JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY: KAKINADA

KAKINADA – 533 003, Andhra Pradesh, India

R25 M.Tech CIVIL ENGINEERING

SOIL MECHANICS & FOUNDATION ENGINEERING

DEPARTMENT OF CIVIL ENGINEERING

COURSE STRUCTURE & SYLLABUS

M.Tech CIVIL ENGINEERING

(Common to

GEOTECHNICAL ENGINEERING/

SOIL MECHANICS & FOUNDATION ENGINEERING)

Programme

(Applicable for batches admitted from 2025-2026)

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY KAKINADA

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VISION AND MISSION OF THE UNIVERSITY

VISION

The University is primarily promoting quality of education in the areas of Science, Technology, Engineering and Mathematics (STEM) as four academic pillars of education, to excel in teaching, learning, research, consultancy and placements through innovative practices with global perspective.

MISSION

Design an Industry relevant curriculum from time to time with a Global perspective Promoting quality education by embracing ICT delivery mechanism with continuous pedagogy through e-learning mechanism Spread across for industry collaborations with a focus to pre-training and placements for technology transfer to society Establishing centers of excellence to promote research and innovations in multidisciplinary areas to bring in patent culture and consultancy practices International Collaborations for student outreach Facilitating international students to study in JNTUK to infuse cross culture learning practices.

Vision and Mission of the Institute

Vision and Mission of the Department

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SOIL MECHANICS & FOUNDATION ENGINEERING

I – Semester

S.No	Category	Course Name	L	T	P	C
1	Program Core1	Advanced Soil Mechanics	3	1	0	4
2	Program Core2	Foundation Engineering	3	1	0	4
3	Program Core3	Ground Improvement Techniques	3	1	0	4
4	Program Elective I		3	0	0	3
		a) Construction in Expansive Soils				
		b) Soil-Foundation Interaction				
		c) Critical State Soil Mechanics d) Finite Element Method				
5	Program Elective II		3	0	0	3
		a) Design with Geo-synthetics				
		b) Rock Mechanics				
		c) Remote Sensing And Geographical Information Systems				
		d) Marine Geotechnical Engineering				
6	Laboratory 1	Geotechnical Engineering Laboratory-1	0	1	2	2
7	Laboratory 2	Geotechnical Engineering Laboratory - 2	0	1	2	2
8		Seminar-I	0	0	2	1
		Total	**15**	**5**	**6**	**23**

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II – Semester

S.No.	Category	Course Name	L	T	P	C
1	Program Core 4	Advanced Foundation Engineering	3	1	0	4
2	Program Core 5	Earth Retaining Structures	3	1	0	4
3	Program Core 6	Soil Dynamics & Machine Foundations	3	1	0	4
4	Program Elective3		3	0	0	3
		a) Pavement Analysis Design & Evaluation				
		b) Construction Planning & Methods				
		c) Geotechnical Earthquake Engineering				
		d) Geotechnics of Underground Structures				
5	Program Elective4		3	0	0	3
		a) Earth Dams				
		b) Geo Environmental Engineering				
		c) Numerical Methods in Geotechnical Engineering				
		d) Reliability Analysis and Design				
6	Laboratory 3	Geotechnical Engineering Laboratory -III	0	1	2	2
7	Laboratory 4	Software Design Laboratory	0	1	2	2
8		Seminar II	0	0	4	2
		Total	15	5	6	**23**

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SOIL MECHANICS & FOUNDATION ENGINEERING

I Semester	ADVANCED SOIL MECHANICS	L	T	P	C
		3	1	0	4

Pre-Requisites: None

Course Outcomes: At the end of the course, the student will be able to

CO1	Acquire complete knowledge on stress components and distribution.
CO2	Acquire the complete knowledge on strain and stress strain relationships.
CO3	Tackle problems on seepage through soils
CO4	Understand consolidation phenomenon and apply it to various Geotechnical problems
CO5	Understand shear strength behavior of soils and its applications in Geotechnical Engineering

DETAILED SYLLABUS:

Unit: 1

Analysis of Stress: Concept of Stress – Body force, Surface force and stress vector – The state of stress at a point – Normal and shear stress components – Rectangular stress components - Stress components on an arbitrary plane – Digression on Ideal fluid – Equality of Cross shears - Cauchy's formula – Equations of Equilibrium – Transformation of coordinates – Plane state of stress. Principal Stresses – Stress Invariants – Particular cases – Mohr's circle for the Three-dimensional state of stress – Mohr's stress plane – Plane of maximum shear – Octahedral stresses – Pure shear decomposition into Hydrostatic and pure shear states.

Unit: 2

Analysis of Strain – Deformation – Deformation in the Neighborhood point – Change in length of a linear element – Change in length of a linear element – Linear component – Rectangular strain components – The state of strain at a point – Shear strain components – Change in direction of a linear element - Cubical Dilation – Change in the angle between Two line elements – Principal Axes of strain and principal strains – Plane state of strain – Compatibility condition – Strain deviator and its Invariants, Stress – Strain relations – Stress – Strain relations for isotropic materials – Modules of Rigidity – Bulk modules.

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Unit: 3

Permeability and Seepage: Darcy's law – Validity of Darcy's Law, Coefficient of Permeability in the Field - Equation of Continuity – Use of Continuity Equation for Solution of Simple flow problems – Flow nets – hydraulic uplift force under structure – Flow nets in anisotropic material – Construction of flow nets for hydraulic structures on non-homogeneous sub soils – Directional variation of permeability in anisotropic medium – Seepage through earth dams – Entrance, discharge and transfer condition of line of seepage through earth dams. Flow net construction for earth dams – filter design.

Unit: 4

Consolidation: Mechanism of consolidation – Primary consolidation – Stress history Pre-consolidation pressure – Terzaghi's one-dimensional consolidation theory and equation – Solution by Fourier series and finite difference methods – Determination of coefficient of consolidation – U versus T relationship for different forms of initial excess pore water pressure distribution – Degree of consolidation under time – dependent loading – secondary compression – Radial consolidation.

Unit: 5

Shear strength: Principle of effective stress – Measurement of strength parameters - Strength tests based on drainage conditions – Skempton's pore pressure coefficients – Stress paths – Shear strength of cohesionless soils – Strength and deformation behaviors – Dilatancy – Critical void ratio – Liquefaction of soils – Shear strength of saturated cohesive soils – Triaxial testing. Normally and over consolidated clays.

