comprehend about vibration isolation and construction practices

UNIT - I

THEORY OF VIBRATIONS

Harmonic motion – undamped and damped free vibrations – Forced vibrations – Transient vibrations – Systems with one, two and multidegree freedom.

UNIT – II

WAVE PROPAGATION

Stress, strain and elastic constants – Elastic wave propagation in rods of finite and infinite length – Wave propagations in elastic half space.

UNIT - III

DYNAMIC SOIL PROPERTIES

Evaluation of design parameters – Laboratory and field tests – Stress – Strain characteristic of soil under dynamic loads – Dynamic Bracing Capacity of soils – Pseudo static analysis and dynamic analysis.

UNIT – IV

ANALYSIS AND DESIGN OF MACHINE FOUNDATIONS

Types of machine foundations – Modes of vibrations – Requirements of machine foundations – Empirical methods of analysis – Elastic half space theory – lumped parameter model – Design of block foundations – Design of framed foundations - Soil mass participating in vibrations.

UNIT – V

VIBRATION ISOLATION

Active and passive types of isolation – Screening of vibrations – Isolation in existing machine foundations.

CONSTRUCTION

Construction details of machine foundations – Permissible vibrations.

Reference Books :

1. Barkan : Dynamics of bases and foundations.
2. Major : Vibration analysis and design of foundations for machines and turbines.

3. P.Sreenivasulu and C.V. Vaidyanathan (1976), Hand Book of Machine Foundations by , Tata McGraw Hill Co. Ltd., New Delhi.
4. C.Venkatramaiah (1995), Geotechnical Engineering, Wiley Eastern Ltd. (New Age International Ltd.), New Delhi,
5. A.V. Narasimha Rao & C.Venkatramaiah (2000), (Numerical Problems, Examples & Objective Questions in Geotechnical Engg. Universities Press (India) Ltd., Hyd.
6. Swamy Saran, Soil Dynamics and Machine Foundations, Galgotia Publications, New Delhi.

Course outcomes

At the end of the course, the students will be able to comprehend the
The students will be able to:
1. Analyze the structures with single degree of freedom for dynamic loading conditions.
2. Find out the natural frequencies and the mode shapes of foundations under dynamic loading.
3. Gain knowledge on the design and perspectives Machine foundations and the codal provisions for their design.

PO&PSO / CO	PO1	PO2	PO3	PO4		PSO1	PSO2	PSO3
CO1		2		2		2		2
CO2	2	3		3		2		2
CO3						2		2

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CEGTC 504 EXPERIMENTAL GEOMECHANICS

L + T / week : 3+1 Hrs | Sessional Marks : 20+20

University Exam : 3 Hrs | End Exam Marks : 60

Course Objectives

- To Gain basic knowledge about Soil Exploration and Planning a sub-surface exploration.
- To know the methods of open excavation and borings.
- To familiarize with the types soil sampling and samplers and types of in-situ testing of soils including geophysical methods in Geotechnical engineering practice.

UNIT - I
GENERAL
Purpose of soil exploration – Planning a sub-surface exploration – Stages in sub-surface exploration – Depth of exploration – Lateral extent of exploration.

UNIT - II
OPEN EXCAVATION AND BORINGS OF EXPLORATION
Pits and Trenches – Drifts and shafts – Auger Borings – Wash borings – Rotary drilling – Percussion drilling – Core drilling.

UNIT - III
SOIL SAMPLES AND SAMPLERS
Types of soil samples – Disturbed samples – Undisturbed samples – Design features affecting the Sample Disturbance – Split Spoon Samplers – Scraper Bucket Samplers – Shellby Tubes and Thin walled Samplers – Piston Samlers – Denison Samplers – Hand-curved Samplers.

UNIT – IV
IN-SITU TESTING
Standard Penetration Tests – Cone Penetration Tests – In-situ Vane Shear Test – Plate Load Test – Field Permeability Tests – In-situ Tests Using Pressure meter – Observation of Ground Water Table.

UNIT – V
GEOPHYSICAL METHODS
Seismic Methods – Electrical Resistivity Methods – Electrical Profiling Method – Electrical Sounding Method – Common Soil Tests – Sub-soil Investigation Report.

References :

1. Subsurface exploration and sampling of soils for Civil Engineering purposes by Hvorslev, M.J., Waterways Experiment Station, Vicksburg, Mississipi, 1949.
2. Foundation Engineering by S.P.Brahma Tata Mc Graw-Hill Publishing Company Limited, New Delhi, 1985.

3. Analysis and Design of Foundations and Retaining Structures by Shamsher Prakash, Gopal Ranjan and Swami Saran, Sarita Prakasham, Meerut, 1979.
4. Soil Mechanics & Foundation Engineering, Vol.2 by V.N.S. Murthy, Sai Kripa Technical Consultants, Bangalore.
5. Geotechnical Engineering by C.Venkatramaiah, Wiley Eastern Ltd., New Delhi.
6. Relevant I.S. Codes.

Course outcomes

- Knowledge of site specific field investigations including collection of soil samples for testing and observation of soil behavior/Building damage.
- Be able to identify and classify soil based on standard geotechnical Engineering practice.
- Be able to perform field and laboratory tests for quality control.

PO&PSO / CO	PO1	PO2	PO3	PO4		PSO1	PSO2	PSO3
CO1	3	3		2		3		2
CO2	2	2		2		2		3
CO3	3	2		2		2		2

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CEGTE 505 MATRIX METHODS OF STRUCTURAL ANALYSIS

L + T / week	: 3+1 Hrs	Sessional Marks	:20+20
University Exam	: 3 Hrs	End Exam Marks	: 60

Course Objectives: This Course Will Enable Students:

- To understand the static and kinematic indeterminacy of the structures
- To understand the concepts of matrix methods of analysis of structures
- To understand the analysis of continuous beams.
- To understand the analysis of rigid and pin jointed frames

UNIT – I

CHARACTERISTICS OF STRUCTURES :

Methods of structural analysis – Static and kinematic indeterminancy of the structures – Principles of Superposition – Flexibility and stiffness matrices – Stiffness and flexibility of systems and elements – Computing displacements and forces from virtual work. Computing stiffness and flexibility coefficients.

ENERGY CONCEPTS IN STRUCTURES :

Strain energy in terms of stiffness and flexibility matrices – Properties of stiffness and flexibility matrices -Interpretation of coefficients – Betti's law – Other energy thorems using matrix notation.

UNIT -II

TRANSFORMATION OF INFORMATION IN STRUCTURES :

Transformation of system forces to element – Element flexibility to system flexibity – system displacements to element displacements – Element stiffness to system stiffness – Transformation of forces and displacements in general – Stiffness and flexibility in general – Normal coordinates and orthogonal transformation.

UNIT – III

THE FLEXIBILITY METHOD :

Statically determinate structures – Indeterminate structures – Choice of redundants –Transformation to one set of redundants to another – Internal forces due to thermal, expansion and lack of fit. Reducing the size of flexibitilty matrix – Application to pin-jointed plane truss – Continuous beams- frames – Grids.