REFERENCES

1. " Advanced soil mechanics" by Braja M. Das., McGraw Hill Co.,
2. "Advanced Solid Mechanics" by L.S. Srinath
3. " Foundations of theoretical soil mechanics" by M.E. Harr., McGraw Hill Co.
4. "Introduction to Geotechnical engineering" by Holtz and Kovacs., Prentice Hall.
5. "Soil Mechanics" by R.F.Craig, Chapman and Hall.
6. "Elements of soil mechanics" by G.N. Smith., B.S.P. Professional Books, Oxford, London.

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SOIL MECHANICS & FOUNDATION ENGINEERING

I Semester	FOUNDATION ENGINEERING	L	T	P	C
		3	1	0	4

Pre-Requisites: None

Course Outcomes: At the end of the course, the student will be able to

CO1	Know the process of the soil exploration and sample collection, preservation and transportation of samples to the laboratory.
CO2	Interpret the results of field tests.
CO3	Determine the bearing capacity of soils for shallow foundations
CO4	Make the choice of foundation based on sub soil conditions.
CO5	Determine the settlement of foundations in different soils.

Mapping of Course Outcomes with Outcomes:

Course Out Comes	PO1	PO2	PO3	PO4	PO5
CO1	1	3	1	1	2
CO2	--	3	1	--	--
CO3	--	3	1	--	1
CO4	--	3	1	--	--
CO5					

1. **Slightly 2. Moderately 3. SubstantiallyDetailed Syllabus:**

Unit: 1

Soil Exploration – Importance, Terminology, - Geophysical methods. Borings - Location, spacing and depth, Methods of Boring including Drilling, Stabilization of Boreholes, – Methods of sampling -Types of Samples and Samplers- Cleaning of Bore holes, Preservation, Labeling and Shipment of Samples - Design Considerations of Open Drive Samplers.

Unit: 2

Field tests - The Standard Penetration Test – its limitations and Corrections – Cone Penetration Test – Field Vane Shear Test – **Borehole** Shear Test – Dilatometer Test – **Pressuremeter** test – Planning of exploration -- Preparation of Soil Report – Bore log.

Unit: 3

Shallow Foundations –Bearing capacity – **Terzaghi's**, Meyerhof's, Hansen's and Vesic's Bearing Capacity Theories – IS method of Bearing Capacity - Factors - Bearing Capacity of Stratified Soils - Bearing Capacity Based onPenetration Resistances - Safe Bearing Capacity and Allowable Bearing Pressure

Unit: 4

Types of foundations and the choice of the type of foundations. Design Considerations including Location and Depth, Proportioning of Shallow Foundations- Isolated and Combined Footings and Mats - Design Procedure for Mats. Floating Foundation- Fundamentals of Beams on Elastic Foundations.

Unit: 5

Settlement Analysis – Elastic settlement in granular soils – Meyerhof's, De Beer and Marten's and Schemertmann's equations-Elastic settlements of surface and subsurface **footings** in clays - Skempton and Bjerrum's pseudo three-dimensional approach to consolidation settlement, settlement from in-situ tests. Tolerable settlements.

REFERENCES

1. Principles of Foundation Engineering by Braja M. Das.
2. Soil Mechanics in Engineering Practice by Terzagi and Peck
3. Foundation Design by Wayne C. Teng, John Wiley & Co.,
4. Foundation Analysis and Design by J.E. Bowles McGraw Hill Publishing Co.,
5. Analysis and Design of sub structures by Swami Saran
6. Design Aids in Soil Mechanics and Foundation Engineering by Shanbaga R. Kaniraj, Tata McGraw Hill.
7. Foundation Design and Construction by MJ Tomlinson – Longman Scientific
8. A short course in Foundation Engineering by Simmons and Menzes - ELBS

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SOIL MECHANICS & FOUNDATION ENGINEERING

I Semester	GROUND IMPROVEMENT TECHNIQUES	L	T	P	C
		3	1	0	4

Pre-Requisites: Soil Mechanics

Course Outcomes: At the end of the course, the student will be able to

CO1	Understand the principles of various ground improvement techniques
	Prefer suitable ground improvement techniques based on the Soil conditions and
CO2	local available Materials
CO3	Understand the principles and suitability of various stabilization techniques
	Select suitable stabilization techniques based on the Soil conditions and local
CO4	available materials Understand the Principles of dewatering techniques and to apply suitable
CO5	dewatering technique in the field depending on the requirement
CO6	Understand the grouting technology and its applications by selecting the suitable grout based on the field conditions

Detailed Syllabus:

Unit: 1

Introduction – Need for Engineering Ground – Classifications of Ground Modification Techniques – Suitability, Feasibility and Desirability. Densification of cohesionless soils – Deep Compaction – Vibroflobation – Vibro Composer method - Blasting – Densification at Ground. -Vibrocompaction- Heavy Tamping

Unit: 2

Improvement of Cohesive soils – Preloading - Soil Replacement – Radial Consolidation – Vertical and Radial Consolidation - Vertical Drains – Sand Drains – Effect of Smear – Sandwicks – Band drains – Dynamic Compaction.

Unit: 3

Stabilization- Mechanical Stabilization, Lime Stabilization, Cement Stabilization, Bitumen Stabilization, Thermal Stabilization, Chemical Stabilization and Stabilization with Different Admixtures

Unit: 4

Dewatering :- Dewatering methods – open sumps and ditches – gravity flow wells – Vacuum dewatering – Electro – kinetic dewatering – Electroosmosis

Grouting: Overview of grouting - Suspension grouts – Solution grouts – Emulsion grouts-Categories of grouting – Grouting Techniques – ascending stage, descending stage and stage grouting – Grouting Plant - Grout control - Grouting applications – Dams, Tunnels, Shafts and drifts, excavations.

Unit: 5

Stone Columns – Methods of installation of Stone Columns – Load shared by stone columns and the stabilized ground – uses of stone columns Lime columns and granular trenches – Installation

– In situ ground reinforcement – ground anchors – types – Components and applications – uplift capability-Stability of foundation trenches and surrounding structures through soil Nailing, tie backs.