Problems solving by Computer (Not for Examination)

UNIT – IV

THE STIFFNESS METHOD :

Introduction – Development of the stiffness method – Stiffness matrix for structures with zero force at same coordinates – Analaging between flexibility and stiffness – Lack of fit – Application of stiffness approach to pin-jointed plane and space trusses.

UNIT – V

THE STIFFNESS METHOD :

Continuous beams – Frames- Grids – Static condensation technique – Choice of method – Direct Stiffness Approach.

Problems solving by Computer (Not for Examination)

REFERENCES :

1. Rubeinstein, M.F. "Matrix Computer Analysis of Structures",Prentice Hall International INC, Canada.
2. Gere, J.M. And Weaver, W.W."Analysis of Framed structrues".
3. Livesely, R.K. "Matrix Methods in Structural Analysis".
4. Mallick, S.K and Rangasamy, K.S. "Introduction to Matrix Analysis of Structures".
5. Elements of Matrix and Stability Analysis of Structures by V.K.Manicka Selvam, Khanna Publishers, Delhi.

Course Outcomes (CO): Student will be able to

- Distinguish determinate and indeterminate structures.
- Identify the method of analysis for indeterminate structures
- Apply matrix methods of analysis for continuous beams
- Apply matrix methods of analysis for rigid and pin jointed frames.

PO&PSO / CO	PO1	PO2	PO3	PO4		PSO1	PSO2	PSO3
CO1								
CO2								
CO3								
CO4								
CO5								

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CEGTE 506 THEORY OF ELASTICITY

L + T / week	: 3+1 Hrs	Sessional Marks	:20+20
University Exam	: 3 Hrs	End Exam Marks	: 60

Course Objectives: This Course Will Enable Students:

- To make students understand the principles of elasticity.
- To familiarize students with basic equations of elasticity
- To expose students to two dimensional problems in Cartesian and polar coordinates.
- To make students understand the principle of torsion of prismatic bars.

UNIT – I

Definition and notation of stress. Components of stress and strain. Generalised Hooke's Law. Stress and strain in three dimensions. Stress components on oblique plane. Transformation of stress components under change of co-ordinate system.

Principal stresses and principal planes. Stress invariants. Mean and deviator stress. Strain energy per unit volume. Distortion strain energy per unit volume. Octahedral shear stress. Strain of a line element.Principal strains, Volumetric strain.

Equation of equilibrium and compatibility in cartesian co-ordinates in three dimensions.

UNIT – II

TWO DIMENSIONAL PROBLEMS IN ELASTICITY :

Plane stress and plane strain situations. Equalibrium equations. Compatibility equation. Saint Venant's principle. Uniqueness of solution. Stress components in terms of Airy's stress functions. Application to cantilever, simply supported and fixed beams with simple loading.

UNIT – III

SOLUTION OF PROBLEMS IN POLAR CO-ORDINATES :

Equilibrium equations. Stress strain components. Compatibility equation. Applications using Airy's stress function in Polar co-ordinates for stress distributions symmetric about an axis. Effect of hole on stress distribution in a plane in tension, stresses due to load at a point on a semi-infinite straight boundary, stresses in a circular disc under diametric loading.

UNIT – IV

TORSION :

Stress function method of solution method of solution. Torsion of Circular and elliptical bars. Thin

walled tubes-applications. Prandtl's membrane analogy solution of torsion of rectangular bars by (1) Rayleigh Ritz method (2) Finite difference method.

UNIT – V

BEAMS ON ELASTIC FOUNDATION :

Beams of infinite and finite lengths with single point load, two point loads and u.d.l.

REFERENCES :

1. Theory of Elasticity by Timishanko and Goodier.
2. Applied Elasticity by Wang.
3. Applied stress Analysis by Sadhu Singh.
4. Beams on Elastic Foundation by Hetenyi.

Course outcomes:

1.Applying the concepts of various stresses, strains and torsion in problems related to elasticity.

2. Applying the principles of theory of elasticity in designing the beams, curved sections etc.,

PO&PSO / CO	PO1	PO2	PO3	PO4		PSO1	PSO2	PSO3
CO1								
CO2								
CO3								
CO4								

CEGTP 507 GEOTECHNICAL ENGINEERING (PRACTICAL)

Practicals / week : 3 Hrs | Sessional Marks : 40

University Exam : 3 Hrs | End Exam Marks : 60

Course Objectives

- To enable study typical soil exposures, collect soil samples
- To observe building performance in problematic areas.
- Facilitate Students to perform visual-manual and washed gradation/Atterberg limit tests to identify and classify soils.
- Apprehend procedures for laboratory test reports, test results and soil classification.

Collection of Disturbed and Undisturbed Soil Samples from Field - Identification and Classification of Soils - Determination of shear strength (Triaxial Shear Test) and compressibility of soil - Evaluation of Allowable Bearing Pressure and Report Preparation - Testing of Expansive Soils - Free Swell Index - Swelling Pressure by Free Swell Method and Constant Volume method - Swelling Index.

Course outcomes

- Students must be able to recognize ground behaviour and identify important geotechnical parameters in soil and rock exposures.
- Students must be able to map pertinent soil/rock features and
- Summarize geotechnical field data.

PO&PSO / CO	PO1	PO2	PO3	PO4		PSO1	PSO2	PSO3
CO1	3	2	2			2		2
CO2	3					2		2
CO3				2				2

***1: Low Correlated, 2: Moderately Correlated, 3: Highly Correlated**

CEGTC 601 ADVANCED FOUNDATION ENGINEERING

L + T / week : 3+1 Hrs | Sessional Marks : 20+20
University Exam : 3 Hrs | End Exam Marks : 60

Course Objectives

- Provide with a basic understanding of the stress distribution in soils
- Introduce the Bearing Capacity Thoeries for assessing bearing capacity of different types of soils.
- Familiarize with the concept of settlement Analysis of soils supporting the foundations of structures.
- To gain the knowledge of types of structural foundations and the design methods.
- Introduce the concept of coffer dams and its design and construction.

UNIT – I
STRESS DISTRIBUTION IN SOILS:
Stress distribution beneath various types of loading including triangular and trapezoidal loadings - Stress distribution in stratified soil systems.

UNIT – II
BEARING CAPACITY THEORIES:
Theories of Vesic and Balla for shallow foundations. Theories of Terzaghi, Meyerhof and Vesic for deep foundations. Bearing Capacity of shallow and deep foundations based on SPT and CPT values. Bearing Capacity for stratified deposits. Ultimate Resistance of laterally loaded piles (Brom's Method).

UNIT – III
SETTLEMENT ANALYSIS:
Types of settlements – Permissible settlements – Prediction of settlements of shallow and deep foundations in cohesive and cohesionless soils – Settlement from penetration tests.

UNIT – IV
ANALYSIS AND DESIGN OF SHALLOW FOUNDATIONS:
Proportioning and design of isolated footings, combined footings, strap footings for equal settlements – Common types of mat foundations – Floating rafts – B.C. and design of rafts – Conventional rigid method – Approximate flexible method (Winkker's model) – Finite difference method.

UNIT – V
COFFERDAMS
Types of Cofferdams – Uses – Stability and design of cellular Cofferdams on rock and soil.

Reference Books :

1. Soil Engineering by Spangler and Handy.
2. Foundation Analysis and Design by Joseph. E. Bowles.
3. Analysis and Design of Foundations and Retaining Structures by Shamsher Prakash, Gopal Ranjan & Swamy Saran.
4. A short course in Foundation Engineering by N.E. Simons and B.K.Menzies.
5. Geotechnical Engineering by C.Venkatramaiah, Wiley Eastern Ltd., New Delhi, 1993.
6. Foundation Engineering by S.P.Brahma, Tata McGraw Hill, New Delhi, 1985.
7. Numerical Problems, Examples and Objective Questions in Geotechnical Engg. by A.V.Narasimha Rao & C.Venkatramaiah, University Press (India) Ltd., Hyd. 2000.

Course outcomes

- A student learn and able to find out the Soil Profile in a given location.
- A student able to select suitable foundation for a given structure and site.
- Expertise in the calculation of load carrying capacity of selected foundation.
- Gain experience in solving field geotechnical engineering problems

PO&PSO / CO	PO1	PO2	PO3	PO4		PSO1	PSO2	PSO3
CO1	2	3				2		2
CO2	2	3		2		2		2
CO3	2	3		2		2		2
CO4				3		2		2

***1: Low Correlated, 2: Moderately Correlated, 3: Highly Correlated**

CEGTC 602 GROUND IMPROVEMENT TECHNIQUES

L + T / week : 3+1 Hrs | Sessional Marks : 20+20

University Exam : 3 Hrs | End Exam Marks : 60

Course Objectives

The course should enable the students to:
1. . Understand the geotechnical problems in various types of soils and the suitable ground improvement techniques.
2. Be familiar with the various dewatering techniques that can be used in the soils with higher ground water level.
3. To know the various techniques and procedures adopted for ground improvement.
4. Understand the concept, types and applications of earth reinforcement.
5. Gain knowledge about the various types, materials and techniques used for grouting

UNIT - I
MECHANICAL STABILISATION OF SHALLOW LAYERS
Need for Engineered Ground improvement – Mechanical modification – Principles of compaction – Evolution of compaction theories – Properties of compacted soil – Compaction control – Specification of compaction requirements.

UNIT - II
PHYSICAL & CHEMICAL STABILISATION OF SHALLOW LAYERS
Lime stabilization – Lime fly ash stabilization – Cement stabilization – Other chemical admixtures – Granular admixtures – Thermal stabilization – Stabilisation by geotextiles.

UNIT - III
HYDRAULIC MODIFICATION AT DEPTH
Heavy tamping and Dynamic Consolidation – Preloading without vertical drains – Preloading with vertical drains – Electric kinetic dewatering.

UNIT - IV
PHYSICAL & CHEMICAL MODIFICATIONS AT DEPTH
Vibro compaction – Deep compaction by heavy tamping – Modification using explosives – Grouting – Stone columns – Lime columns.

UNIT – V
REINFORCED EARTH
Theory and Principles - Reinforcing strips - Design Criteria - Stability Analysis - Application.

References Books:

1. Soil stabilization principles and practice by Ingles O.G., and Met Calf J.P., Butter Worths, 1972.
2. Soil Mechanics for Road Engineers, HMSO, London.
3. Construction and Geotechnical methods in foundation engineering by Robert M. Koerner, Mc Graw Hill, New York, 1985.

4. Earth Reinforcement and Soil Structures by Colin Jones, Butter Worths, 1985.
5. Engineering with Geosynthetics by G.Venkatappa Rao and GVS Suryanarayana Raju, Tata Mc Graw Hill, New Delhi, 1990.
6. Geotechnical Engineering by C.Venkatramaiah, Wiley Eatern Ltd., New Delhi, 1993.

Course outcomes

1.Assess the geotechnical problems in various types of soils and suggest suitable ground improvement techniques.
2. Choose the suitable dewatering techniques for construction sites where the ground water table is at a higher level.
3. Identify the apt ground improvement technique for various types of soils and site conditions.
4. Apply the earth reinforcement techniques for retaining walls and slopes.
5. Use the various types of grouting materials and techniques to strengthen the soil.

PO&PSO / CO	PO1	PO2	PO3	PO4		PSO1	PSO2	PSO3
CO1	2	2				2		2
CO2	2	3						
CO3	2	2				2		2
CO4	2	2	3					2
CO5	2	2				2		2

***1: Low Correlated, 2: Moderately Correlated, 3: Highly Correlated**

CEGTC 603 EARTH AND EARTH RETAINING STRUCTURES

L + T / week : 3+1 Hrs | Sessional Marks : 20+20
University Exam : 3 Hrs | End Exam Marks : 60

Course Objectives

1. This course will develop students
2. To gain knowledge of earth pressure theories,
3. To know the analysis and design methods
    a. for retaining walls.
    b. To learn the concept of sheet pile walls and their design methods.
4. To learn the design aspects of Braced cuts
5. To develop students knowledge of Shafts, tunnels and Underground Conduits.

UNIT - I

EARTH PRESSURE

Advanced concepts of earth pressure – Approaches for active and passive pressures of cohesionless and cohesive soils – Log-spiral approach.

UNIT – II

DESIGN OF RETAINING WALLS

Types of retaining walls – Principles of design of retaining walls – Gravity retaining walls – Cantilever retaining walls – Counterfort retaining walls – Drainage from the back fill – Joints in retaining walls.

UNIT – III

DESIGN OF SHEET PILE WALLS

Types of sheet pile walls – Free cantilever sheet pile – Cantilever sheet pile in cohesionless soils – Cantilever sheet pile in cohesive soils. Anchored sheet pile wall with free earth support method – Rowe's moment reduction curves – Anchored sheet pile with fixed earth support method – Design of Anchors.

UNIT – IV

BRACED CUTS

Lateral earth pressure on sheetings – Different types of sheeting and bracing systems – Design of various components of bracing – Other criteria for design of braced cuts.

UNIT – V

SHAFTS, TUNNELS AND UNDERGROUND CONDUITS

Stress distribution in the vicinity of shafts and around tunnels – Arching in soils – Types of conduits – Loads on conduit due to surface loads – Construction of earth tunnels and conduits.

References :

1. Soil Mechanics - Jumikis

2. Foundation Engineering : Peck, Hanson & Thornburn
3. Foundation Analysis & Design : Bowles
4. Foundation Design : Teng
5. Soil Engineering : Merlin Grant Spangler.
6. Numerical Problems, Examples and Objective Questions in Geotechnical Engg. by A.V.Narasimha Rao & C.Venkatramaiah, University Press (India) Ltd., Hyd. 2000.