REFERENCE:

1. Construction and Geotechnical Methods in Foundation Engineering By R.M. Koerner, McGraw – Hill Book Co.
2. Current Practices in Geotechnical Engineering Vol.1, Alam Singh and Joshi, International Book Traders, Delhi, & Geo-Environ Academia.
3. Foundation Analysis and Design (1V Ed.) By J.E. Bowles, McGraw – Hill Book Co.,
4. Ground Improvement Techniques by P. Purushotham Raj, Laxmi Publications (P) Ltd., New Delhi.
5. Ground Improvement – Edited by M.P. Moseley, Blackie Academic & Professional.
6. Soil Mechanics for Road Engineers, H.M.S.O, Londan.
7. Ground Improvement Techniques by Bergado et al.

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I Semester	CONSTRUCTION IN EXPANSIVE SOILS	L	T	P	C
		3	0	0	3

Pre-Requisites: None

Course Outcomes: At the end of the course, the student will be able to

CO1	Understand the behaviour of expansive soils
CO2	Assess the foundation practices on expansive soils
CO3	Perform the methods of stabilization expansive soils
CO4	Select additives and the methodology for stabilization
CO5	Apply the gained knowledge for suitable performance

Detailed Syllabus:

Unit: 1

Clay mineralogy-Nature of soils-clay mineral structures-cation exchange-soil water-soil structure-soil water interaction.

Unit: 2

Swelling characteristics: swelling-factors effecting swelling-swell potential-swell pressure-methods of determination – factors affecting swelling potential and swell pressure – Heave ---factors affecting heave- methods of determination of heave.

Unit: 3

Foundation Practices in Expansive Clays – Sand cushion – Belled Piers – CNS layer technique – Under – reamed pile foundations – Construction techniques – design specifications – Load - carrying capacity in compression and uplift of single and multi – under reamed piles in clays and sands – granular pile Anchors.

Unit: 4

Lime soil columns and Lime slurry pressure injection – Stabilization with admixtures – Preponding – Vertical and Horizontal Moisture Barriers .

Unit: 5

Shear strength of expansive soils-Kattis concept of bilinear strength envelope-Stress state variables in partly saturated soils-fredlunds strength parameters-determination of matrix suction by axis translation technique-field suction measurement

References:

F.H.Chen, Foundations on Expansive Soils, Eleveir Scientific Publishing Company, Newyork.

J.D.Nelson and D.I. Miller, Expansive soils- Problems and Practice in Foundation and Pavement Engineering by, John Wiley & Sons, Inc.

D.G. Fredlund and H.Rahardjo, Soil Mechanics for Unsaturated Soils, WILEY Inter science Publication, John Wiley & Sons, Inc

D.R. Katti, AR Katti, Behaviour of Saturated Expansive Soils and Control methods, Taylor and Francis Gopal Ranjan and AS Rao, Basic and Applied Soil Mechanics, New Age International Publishers,

NewDelhi. Hand Book on Under reamed and Bored Compaction Pile Foundations – CBRI, Roorkee. IS: 2720(Part XLI) – 1977 Measurement of Swelling Pressure of Soils.

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		L	T	P	C
I Semester	**SOIL FOUNDATION INTERACTION**	**3**	**0**	**0**	**3**

Pre-Requisites: Soil Mechanics, Mathematics

Course Outcomes: At the end of the course, the student will be able to

	Use a stress strain behavior of Soil in modelling to determine the soil response with
CO1	the applied loads.
CO2	Apply concepts to analyze and to compute the response of the infinite and finite
	beams, plates on the soil medium

Detailed Syllabus:

Unit: 1

Introduction to Soil – Foundation Interaction Problems – Contact Pressure Distribution – Idealized Soil Behaviors, Foundation Behaviour, Interface Behaviour, Analytical techniques.

Unit: 2

Idealized Soil Response Models for the Analysis of Soil – Foundation Interaction – Elastic Models for Soil Behaviour, Cointler model, Elastic Continuous Model, Two –Parametric Elastic Models – Elastic – Plastic and Time Dependent Behaviour of Soil Masses.

Unit: 3

Plane Strain Analysis of an Infinite plate and an Infinitely Long. Beam; Bernoulli – Euler Beam Theory and its Modifications – Effect of Shear Deformations.

Unit: 4

Finite Beams on a Winkler Medium – Method of Initial Parameters – Method of Super Position – Strain Energy Method.

Unit: 5

Analysis of finite plats – Axi Symmetric Leading of a Circular Plate – Circular Plate Resting on a Winkler Medium – Circular Plate Resting on a Two – parameter elastic

REFERENCE:

1. Analytical and computer methods in foundation engineering, JE Bowles, McGraw Hill publications.
2. Foundation analysis and design, JE Bowles, McGraw Hill Publications.
3. Foundation analysis by RF Scott, Printice Hall
4. Hytenyi, Beams on Elastic Foundations – university of Michigan Press.
5. Elastic Analysis of soil – Foundation Interaction. APS Selvadurai – Elsevier

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SOIL MECHANICS & FOUNDATION ENGINEERING

I Semester	CRITICAL STATE SOIL MECHANICS	L	T	P	C
		3	0	0	3

Pre-Requisites: Soil Mechanics

Course Outcomes: At the end of the course, the student will be able to

CO1	Use a critical state framework to determine soil response
CO2	Use a constitutive model to determine soil response
CO3	Analyze the behaviour of soil under different boundary conditions

Detailed Syllabus:

Unit: 1

Stress and strain – Stress and Strain Paths and Invariants – Critical State line – families of Undrained and Drained tests – Undrained and Drained planes – The Roscoe surface – Rosco surface as a state boundary surface.

Unit: 2

Behaviour of Over Consolidated Samples – Hvorslev Surface – Critical State Line – Complete State Boundary surface – Volume Changes and Pore Pressure changes – Behaviour of Sands – Effect of Dilation.

Unit: 3

Soil behaviour Before failure – Plasticity of Soils – Cam clay - Power in Cam – Clay – Critical States and Yielding of Cam – clay, Compression of Cam – Clay.

Unit: 4

Routine Soil Tests and the Critical State Model – Mohr – Coulomb Failure Criterion – One – dimensional compression – Undrained Shear Strength – General states of stress – Pore pressure Parameters – Interpretation of Index Test Data.

Unit: 5

Test paths in consolidation and shear testing -- Soil Parameters for Design – Choice of Analysis – Methods – Choice of Strength Parameters.