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Course outcomes

1. Develop an understanding of the fundamental concepts that governs the behaviour of Earth and Earth Retaining Structures.
2. Able provide designs of the Earth and Earth Retaining Structures in the field.

PO&PSO / CO	PO1	PO2	PO3	PO4		PSO1	PSO2	PSO3
CO1	2	3				2		2
CO2	2	3				2		2

***1: Low Correlated, 2: Moderately Correlated, 3: Highly Correlated**

CEGTC 604 NUMERICAL METHODS IN GEOTECHNICAL ENGINEERING

L + T / week : 3+1 Hrs | Sessional Marks : 20+20

University Exam : 3 Hrs | End Exam Marks : 60

Course Objectives

The course should enable the students to:

1) Learn the techniques of solving the algebraic and transcendental equations.
2) Learn to interpolate using Newton's forward and backward difference formulae for equal and unequal intervals
3) Understand the use of numerical differentiation and understands to find the approximate area using numerical integration.
4) Understand solving numerically the initial value problems for ordinary differential equations using single step and multi step method.
5) Learn the methods of solving second order partial differential equations numerically and use it to solve initial and boundary value problems for partial differential equations.

UNIT - I

BASIC CONCEPTS OF FINITE DIFFERENCE METHOD

Introduction - Basic Concept – Finite Difference Approximations : Diagonal five point formula. Laplace's Equation : Jacobi Method Gauss-Siedal Method. Parabolic Equations.

UNIT – II

GEOTECHNICAL APPLICATIONS OF FINITE DIFFERENCE METHOD

Applications of Geotechnical Engineering: Finite Difference formulations for one dimensional consolidation and two dimensional seepage.

UNIT – III

BASIC OF FINITE ELEMENT METHOD

Introduction; Boundary and Initial Value Problems; Methods of approximation : The Reyleigh Ritz Method and the Galerkin Method. One Dimensional Finite Elements, Interpolation function, Shape Function, Stiffness Matrix, Connectivity, Boundary Conditions.

UNIT – IV

FINITE ELEMENT MODELLING

Two dimensional problems using constant strain triangles. Introduction, Finite Element Modelling, Constant Strain Triangle. Problem Modelling and Boundary Conditions. Finite Element Applications to Geotechnical engineering problems such as stress distribution and stress-strain behaviour.

UNIT – V

CONSTITUTE MODELS FOR SOILS

Use of models in Engineering, Elasticity : Isotropic Elasticity, soil elasticity, anisotropic elasticity, the role of elasticity in soil mechanics. Plasticity and yielding : Introduction, Basic features : Yield function, failure criteria; Hardening law. Flow rule, examples of von mises criterion and cam clay model.

References

1. Introductory Methods of Numerical Analysis by SS Sastry, Prentice Hall of India.
2. Soil Mechanics and Foundations by Muni Budhu, John Wiley and Sons, INC.
3. Finite Element Analysis by George R.Buchanan, Schaum's Out line series, Mcgraw-Hill Internations Editions.
4. Introduction to Finite Elements in Engineering by TR Chadrupatla and AD Belegundu.
5. An Introduction to Critical State Soil Mechanics by Atkinson and Bransby, Mc Graw hill.
6. Analytical and Computer Methods in Foundation Engineering by Bowels JE, Mc Graw Hill.
7. Numerical Methods in Geotechnical Engineering by Desai and Christian JT, Mc Graw hill.

Course outcomes

The students should be able to:

1) Find out the roots of nonlinear (algebraic or transcendental) equations, solutions of large system of linear equations by direct and indirect methods.

2) Solve problems where huge amounts of experimental data are involved, the methods discussed on interpolation will be useful in constructing approximate polynomial to represent the data and to find the intermediate values.

3) Use the numerical differentiation and integration when the function in the analytical form is too complicated or the huge amounts of data are given such as series of measurements, observations or some other empirical information.

4) Solve engineering problems which are characterized in the form of nonlinear ordinary differential equations, since many physical laws are couched in terms of rate of change of one independent variable

5) Solve the initial and boundary value problems related heat flow, both one and two dimensional and vibration problems. Understands the numerical techniques of solving the partial differential equation in engineering applications.

PO&PSO / CO	PO1	PO2	PO3	PO4		PSO1	PSO2	PSO3
CO1	2	2				2		
CO2	2							
CO3	2	2		3			2	
CO4				2		2		2
CO5				2		2		2

***1: Low Correlated, 2: Moderately Correlated, 3: Highly Correlated**

CEGTE 605 STRUCTURAL DYNAMICS

L/week : 3Hrs Sessional Marks : 40

University Exam : 3 Hrs End Exam Marks: 60

Course Objectives: This Course Will Enable Students to

- Determine vibration characteristics of structures like frequency, amplitude, impedence and time
- period Differentiate the response of single and multi degree of freedom systems
- Determine the response of structures for pulse excitation like blast load
- Differentiate the response of Multi Degree of Freedom systems

UNIT - I
RESPONSE OF SIMPLE – SINGLE DEGREE OF FREEDOM SYSTEM
Definition of DOF – Idealization of structure as SDOF system – Formulation of equations of motion for various SDOF systems – Free vibration of un-damped systems – Determination of natural frequency - Free vibration of viscously damped systems – Determination of Damping in structures.
UNIT - II
RESPONSE OF SINGLE DEGREE OF FREEDOM SYSTEMS- FORCED VIBRATIONS
Forced vibration of systems – Steady state response to harmonic forces – Duhamel's integral- Numerical Evaluation – Response to support motion – Transmissibility – Construction of response Spectrum.
UNIT - III
ANALYSIS OF MULTI-DEGREE OF FREEDOM SYSTEMS
Formal Derivations — Formulation of equation of motion - Evaluation of natural frequencies and modes — Free vibration of undamped systems — Forced vibration of damped systems.

UNIT — IV
APPROXIMATE METHODS OF COMPUTING NATURAL FREQUENCIES
Rayleigh's method – Dunkerley's method – Methods of iteration – Stodola – Vainello Method –Rayleigh – Ritz method.
UNIT — V
DYNAMIC ANALYSIS OF CONTNUOUS SYSTEM
Vibration of flexural beams — Equation of motion — Free vibrations of Uniform Beams - Natural frequencies and Mode Shapes of Beams with different Support Conditions - Orthogonality Condition between Normal Modes.

References :
1. Dynamics of Structures, Clough R.W, and Penzien J, McGraw Hill.
2. Structural Dynamics and Introduction to Earthquake Engineering, Chopra A K, Prentice Hall.
3. Vibrations of Structures – Application in Civil Engg Design, Smith J. W.Chapman and Hall.
4. Dynamics of Structures, Humar J L, Prentice Hall.
5. Structural Dynamics - Theory and Computation, Paz Mario, CBS Publication.

Course Outcomes: At the end of the course, students will be able to
- Analyze the dynamic response of single degree freedom system using fundamental theory and equation of motion.
- Analyze dynamic response of Multi-degree of freedom system with lumped parameters.
- Apply approximate methods to obtain fundamental natural frequency of structures.

- Analyze dynamics response of Multi degree of freedom system with distributed mass.

PO&PSO / CO	PO1	PO2	PO3	PO4		PSO1	PSO2	PSO3
CO1								
CO2								
CO3								
CO4								
CO5								

***1: Low Correlated, 2: Moderately Correlated, 3: Highly Correlated**

CEGTP 607 COMPUTING TECHNIQUES (PRACTICAL)

Practicals / week : 3 Hrs — Sessional Marks : 40

University Exam : 3 Hrs — End Exam Marks : 60

Course Objectives

To develop skills for developing programs for different civil engineering applications using computers.

Analysis of geotechnical engineering laboratory test results and design of geotechnical problems using spread sheets – Use of Software like MATLAB, Statistical Software, AUTOCAD, etc.

Course outcomes

Able to develop and design the civil engineering structures.

PO&PSO / CO	PO1	PO2	PO3	PO4		PSO1	PSO2	PSO3
CO1	2	2		2		2	2	3

***1: Low Correlated, 2: Moderately Correlated, 3: Highly Correlated**

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ELECTIVES

01 CRITICAL STATE SOIL MECHANICS

L + T / week : 3+1 Hrs | Sessional Marks : 20+20
University Exam : 3 Hrs | End Exam Marks : 60

Course Objectives

The course should enable the students to:

- Get brief review of some fundamentals of Stresses and Strains and their states in soils.
- Able to understand the critical state line and the Roscoe surface.
- Gain knowledge on Cam-Clay for analyzing the the plastic behaviour of soils before failure.

UNIT - I

STRESSES AND STRAINS IN SOILS :

Introduction - Normal stress and strain - Shear stress and strain - Soil as a continuum - Pore pressure and total stress - The principal of effective stress - The significance of effective stress.

STATES OF STRESS AND STRAIN SOILS :

Introduction - Two-dimensional states of stress - Mohr's circle of stress - Principal stresses and principal planes - Mohr's circles of total and effective stress - Two dimensional states of strain-plane strain - Relationships between states of stress and states of strain.

UNIT - II

STRESS AND STRAIN AND INVARIANTS :

Introduction - Stress paths - Stress paths with 1 : 2 axes - Stress paths with t':s' and t:"s axes - Invariants of stress - Stress paths with q':p' or q:p axes - Invariants of strain - strain paths - Volumetric strains - Correspondence between parameters for stress and strain - Stress-strain behaviour of an ideal elastic soil.

UNIT - III

THE CRITICAL STATE LINE AND THE ROSCOE SURFACE :

Introduction - Families of undrained tests - Families of drained tests - The critical state line - Drained and undrained planes - The Roscoe surface - The shape of the Roscoe surface - The Roscoe surface as a state boundary surface.

UNIT - IV

THE BEHAVIOUR OF OVERCONSOLIDATED SAMPLES :

Introduction - Drained tests - The Hvorslev surface - The critical state line - The complete state boundary surface - Volume changes and pore water pressure changes.

UNIT - V

THE BEHAVIOUR OF SANDS :

Introduction - The critical state line for sand - Normalized plots - The effect of dilation - Consequences of Taylor's model.

BEHAVIOUR OF SOILS BEFORE FAILURE :

Introduction - Elastic and Plastic deformations : the elastic wall - Calculation of elastic strains - Calculation of elastic strains for undrained loading in terms of total stresses - Essential plasticity theory - Plasticity for soils - Cam-clay.

Reference Books :

1. Atkinson and Branaby Mechanics of Soils - An introduction to critical state soil mechanics, Mc Graw Hill (1978).
2. Schofield and Wroth, Critical State Soil Mechanics Mc Graw Hill (1968).

Course Outcomes:

Familiarize with the Development of constitutive laws for geotechnical materials including linear or nonlinear elastic (hyperbolic), linear elastic perfectly plastic, and non-linear elastic-plastic models based on the Critical State Soil Mechanics theory.

PO&PSO / CO	PO1	PO2	PO3	PO4		PSO1	PSO2	PSO3
CO1	2	2	2	2		2		2

***1: Low Correlated, 2: Moderately Correlated, 3: Highly Correlated**

02 DEEP FOUNDATIONS

L + T / week : 3+1 Hrs | Sessional Marks : 20+20

University Exam : 3 Hrs | End Exam Marks : 60

Course Objectives

- The course should enable the students to :
- To develop and understand of the behaviour of foundations for engineering structures and to gain knowledge of the design methods that can be applied to practical problems.
- Provide with a basic understanding of the Pile Foundations.
- Get introduced to the Laterally loaded piles and the methods for estimation of Ultimate resistance and deflection of laterally loaded piles.
- Familiarize with the concept of pile groups procedures used for: a) bearing capacity estimation, b) end bearing capacity, c) skin friction – pile foundation.
- Introduce the concept of well foundation and its design and construction.
- Developing skills for developing, executing the computer programs for Pile Foundations.

UNIT - I

INTRODUCTION

Pile foundation – Necessity – Classification of piles – Methods of installation – Axially Loaded Piles - Single pile in cohesive and cohesionless soils – Piles in layered soils – Compressive and uplift loads – Negative skin friction – Settlement analysis.

UNIT – II

Laterally Loaded Piles – The occurence of lateral loading - Rigid and flexible piles - Ultimate lateral resistance and deflection of vertical piles carrying lateral loads by I.S. Code method, Brom's method and Reese and Matlock method.

UNIT – III

PILE GROUPS

Pile groups – Necessity – Spacing – Group efficiency – Pile groups in cohesive and cohesionless soils – Individual pile failure – Block failure – Negative skin friction – Free standing pile groups and piled rafts – Settlement analysis.

UNIT - IV Well Foundations – Types of wells - Depth of well foundation - Bearing capacity and stability considerations - Terzaghi's analysis - IRC method.

UNIT - V

Computer Aided Design

Pile Foundations – Axially Loaded Piles – Laterally Loaded Piles and Pile Groups.

Reference Books :

1. Bowles : Foundation Analysis and Design.
2. V.N.S.Murthy : Soil Mechanics & Foundation Engineering.
3. Bowles : Analytical and Computer Methods in Foundation Engineering.
4. Zeevaret : Foundations for difficult subsoil conditions.
5. Chellis : Pile foundations.
6. Tschebotarioff : Soil Mechanics, Foundations and earth structure.
7. C.Venkatramaiah (1995), Geotechnical Engineering, Wiley Eastern Ltd. (New Age International Ltd.), New Delhi.
8. AV Narasimha Rao and C.Venkatramaiah, (2000), Numerical Problems, Examples and Objective Questions in Geotechnical Engg., Universities Press (India) Ltd., Hyderabad.
9. M.J.Tomlinson, Pile Design and Construction Practice, A View Point Publication, London.
10. H.G. Poules, Pile Foundation Analysis and Design, Ed. Davis, John Wiley & Sons, New York.
11. IS 2911 Part 1-1979 - Code of Practice for design and construction of pile foundations.