REFERENCES:

1. The Mechanics of Soils by J.H. Atkinson and P.L. Bransby& ELBS McGraw – Hill Book Co.,

2. Critical State Soil Mechanics – A. Sehofield and P. Wroth McGraw Hill Book Co.

3. Guide to soil Mechanics – Bolton seed, Mac millan Press Ltd., London.

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SOIL MECHANICS & FOUNDATION ENGINEERING

I Semester	FINITE ELEMENT METHOD	L	T	P	C
		3	0	0	3

Pre-Requisites: None

Course Outcomes: At the end of the course, the student will be able to

	Develop finite element formulations of 1 degree of freedom problems and solve
CO1	them
CO2	Understand any Finite Element software to perform stress, thermal and modal
	analysis
CO3	Compute the stiffness matrices of different elements and system
CO4	Interpret displacements, strains and stress resultants

Detailed Syllabus:

Unit: 1

Introduction: Review of stiffness method- Principle of Stationary potential energy-Potential energy of an elastic body- Rayleigh-Ritz method of functional approximation -variational approaches -weighted residual methods

Unit: 2

Finite Element formulation of truss element: Stiffness matrix- properties of stiffness matrix – Selection of approximate displacement functions- solution of a plane truss- transformation matrix and stiffness matrix for a 3 -D truss- Inclined and skewed supports-Galerkin's method for 1-D truss – Computation of stress in a truss element.

Unit: 3

Finite element formulation of Beam elements: Beam stiffness- assemblage of beam stiffness matrix- Examples of beam analysis for concentrated and distributed loading-Galerkin's method

-2-D Arbitrarily oriented beam element – inclined and skewed supports –rigid plane frame examples

Unit: 4

Finite element formulation for plane stress, plane strain and axi-symmetric problems- Derivation of CST and LST stiffness matrix and equations-treatment of body and surface forces-Finite Element solution for plane stress and axi-symmetric problems- comparison of CST and LST elements –convergence of solution- interpretation of stresses.

Unit: 5

Iso-parametric Formulation: An iso-parametric bar element- plane bilinear iso-parametric element – quadratic plane element - shape functions, evaluation of stiffness matrix, consistent nodal load vector - Gauss quadrature- appropriate order of quadrature – element and mesh instabilities – spurious zero energy modes, stress computation- patch test.

REFERENCES:

1. Concepts and applications of Finite Element Analysis – Robert D. Cook, Michael E Plesha, John Wiley & sons Publications
2. A first course in the Finite Element Method – Daryl L. Logan, Thomson Publications.
3. Introduction to Finite Elements in Engineering-Tirupati R. Chandrupatla, Ashok D. Belgunda, PHI publications.

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SOIL MECHANICS & FOUNDATION ENGINEERING

I Semester	**DESIGN WITH GEO-SYNTHETICS**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

Pre-Requisites: None

Course Outcomes: At the end of the course, the student will be able to

CO1	Use geosynthetic materials in the field of geotechnical construction works.
CO2	Assess the properties of different materials of
	Geosynthetics
CO3	Distinguish and describe various manufacturing methods of geotextiles, geogrids,
	geomembranes and geo-composites
CO4	Understand concepts and design the geosynthetics for the functions of separation,
	reinforcement, stabilization, filtration, drainage and moisture barriers
	Design reinforced earth retaining walls, gabions, pond liners, covers for reservoirs,
CO5	canal liners,
	landfill liners, caps and closures, dams and embankments etc
CO6	Distinguish survivability requirements of geo-composites and design geo-webs,
	geo-cells, sheet drains, strip drains and moisture barriers etc

Detailed Syllabus:

UNIT-I

Types, Applications and Functions of Geosynthetics: Introduction – Types of Geosynthetics – Function: Reinforcement, separation, drainage, filtration and barrier – Uses and Applications.

UNIT-II

Manufacture, Properties and Testing Methods of Geosynthetics: Raw materials – manufacturing process of various types of geosynthetics--

UNIT-III

Design of reinforced earth retaining Walls: -Types of soil reinforced structures like wrap-around walls -full-height panel walls -discrete-facing panel walls -modular block walls, Construction aspects -Usage of BS 8006 -FHWA design codes -Internal and External stability analyses -Seismic loads.

UNIT-IV

Design of reinforced earth slopes: Basal reinforcement for construction on soft clay soils, construction of steep slopes with reinforcement layers on stable foundation soil, different slope stability analysis, erosion control on slopes using geosynthetics.

Unit-V

Design of Filters, Drains, Prefabricated vertical drains and Erosion Control Measures using Geosynthetics: Different filtration requirements- Criteria for selection of geotextiles for filtration-Erosion control techniques for slopes and coastal regions, Designing of PVD for stabilizing soft and marine soils

REFERENCE:

1. “Designing with Geosynthetics” by Robert M. KoernerPrantice Hall, Eaglewood Cliffs, NJ 07632.

2. “Construction and Geotechnical Engineering using Synthetic Fabries” by Robert M. Koerner and Josoph P. Welsh. John Willey and Sons, New York.

3. “Engineering with Geosynthetics”, by G. Venkatappa Rao and GVS Suryanarayana Raju – Tata McGraw Hill Publishing Company Limited, New Delhi.
4. “Foundation Analysis and Design” by J.E. Bowles McGraw Hill Publications.

5. FHWA code

6. BS 8006 code

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I Semester	ROCK MECHANICS	L	T	P	C
		3	0	0	3

Pre-Requisites: None

Course Outcomes: At the end of the course, the student will be able to
CO1 Classify Rock mass based on field investigation data

.

CO2 Select the rock strength parameters for design
CO3 Suggest suitable tests on rocks for intended purpose CO4 Design
suitable rock important techniques

Detailed Syllabus:

Unit: 1

Introduction and Classification of Rocks: Development of Rock Mechanics:

Applications of Rock Mechanics – Rock Vs. Soil: Engineering Classification of intact rock and fissured rocks: Classification based on Structural features – Rock quality Designation Number and Velocity Ratio Methods.

Unit: 2

Strength and Deformation Behaviour of Rocks and Failure Theories: Typical Stress – Strain Curves – Static and Creep Test; Strength of rock – Unconfined Shear Strength and Triaxial Shear Strength of Rocks; Creep behaviour of Rocks; rock fracture and friction; Coulomb – Navier; Mohr's and Griffith Theory and its Modification (General discussion only – derivation of equation not included.)

Unit: 3

Laboratory Testing of Rock Samples – Factors affecting test results sampling procedure and preparation of specimens; Tensile Tests – Direct, Indirect and Flexural tests; Uniaxial compression test; Unconfined and

Triaxial shear tests; Determination of Elastic constants – Pulse generation and Resonant Frequency of a vibrating bar methods.