Course Outcomes:

1. The students will be able to:
   Get expertise in the methods of installation and calculation of load carrying capacity of different types of Piles.

2. Gain experience in solving field geotechnical engineering problems with deep foundations such as Pile and Well foundations.

PO&PSO / CO	PO1	PO2	PO3	PO4		PSO1	PSO2	PSO3
CO1	2	2		2		2		2
CO2	2	3		2		2		2

***1: Low Correlated, 2: Moderately Correlated, 3: Highly Correlated**

03 EARTH AND ROCKFILL DAMS

L + T / week : 3+1 Hrs | Sessional Marks : 20+20

University Exam : 3 Hrs | End Exam Marks : 60

Course Objectives:

1. This course will develop students
2. To gain knowledge of Embankment Dams and their considerations.
3. To know methods for the analysis and Earthquake Considerations for retaining walls.
4. To learn the concept of Seepage Flow and analysis for assessment of seepage.
5. Familiarize with the treatment methods for reducing seepage in different structures.
6. To gain knowledge on Rockfill dams and their design. Considerations

UNIT – I
EMBANKMENT DAMS – BASIC CONSIDERATIONS
Selection of dam site – Choice of type of dam – Classification of embankment dams – Types of failures – Criteria for safe design – Foundation investigation – laboratory tests – Construction of earth dams – Quality control and instrumentation.

UNIT – II
SEEPAGE THEORY
Fundamentals of seepage flow – Kozney's solution – Anisotropic seepage – Top flow line – Flownet for earth dams – Seepage force and its effects – Control of seepage through embankment dams – Filter design – Drainage measures.

UNIT – III
FOUNDATION TREATMENT
Rock foundations – Alluvial foundations – Primary foundation – Clayey soils – Seepage containment – Upstream impervious danket – Dam stream drainage.

UNIT – IV
STABILITY ANALYSIS
Critical stage & port pressures in earth dams – Stability analysis – Effective and total stress approach – Method of slices – Location of critical circle – Earthquake considerations.

UNIT – V
ROCKFILL DAMS
General characteristics – Materials – Foundations – Design of dam suction – Drainage – Construction.

References

1. Earth and Earth Rock Dams by J.L. Sherard et al.
2. Earth and Rockfill Dams by Bharat Sigh and H.D. Sharma.
3. Development in Soil Mechanics – I edited by C.R. Scoott.

Course Outcomes

- Develop an understanding of the fundamental concepts that governs the behaviour of Earth and Rockfill Dams
- Able provide designs of the Earth Rockfill Dams in the field.

PO&PSO / CO	PO1	PO2	PO3	PO4		PSO1	PSO2	PSO3
CO1	3	2	2	2		2		2
CO2	3	2	2	2		2	2	2

***1: Low Correlated, 2: Moderately Correlated, 3: Highly Correlated**

04 EVIRONMENTAL GEOTECHNIQUES

L + T / week : 3+1 Hrs | Sessional Marks : 20+20
University Exam : 3 Hrs | End Exam Marks : 60

Course Objectives:

- To know the composition and structure of the soils and their role in engineering behavior

To understand waste reduction techniques and waste containment systems

UNIT – I

INTRODUCTION TO ENVIRONMENTAL GEOTECHNIQUES:

Impact of wastes on ground water quality - Current methodology of land disposal of solid wastes - Contaminant migration - Pollution control barriers - Cut-off walls and permeable surrounds - Synthetic liners.

SOURCE PRODUCTION AND CLASSIFICATION OF WASTES :

Sources and types of wastes, hazardous waste - Characteristics and classification of hazardous wastes - Generation rates.

UNIT – II

SOIL POLLUTANT INTERACTION :

Soil structure, geotechnical parameters, practical implications, soil-water interaction.

UNIT – III

DOUBLE LAYER THEORY AND COMPRESSIBILITY OF CLAYS :

Fundamentals of double layer theory, factors influencing the compressibility behaviour : ion concentration, clay type, cation valency, dielectric constant, temperature.

UNIT – IV

CRITERIA FOR SELECTION OF SITES FOR WASTE DISPOSAL FACILITIES :

Process selection, criteria for selection, construction facility.

UNIT – V

RIGID OR FLEXIBLE MEMBRANE LAYERS :

Introduction - Clay liners, construction of clay liners, geomembranes, design considerations, composite liners - Case studies.

Reference Books :

1.Kays W.D. (1986), Construction of Lining for Reservoirs, Tanks and Pollution Control Facilities, John Wiley.
2.Fetter C.W. (1988), Applied Hydrogeology, Merrit Publishing Co. U.S.A.

Course Outcomes:

Able to analyze and design waste containment systems to preserve and conserve the environment

PO&PSO / CO	PO1	PO2	PO3	PO4		PSO1	PSO2	PSO3
CO1	2					2		2

***1: Low Correlated, 2: Moderately Correlated, 3: Highly Correlated**

05 MARINE FOUNDATIONS

L + T / week : 3+1 Hrs | Sessional Marks : 20+20

University Exam : 3 Hrs | End Exam Marks : 60

Course Objectives:

- Provide with a basic understanding of the Ocean resources and types of Offshore Structures.
- Introduction to Marine soils and the geotechnical investigations in Marine Soils.
- Gain knowledge on Shallow Foundations for structures on Sea bed , Deep foundations and Anchored Foundations.
- Introduce to the students, the principal types of foundations and the factors governing the choice of the most suitable type of foundation for a given marine Structure.

UNIT – I
OFFSHORE STRUCTURES
Ocean resources – Types of offshore structures – Fixed and floating platforms – Design considerations – Wind, wave and current loads – Construction and installation.

UNIT – II
MARINE SOILS
Origin, nature and distribution of marine soils - their engineering properties - sampling and sample disturbance - in-situ testing – Soil behaviour under cyclic loading – Practical approaches for sands and clays.

UNIT – III
MARINE GEOTECHNICAL INVESTIGATIONS
Phases of investigations – Geophysical surveying – Drilling and sampling procedures – Insitu testing – laboratory testing.

UNIT – IV

SHALLOW FOUNDATIONS
Site investigation – Types of shallow foundations for structures on sea bed – Bearing capacity – Effect of eccentric and inclined loads – Construction.

UNIT – V
DEEP FOUNDATIONS AND ANCHORS :
Pile foundation – Axial capacity – Lateral capacity – Deflections – Construction – Anchored foundations.