Unit: 4

In-Situ Testing of Rock masses Plate –bearing test, Pressure Tunnel test; Flat Jack Test; Permeability of Rock and rock masses; Pore water pressure in rocks.

Unit: 5

Methods of Improving the Properties of Rock Masses – Pressure Grouting and Rock bolting. -- Design of simple – Openings in competent rocks; laminated rocks and rocks containing planes of weakness. (Distribution of stresses around simple openings suction only without derivation)

REFERENCE:

1. Jaegar, J.C., and Cook, N.G.W. – Fundamentals of Rock Mechanics
2. Stagg, K.C. and Zienkiewicz., O.C – Rock Mechanics in Engineering Practice.

3. Obert, L & Duvall, W.L. – Rock Mechanics and the Design of St

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SOIL MECHANICS & FOUNDATION ENGINEERING

I Semester	**REMOTE SENSING AND GEOGRAPHICAL INFORMATION SYSTEM**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

Pre-Requisites: None

Course Outcomes: At the end of the course, the student will be able to

CO1	Familiar with ground, air and satellite based sensor platforms.
	Select and apply appropriate data manipulation and visualization methods for a
CO2	number of Earth
	science applications, including Geographical Information Systems (GIS)
CO3	Operate PC- based visualization software effectively
CO4	to plot, map and interpret, Geo-spatial data and present the results in an organised
	fashion.

Detailed Syllabus:

Unit: 1

Remote Sensing : Definition, Elements involved in Remote Sensing, Ideal Vs Real Remote Sensing, Characteristics of Real Remote Sensing System, Nature of Electromagnetic Radiation. The Electromagnetic Spectrum, Remote Sensing Terminology and Units, Energy Interaction with Earth Features, Vegetation, Soils and Water bodies, Energy interaction in the atmosphere. Spatial Resolution, Spectral Resolution and Radiometric Resolution, Characteristics of Various sensors and satellites: LANDSAT, SPOT, IRS, ERS.

Unit: 2

Introduction to GIS: What is GIS , Components of GIS, Overview of GIS, Examples of GIS application for civil engineering, Using a GIS for Decision making under uncertainty, Geo-referenced data.

Data Input/Output: Keyboard entry, Manual Digitizing, Scanning, remotely sensed data, Existing Digital data – Cartographic database, Natural resources data sets, Digital elevation data and census related data sets, Data output devices.

Unit: 3

Data Quality: Components of data Quality, Sources of error. Data management: Data Base approach, Three classic data models (Hierarchical network Relational data models), Query languages, Nature of Geographic data.
Spatial data models: Raster and Vector data models. Data bases for GIS managing Spatial and attribute data together – Organizing Geographic Information within a DBMS, Limitations and Practical Approaches.

Unit: 4
GIS Analysis functions : Organizing data for analysis, Classification of GIS Analysis function, Maintenance and Analysis of Spatial data – Transformations, Edge matching and editing, Maintenance and analysis of non-spatial attribute data – Editing and query functions.

Unit: 5
GIS analysis functions for Integrated analysis of spatial and attribute data: Retrieval and Classification functions, Overlay operations, Neighborhood operations, Connectivity function, Output, Formatting – Map annotation, Text pattern and line styles, Graphic symbols, Cartographic modeling by GIS, analysis procedure with an example.

TEXT BOOKS:

1. Principles of Geographic Information Systems by Peter A. Burrough and Rachael A.McDonnell – Oxford University Press.

2. Principles of Remote Sensing by Paul J Curran Geographic Information Systems, - A Management Perspective by STAN ARONOFF, Published by WDL Publications, Ottawa, Canada.

3. Michael Hord. Remote Sensing Methods and Applications, John Wiley.
4. Remote Sensing and Geographical Information Systems – 2nd Edition by M. Anji Reddy.

REFERENCE BOOKS:

1. Remote sensing and Image Interpretation by LILESAND and KIEFER, Published by john Wiley and sons.

2. Fundamental of GIS by MICHAEL N DEMERS Published by John Wiley & Sons Inc.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY: KAKINADA
KAKINADA – 533 003, Andhra Pradesh, India
R25 M.Tech CIVIL ENGINEERING
SOIL MECHANICS & FOUNDATION ENGINEERING

I Semester	MARINE GEOTECHNICAL ENGINEERING	L	T	P	C
		3	0	0	3

UNIT1
Classification of marine sediments and soils; basic soil properties, correlation between engineering parameters, geotechnical investigation, bore techniques;
UNIT 2
Soil testing methods in laboratory and fields; very soft and recent deposits in river mouth; characteristics of thixotropic soils; Advanced testing methods for soft marine clays; sensitivity of soils; time-dependent behaviour of marine sediments. Upper and lower bound soil characteristics;
UNIT 3
Soil stabilization; fills and reclamations; soil treatments and ground improvement methods; stone columns and band drains; coastal protections and reclamation dykes;
UNIT 4
Bearing capacity, sliding stability, over-turning stability, short-term and long-term settlements, factor of safety; Bucket foundation; Suction anchors; Gravity foundation; Earth retaining structures; Diaphragm walls; stability of breakwater on soft soils;
UNIT 5
RC bored piles; Driven piles, drilled and grouted steel piles; Axial and lateral capacity, point bearing and skin friction, factor of safety, lateral load on piles, p-y, t-z and q-z curves, linear spring methods; bearing capacity in soils, weathered rock, and intact rock. Pile group effect, scour around piles, seabed subsidence and design of piles against seabed movement, negative skin friction, cyclic degradation. Pile driving and monitoring; pile testing and correlations; Pile remedial measures.

Reference books:

1. Chakrabarti, SK. 2005. Handbook of Offshore Engineering, Elsevier, ISBN: 978-008-05-2381-1 2. Tomlinson, MJ. 1994. Pile Design and Construction practice, 4th Ed., E&FN Spon, London, UK, ISBN: 0-203-47457-0. 3.
2. Joseph E. Bowles. 1988. Foundation analysis and design, 5th Ed., McGraw-Hill, Singapore, ISBN: 0-07-118844-4 4. Ben C.
3. Gerwick Jr. 2007. Construction of Marine and Offshore Structures, CRC Press, USA, ISBN: 978-042-91-2502-7

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SOIL MECHANICS & FOUNDATION ENGINEERING

I Semester	GEOTECHNICAL ENGINEERING LABORATORY -I	L	T	P	C
		0	1	2	2

Pre-Requisites: None

Course Outcomes: At the end of the course, the student will be able to

CO1 conduct various laboratory tests on soils, analyze and the interpretation of results

Syllabus:

List of Experiments:

1. Determination of moisture content and specific gravity of soil
2. Grain size distribution analysis and hydrometer analysis
3. Atterberg limits (liquid limit, plastic limit, shrinkage limit)
4. Field identification tests
5. Vibration test for relative density of sand
6. Standard and modified proctor compaction tests
7. Falling head permeability test and constant head permeability test
8. CBR

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SOIL MECHANICS & FOUNDATION ENGINEERING

I Semester	GEOTECHNICAL ENGINEERING LABORATORY LAB - II	L	T	P	C
		0	1	2	2

Pre-Requisites: None

Course Outcomes: At the end of the course, the student will be able to

CO1 conduct various laboratory tests on soils, analyze and the interpretation of results

Syllabus:

List of Experiments:

1. Unconfined compression test
2. Direct shear test
3. Tri-axial compression test-UU,CU,CD tests.
4. Laboratory vane shear test
5. Free swell index test
6. Swell pressure test
7. Consolidation test
8. Field density test (core cutter and sand replacement methods)
9. PH, electrical conductivity, chloride and sulphate in soils

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SOIL MECHANICS & FOUNDATION ENGINEERING

II Semester	ADVANCED FOUNDATION ENGINEERING	L	T	P	C
		3	1	0	4

Pre-Requisites: Geotechnical Engineering – I & II

Course Outcomes: At the end of the course, the student will be able to

CO1	Determine the bearing capacity of shallow foundations for different loading and
	ground conditions using different methods
CO2	Know the choice and type of shallow foundation and the design considerations and its
	design.
CO3	Determine the allowable bearing capacity
CO4	Understand classification of piles and determine the load carrying capacity of piles by
	various methods and the pull-out capacity of piles and down drag forces on piles due
	to negative skin friction
CO5	Determine the load carrying capacity of pile groups and the load carrying capacity of
	laterally loaded piles

Detailed Syllabus:

Unit: 1

Shallow Foundations –Bearing capacity – Terzaghi, Meyerhof's, Hansen's and Vesic's Bearing Capacity Theories – IS method of Bearing Capacity - Factors - Bearing Capacity of Stratified Soils

- Bearing Capacity Based on Penetration Resistances - Safe Bearing Capacity and Allowable Bearing Pressure.

Unit: 2

Types and choice of type. Design Considerations including Location and Depth, Proportioning of Shallow Foundations- Isolated and Combined Footings and Mats - Design Procedure for Mats. Floating Foundation- Fundamentals of Beams on Elastic Foundations –Introduction to Drilled pier and Caisson Foundations

Unit: 3

Settlement Analysis – Elastic settlement in granular soils – Meyerhof's, De Beer and Marten's and Schemertmann'sequations-Elastic settlements of surface and subsurface footing in clays

-Skempton and Bjerrum's pseudo three-dimensional approach to consolidation settlement, settlement from in-situ tests. Tolerable settlements.

Unit: 4

Pile Foundation -Classification of Piles-Factors influencing - Choice- Load Carrying Capacity of Single Piles in Clays and Sands Using Static Pile Formulae- α - β - and λ - Methods –Dynamic Pile Formulations

Pull-out resistance of piles -Meyerhof's, Vesic's equations and Coyle and Castello correlations for piles in sands (Elastic settlement of piles)- Pull out Resistance of piles - Negative skin friction in piles – Typical field situations – Estimation of downdrag- Neutral point – Methods of minimizing downdrag.

Unit: 5

Pile Groups: -- -Efficiency of Pile Groups- Different Formulae-Load Carrying Capacity of Pile Groups in Clays and Sands – Settlement of Pile Groups in Clays and Sands – Computation of Load on each Pile in a Group.

Laterally loaded vertical piles - Modulus of subgrade reaction – Piles in granular soils and cohesive soils subjected to lateral loading - Matlock & Reese analysis for piles in sands - Davisson & Gill analysis for piles in clays, Broms' Analysis for piles in sands and clays.

REFERENCE

1. Principles of Foundation Engineering -Braja M. Das
2. Foundation Analysis and Design – J.E. bowles, McGraw – Hill Publishing Co.,
3. Analysis and design of foundations and Earth Retaining Structures. –S. Prakash, Gopal Rajan and Swami Saran – SaritaPrakasan, Merut.
4. Foundation Design and Construction – M.J. Tomlinson, Pitman
5. Soil Mechanics and Foundation Engineering, Vol. II, Foundation Engg., - VNS Murthy
6. Pile Foundation Analysis & Design by Poulos and Davis.

II Semester	EARTH RETAINING STRUCTURES	L	T	P	C
		3	1	0	4

Pre-Requisites: Soil Mechanics

Course Outcomes: At the end of the course, the student will be able to

CO1	Quantify the lateral earth pressures associated with different earth systems
CO2	Evaluate the mechanical properties of geosynthetics used for soil reinforcement
CO3	Identify the merits and demerits of different earth retaining systems.
	Select the most technically appropriate type of retaining wall for the application from
CO4	a thorough
	knowledge of available systems
	Design of retaining structures using appropriate design methods, factors of safety,
CO5	earth
	pressure diagrams and field verification methods
CO6	Aware of current guidelines regarding the design of earth retaining structures.
CO7	Design retaining structures considering both external and internal stability aspects

Detailed Syllabus:

Unit: 1

Earth pressures – Different types and their coefficients- Classical Theories of Earth pressure – Rankine's and Coulomb's Theories for Active and Passive earth pressure- Computation of Lateral Earth Pressure in Homogeneous and Layered soils- Graphical solutions for Coulomb's Theory in active and passive conditions.

SOIL MECHANICS & FOUNDATION ENGINEERING

Unit: 2

Retaining walls – different types - Type of Failures of Retaining Walls – Stability requirements – Drainage behind Retaining walls – Provision of Joints – Relief Shells.

Unit: 3

Sheet Pile Structures – Types of Sheet piles – Cantilever sheet piles in sands and clays – Anchored sheet piles – Free earth and Fixed earth support methods – Rowe's moment reduction method – Location of anchors and Design of Anchorage system.