Reference Text Books :

1. Swamisaran, Analysis & Design of Substructures, OXFORD & IBH Publishing Company Private Limited, Delhi.

2. H.G. Poulos, Marine Geotechniques, Unwin Hyman, London.

3. Pienne Le Tirant, See Bed Recermaissquce and Offshore Soil Mechanics for the installation of petroleum structures, Gulf Publishing Company, Hougtan, Texas.

Course Outcomes:

- Able to select suitable foundation for a given marine structure..
- Know in the calculation of load carrying of selected foundation.

PO&PSO / CO	PO1	PO2	PO3	PO4		PSO1	PSO2	PSO3
CO1	2	3		2		2		2
CO2	2	3		2			2	2

***1: Low Correlated, 2: Moderately Correlated, 3: Highly Correlated**

06 PAVEMENT DESIGN

L + T / week : 3+1 Hrs | Sessional Marks : 20+20
University Exam : 3 Hrs | End Exam Marks : 60

Course Objectives:

1. To study theory of vibrations and its effect on machine foundation.
2. To learn about different types of machine foundations.
3. To develop and understand the behaviour of machine foundation and to gain knowledge of design method that can be applied to practical problems

UNIT – I
GENERAL PRINCIPLES OF PAVEMENT DESIGN
Pavement types, comparison of Highway and Airport Pavements, Wheel loads, Design factors.

UNIT – II
DESIGN OF FLEXIBLE HIGHWAY PAVEMENTS
Stresses in flexible pavements and design of flexible highway pavements.

UNIT – III
DESIGN OF RIGID HIGHWAY PAVEMENTS
Stresses in rigid pavements, Design of rigid highway pavements and joints and reinforcement requirements.

UNIT – IV
DESIGN OF AIRPORT PAVEMENTS
Flexible Pavements : Design methods for flexible airport pavements including LCN system of flexible pavement.
Rigid Pavements : Design methods for rigid airport pavement, LCN system of rigid pavement and joints and reinforcement requirements.

UNIT – V
PAVEMENT EVALUATION AND STRENGTHENING
Pavement evaluation – Structural evaluation and evaluation of pavement surface condition. Strengthening of existing pavements – Types of overlay and their design.
References :

1. Principles of Pavement Design (Second Edition) – E.J.Yoder & M.W.Witczak – John Wiley & Sons, Inc.
2. Highway Engineering – S.K. Khannan & C.E.G. Justo – Nemchand & Bros., Roorkee.
3. Airport Planning & Design – S.K. Khanna, M.G. Arora & S.S.Jain – Nemchand & Bros., Roorkee.
4. Principles of Transportation and Highway Engineering – G.V. Rao – Tata McGraw Hill, New Delhi.

Course Outcomes:

- Familiarize the student to learn wave and wave propagation and dynamic properties of soils
- Familiarize the student with the procedure used for machine foundation design.
- Familiarize the student about the vibration isolation and screening techniques.

PO&PSO / CO	PO1	PO2	PO3	PO4		PSO1	PSO2	PSO3
CO1								
CO2	2	3				2		2
CO3				2		2		2

***1: Low Correlated, 2: Moderately Correlated, 3: Highly Correlated**

07 ROCK MECHANICS

L + T / week : 3+1 Hrs | Sessional Marks : 20+20
University Exam : 3 Hrs | End Exam Marks : 60

Course Objectives:

1. To furnish the junior year students with the elementary techniques about decision making in conjunction with the systematic approach as applied to engineering.
2. To provide students with exposure to the essentials of resource optimization and allocation in the presence of constraints and uncertainties constitute the main body of the course.
3. To establish a bridge to the higher level of design, engineering management, and environmental engineering courses with the elementary linear algebra and probability and statistics, in order to form students as short-and long-term decision makers.

UNIT – I

PHYSICAL AND MECHANICAL PROPERTIES OF ROCKS

Physical Properties – Porosity; Density; Moisture Content; Degree of saturation; Coefficient of permeability; Electrical properties ; Thermal properties ; Swelling ; Anisotropy; Durability.
Mechanical Properties – Strength; Elasticity; Plasticity; Deformability; Hardness.

UNIT – II

STRENGTH AND FAILURE OF ROCKS

Failure; Types of failure; Yield criteria or failure theories – Maximum principal stress theory; Maximum principal strain theory; Maximum shear stress theory; Maximum strain energy theory; Maximum shear strain energy theory; Mohr's theory; Coulomb's theory; Griffith criterion of brittle failure.

UNIT – III

LABORATORY & IN-SITU TESTS

Uniaxial compressive strength test; Tensile strength test; Flexural strength test; Shear strength test; Tests for elastic constants.

IN-SITU TESTS

Insitu test for deformability-plate load test – Pressure tunnel test – Bore hole test; Shear tests; Strength tests – Bearing capacity test – Compressive strength tests – Tensile strength tests; Tests for internal stress in rock.

UNIT – IV

DYNAMIC PROPERTIES OF ROCK

Types of waves; Theory of wave propagation; Factors influencing wave velocity; In-situ determination of elastic properties of rocks.

UNIT – V

METHODS OF IMPROVING THE PROPERTIES OF ROCK MASSES

Grouting, Grouting material – Cement grout – Chemical grouts – Bituminous grouts; Grouting operations; Methods of grouting; rock bolting – Mechanism – Principles of design.

Text Books

1. Engineering Properties of Rocks by I.W. Farmer.
2. Engineering Properties of Soils and Rocks by F.G. Bell.
3. Introduction to Rock Mechanics by R.F. Goodman
4. Fundamentals of rock Mechanics by J.C. Jaeger and N.G.W. Cook.

Course Outcomes:

- An ability to apply knowledge of mathematics, science and engineering
- An ability to identify, formulate and solve engineering problems
- The broad education necessary to understand the impact of engineering solutions in a global and societal context
- A knowledge of contemporary issues

An ability to use the techniques, skills and modern engineering tools necessary for engineering practice

PO&PSO / CO	PO1	PO2	PO3	PO4		PSO1	PSO2	PSO3
CO1								2
CO2	2	2		3		2	2	2
CO3	2	2	2	2		2	2	2
CO4	2	2	2	2		2	2	2

***1: Low Correlated, 2: Moderately Correlated, 3: Highly Correlated**

08 STRUCTURAL ANALYSIS AND DESIGN OF FOUNDATIONS

L + T / week : 3+1 Hrs | Sessional Marks : 20+20
University Exam : 3 Hrs | End Exam Marks : 60

Course Objectives:

1. To develop and understand of the behavior of foundations for engineering structures and to gain knowledge of the design methods that can be applied to practical problems.
2. Provide the students with a basic understanding of the eccentrically loaded footings and footings subjected to moments.
3. Introduce to the students, the principal types of footings and foundations and the factors governing the choice of the most suitable type of foundation for a given solution.
4. Familiarize the students with the procedures used for: design of a Combined and Strap Footings, b) Raft Foundations and c) Limit State method design for Precast concrete Piles and Pile Cap
5. Familiarize the students the concept of well foundation and its design and construction.