Unit: 4

Braced cuts and Cofferdams: Lateral Pressure in Braced cuts – Design of Various Components of a Braced cut – Stability of Braced cuts – Bottom Heave in cuts. – types of cofferdam, suitability, merits and demerits – Design of single – wall cofferdams and their stability aspects – TVA method and Cummins' methods.

Unit: 5

Pseudo static analysis of Earth Retaining Structures using Mononobe& Okabe Solution :

REFERENCES

1. Principles of Foundation Engineering by Braja M. Das.
2. Foundation analysis and design – Bowles, JE – McGraw Hill
3. Soil Mechanics in Engineering Practice – Terzaghi, K and Rolph, B. peck 2ndEdn. – John Wiley & Co.,
4. Analysis and Design of Foundations and Retaining Structures, Prakash, S – SarithaPrakashan, Mearut.

II Semester	SOIL DYNAMICS & MACHINE FOUNDATIONS	L	T	P	C
		3	1	0	4

Pre-Requisites: None

Course Outcomes: At the end of the course, the student will be able to

	Understand the fundamental behaviour of geotechnical structures under dynamic
CO1	loading
CO2	Understand the theories of vibration analysis
	Conduct various laboratory and filed tests to determine the dynamic soil prosperities
CO3	and its interpretation
CO4	Design the machine foundations
	Design vibration isolators under any vibratory machines and analysis of geotechnical
CO5	structures under dynamic loads

Detailed Syllabus:

Unit: 1

Introduction: Types of motion- SHM- Fundamental definitions- SDOF systems- Free and forced vibration with and without damping- Types of damping-Equivalent stiffness of springs in series and parallel- Principles of vibration measuring devices- Introduction to two and multi degree freedom systems

Unit: 2

Theories of Vibration Analysis- EHS Theory and lumped parameter model- Different modes of vibration- Natural frequency of foundation soil system – Barkan and IS methods – Pressure bulb concept – Reisner Theory – Limitations of Reisner theory – Sung's solutions --Pauw's Analogy – Heigh's Theory.

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Unit: 3

Dynamic properties of soils, Determination of E, G and Poisons ratio from field and laboratory tests, recommendations of Indian codes- Stress waves in bounded elastic medium- Use of wave theory in the determination of elastic properties, Elastic coefficients of soils and their determination- damping factor from free and forced vibration tests.

Unit: 4

Machine Foundations: Classification based on the type of dynamic force and structural form, design data, design criteria, foundations for reciprocating, impact and high speed machined like turbo generators- IS code provisions for the design of the same

Unit: 5

Vibration Isolation and Special Topics: Transmissibility, Principles of isolation- Methods of isolation- Vibration isolators- Types and their characterizes - Liquefaction of soils, Dynamic bearing capacity, Earth retaining structures under dynamic loads-Pile foundations with dynamic loads

REFERENCES:

1. Vibrations of Soils and Foundations – Richart Hall and Woods
2. Vibration Analysis and Foundation Dynamics, NSV Kameswara Rao, Wheeler Publishing, New Delhi.
3. Foundations of Machines- Analysis and Design- Prakash and Puri
4. Analysis and design of Foundations for Vibrations- P J Moore
5. Fundamentals of Soil Dynamics- B M Das
6. Dynamics of bases and Foundations- D DBarkar

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SOIL MECHANICS & FOUNDATION ENGINEERING

II Semester	**PAVEMENT ANALYSIS, DESIGN AND EVALUATION**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

Pre-Requisites: None

Course Outcomes: At the end of the course, the student will be able to

CO1	Understand the design parameters of pavement design
CO2	Design flexible and rigid pavements for different field conditions
CO3	Compute the stress distribution in different pavement layers
CO4	Evaluate the pavements and design overlay systems

Syllabus:

Unit: 1

Pavement Types, Wheel Loads and Design Factors: Definition of Pavement Types, Comparison of Highway pavements, Wheel Loads, Tyre pressure, Contact pressure, Design Factors: Traffic and Loading, Environment, Materials, Failure criteria, Reliability.

Unit: 2

Stresses in Pavements: Layered System Concepts: One Layer System: Boussinesq's Theory. Two Layer Theory: Burmister's Theory. Three Layer System. Stresses in Rigid Pavements. Relative Stiffness of Slabs, Modulus of Subgrade Reaction, Stresses due to Warping, Stresses due to Friction, Stresses due to Load, IRC Recommendations.

Unit: 3

Pavement Design: IRC Method of Flexible Pavement Design, AASHTO Method of Flexible Pavement Design, IRC Method for Rigid Pavements, use of Geosynthatics in pavements.

Unit: 4

Pavement Inventories: Serviceability Concepts, Visual Rating, Pavement Serviceability Index, Roughness Measurements, Measurement of Distress Modes Cracking, Rutting, Rebound Deflection using Benkleman Beam Deflection Method, Load Man Concept, Skid Resistance Measurement.

Unit: 5

Pavement Evaluation: Functional Pavement Performance Evaluation: AASHTO Method, Psycho Physical and Psycho Metric Scaling Techniques, Deduct Value Method.

Structural Conditional Evaluation Technique: Benkelman Beam Deflection Method, Pavement Distress Rating Technique. Design of Overlays by Benkelmen Beam Deflection Methods as per IRC – 81 - 1997 – pavements on problematic soils.

REFERENCES:

1. Yoder and Witzorack, "Principles of Pavement Design", John Willey and Sons.

2. Yang, H. Huang, "Pavement Analysis and Design", Prentice Hall Publication, Englewood Cliffs, New Jersy.

3. Sargious, M.A. Pavements and Surfacings for Highways and Airports – Applied science Publishers limited

4. Ralps Hass and Hudson, W.R. " Pavement Management System" Mc-Graw Hill Book Company.

5. IRC codes of practice

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SOIL MECHANICS & FOUNDATION ENGINEERING

II Semester	CONSTRUCTION PLANNING AND METHODS	L	T	P	C
		3	0	0	3

Pre-Requisites: None

Course Outcomes: At the end of the course, the student will be able to

CO1	understand the construction planning
CO2	utilize the various earth moving equipment
CO3	to prepare the Project Budget

Syllabus:

Unit: 1

Project Management: Planning – Scheduling – Control – Bar chart – Milestone charts – Development of CPM and Pert networks – Time Estimates – Evaluation of Project duration – Cost Analysis – Updating – Crashing and Resource Allocation.