UNIT – I

Structural analysis and design of the following types of footings and foundations :

Eccentrically loaded footings and footings subjected to moments.

UNIT – II

Combined footings, strap footings.

UNIT – III

Raft foundations (Conventional design).

UNIT – IV

Rafts - modulus of subgrade reaction approach, finite difference approach (Design examples excluded).

UNIT – V

Precast concrete piles and pile cap.
(NOTE : Limit State Method of Design only is included).

Reference Books :

1. Bowles : Foundation Analysis and Design.
2. Teng : Foundation Design.
3. Vazirani and Ratwani : Analysis and Design of Structures - Vol. II (Concrete Structures).
4. Analysis and Design of Substructures by Swamy Saran, OXFORD & IBH Publishing Company Pvt. Ltd., Delhi.

Course Outcomes:

1. Able to select suitable foundation for a given structure and site.
2. Expertise in the calculation of load carrying capacity of selected foundation.
3. Gain experience in solving field geotechnical engineering problems involving Shallow and Deep Foundations.

PO&PSO / CO	PO1	PO2	PO3	PO4		PSO1	PSO2	PSO3
CO1	2	2		2				2
CO2	2	3		2		2	2	2
CO3	2	3		2		2	2	2

***1: Low Correlated, 2: Moderately Correlated, 3: Highly Correlated**

09 GEOSYNTHETICS IN CIVIL ENGINEERING

L + T / week : 3+1 Hrs | Sessional Marks : 20+20

University Exam : 3 Hrs | End Exam Marks : 60

Course Objectives:

1. To acquaint the student with the traditional and the most recent developments of improving the geotechnical characteristics of the soils for construction purposes.
2. To know soil improvement techniques using different forms of fibres.
3. Gain knowledge about properties, different forms and functions of geotextiles.
4. Applied to d of increase the shear strength, or to reduce the pore pressure, permeability or compressibility in such a way that the soil properties do not deteriorate as a result of weathering or of changes in water content.

UNIT – I
AN OVERVIEW
Historical Development – Types of Geosynthetics – Geotextiles – Geogrids – Geonets – Geomembranes – Geocomposites – Functions – Reinforcement – Separation – Filtration – Drainage – Barrier Functions.

UNIT – II
RAW MATERIALS AND MANUFACTURING METHODS
Methods – Polyamide – Polyster – Polyethylene – Polypropylene – Poly Vinyl chloride – Woven – Monofilarment – Multifilament – Slit Filament – Non-Woven – Mechanically bonded – Chemically bonded – Thermally bonded.

UNIT – III
PHYSICAL AND HYDRAULIC PROPERTIES
Physical Properties : Mass per unit area – Thickness – Specific gravity

Hydraulic properties : Apparent open size – Permittivity – Transmissitivity.

UNIT – IV
MECHANICAL PROPERTIES AND DURABILITY
Mechanical Properties : Uniaxial Tensile Strength – Burst and Puncture Strength – Soil Geosynthetic friction tests Durability : Abrasion resistance – Ultraviolet resistance.

UNIT – V
APPLICATIONS OF GEOSYNTHETICS
Use of geosynthetics for filtration and drainage – Use of geosynthetics in roads – Use of reinforced soil in Retaining walls – Improvement of bearing capacity – Geosynthetics in land fills.

References :

1. Engineering with Geosynthetics by G. Venkatappa Rao and G.V.S. Suryanarayana Raju – Tata Mc Graw Hill, New Delhi, 1990.

2. Construction and Geotechnical Methods in Foundation Engineering by Robert M. Koerner – Mc Graw Hill, New York, 1985.
3. Designing with Geosynthetics by Robert M. Koerner, Prentice Hall, New Jersey, USA, 1989.

Course Outcomes:

By the completion of the course, the students should be able to:

1. Familiarize with functions of geosynthetics
2. Able to use appropriate geosynthetics for a particular application.

PO&PSO / CO	PO1	PO2	PO3	PO4		PSO1	PSO2	PSO3
CO1	2	2		2				2
CO2				2		2		2

***1: Low Correlated, 2: Moderately Correlated, 3: Highly Correlated**

10 FOUNDATIONS ON EXPANSIVE SOILS

L + T / week : 3+1 Hrs | Sessional Marks : 20+20
University Exam : 3 Hrs | End Exam Marks : 60

Course Objectives:

1. To gain knowledge on the Composition, general behaviour , Swelling Characteristics of Expansive Soils.
2. Able to know the techniques for controlling swelling in expansive soils .
3. to know the criteria considerations for design and construction of structures on expansive soils.
4. to familiarize with differents methods for modification of swelling characteristics of expansive soils

UNIT – I

GENERAL PRINCIPLES :

Origin of expansive soils - Physical properties of expansive soils – Mineralogical composition - Identification of expansive soils - Field conditions that favour swelling - Consequences of swelling .

UNIT – II

SWELLING CHARACTERISTICS :

Swelling characteristics – Laboratory tests – Prediction of swelling characteristics – Evaluation of heave.

UNIT – III

TECHNIQUES FOR CONTROLLING SWELLING

Horizontal moisture barriers – Vertical moisture barriers – Surface and subsurface drainage – Prewetting – Soil replacement – Sand cushion techniques – CNS layer technique.

UNIT – IV

FOUNDATIONS ON EXPANSIVE SOILS :

Belled piers - Bearing capacity and skin friction - Advantages and disadvantages - Design of belled piers - Underreamed piles - Design and construction.

UNIT – V

MODIFICATION OF SWELLING CHARACTERISTICS

Lime stabilization – Mechanisms – Limitations – Lime injection – Lime columns – Mixing – Chemical stabilization – Construction.

Reference Books :

1. FU HUA CHEN, Foundations on Expansive Soils, Elsevier Scientific Publishing Company, New York.
2. Gopal Ranjan & A.S.R.Rao, Basic and Applied Soil Mechanics, New Age International Publishers - New Delhi.
3. Hand Book on Underreamed and Bored Compaction Pile Foundation, CBRI, Roorkee.
4. IS : 2720 (Part XLI) - 1977 - Measurement of Swelling Pressure of Soils.
5. R.K.Katti, Search for Solutions in Expansive Soils.

6. Alam Singh, Modern Geotechnical Engineering, Geo-Environ Academia, Jodhapur.
7. Swami Saran, Analysis and Design of Substructures, Oxford & IBH, New Delhi.

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Course Outcomes:

1. Able to measure and estimate the swelling characteristics of expansive soils.
2. Can design the structures on expansive soils.

PO&PSO / CO	PO1	PO2	PO3	PO4		PSO1	PSO2	PSO3
CO1	3	3		2		2	2	2
CO2	2	3		3		2		2

***1: Low Correlated, 2: Moderately Correlated, 3: Highly Correlated**