Unit: 2

Equipment: Equipment Economics – Cost of Owning and operating – Earth moving equipment – Dozers – Scrapers – graders – shovels – hoes – loaders – clamshell buckets – Draglines – Cranes

Unit: 3

Trucks and Handling Equipment: Rear dump trucks – Capacities of trucks and handling equipment – calculation of truck production – compaction equipment – types of compaction rollers – quality control – soil stabilization

Unit: 4

Aggregate production: Crushers – Jaw Crushers – Gyratory crushers – impact crushers – selection of crushing equipment – screening of aggregate – concrete mixers – mixing and placing concrete – consolidating and finishing.

Unit: 5

Project Budgeting: Introduction – Project costs – types of costs – Accuracy and timing of cost estimates – methods of crushing costs – cost control – cost inflation – escalation and contingencies.

References:

1.Peurifoy and Schexnayder, " Construction Planning, Equipement and Methods", Tata McGraw Hill Edition, New Delhi.

2.Kraig Knutson, Clifford, J.S, Christine Flori and Rishard E. Mayo, "Construction Management Fundamentals". Tata McGraw Hill Edition, New Delhi.

3.Chitkara, "Construction Project Management", Tata McGraw Hill Edition, New Delhi.

Timothy.J. Kopprnborg, "Contemporary Project Management", CenageLerraning.

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SOIL MECHANICS & FOUNDATION ENGINEERING

II Semester	GEOTECHNICAL EARTHQUAKE ENGINEERING	L	T	P	C
		3	0	0	3

Pre-Requisites: None

Course Outcomes: At the end of the course, the student will be able to

CO1	Learn the fundamental definitions of earth quake engineering
CO2	Understand earth quake ground motions
CO3	Gain knowledge on dynamic properties of the soil and its estimation
CO4	Understand liquefaction and lateral spreading of soil.
CO5	Do the seismic design of foundations, slopes and retaining structures

Detailed Syllabus:

Unit: 1

Earthquake Seismology: Introduction -- Seismic waves - Causes of earth quake - Continual drift and Plate tectonics – Earthquake fault sources – Faults, fault geometry, fault movement - Elastic Rebound Theory – Location of Earth Quakes - Quantification of Earthquakes – Intensity and magnitude – Earthquake Energy.

Unit: 2

Earthquake ground motion: Seismograph - Characteristics of Ground motion: - Ground motion parameters – Amplitude Parameters – peak acceleration, peak velocity, peak displacement other amplitude parameters – Frequency content parameters – ground response spectra, Fourier spectra, Power spectra, response spectra – spectral parameters – duration. Local site Specification and Code based design

Unit: 3

Dynamic Soil Properties: Representation of Stress conditions by the Mohr Circle – Measurement of Dynamic properties – field, laboratory, interpretation of observed ground response -- One dimensional response analysis - linear approach, E quivalent linear approach.

Unit: 4

Liquefaction and Lateral Spreading – Liquefaction Related phenomena - Liquefaction susceptibility – Initiation of Liquefaction – Effects of Liquefaction – Remedies on Seismic hazards – Densification – Reinforcement – Grouting and mixing Techniques – Drainage Techniques

Unit: 5

Seismic Design of Foundation, Slopes and Retaining Structures: Seismic Design requirements for Foundation – Seismic Bearing capacity - Seismic Settlement -- Internal stability and weakened instability of slopes - Seismic design of retaining walls: Dynamic Response of Retaining walls - Seismic Displacement of Retaining walls - Seismic Design Considerations.

REFERENCES:

1. "Geotechnical Earth Quake Engineering" by SL Kramer, Pearson Education.
2. "Earth Quake" W.H. Freeman, New York

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SOIL MECHANICS & FOUNDATION ENGINEERING

II Semester	GEOTECHNICS OF UNDERGROUND STRUCTURES	L	T	P	C
		3	0	0	3

UNIT 1
Arching in soils, prerequisites and features of arching, Theory of arching in soils, Application of arching in cohesive frictional and cohesive-frictional soils.
UNIT 3
Soil pressures on conduits- Loads on ditch, negative and positive projecting conduits, Bedding conditions for conduits and types of conduits, Pressures in silos, Janssen's theory for pressures in silos
UNIT 3
Stresses in Vicinity of Vertical Shafts, Tunnels, Construction of Erath Tunnels Retaining Systems for Underground Excavations
UNIT 4
Braced Cuts: Lateral Earth pressure on Sheeting, Types of Sheeting and Bracing Systems, Design of Braced Cuts
Tie Backs: Components, advantages over Braced Cuts, Design concepts
UNIT 5
Soil Nailing: Components of nailing system, Driven and Grouted Nails, Design of nailing system, anchored Spider Netting
Types of Anchorage Systems for anchored Sheet pile walls, Design of anchorages, considerations in positioning of anchorages
Text Book
1. Shamsher Prakash, Gopal Ranjan and Swami Saran (1987) "Analysis and Design of Foundations
Reference books
1. Leonards, G.A (1962) "Foundation Engineering", Mc Graw Hill Co.
2. Design of Foundation Systems by Nainan P Kurian, Narosa Publishing House.Retaining Structures", Sarita prakasha.

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SOIL MECHANICS & FOUNDATION ENGINEERING

II Semester	EARTH DAMS	L	T	P	C
		3	0	0	3

Pre-Requisites: None

Course Outcomes: At the end of the course, the student will be able to

CO1	Understand the basic concepts of earth-fill dams and rock-fill dams and identify the site topography and foundations conditions
	Identify basic design requirements and causes of failures of dams, distinguish CO2 foundation types
	and the different fill materials
	Estimate seepage through dam sections, foundations and select core and shell CO3 materials
	Understand and design the methods to control seepage through different units of CO4 dams
CO5	Able to undertake slope stability analysis of dams

distinguish different types of instruments like piezometers, settlement gauges and CO6 inclinometers to install for performance studies of dams

Detailed Syllabus:

Unit: 1

BASIC CONCEPTS AND MISCELLANEOUS TOPICS.: Evolution – Types of Dams – Earthfill Dams – Rockfill Dams – Selection of Type of Dam – Site Topography – Foundation Conditions – Basic Design Requirements – Causes of Failure and Deterioration of Dams – Design Investigations – Fill Material – Foundations – Design Studies .

Unit: 2

SEEPAGE THROUGH DAM SECTION AND ITS CONTROL: Estimation of Seepage through Dam Section and foundation – Considerations in selection and design of core and determination of shell material

Drains: – Pervious Downstream Shell – Chimney Drains – Rock Toe and Drains – Use of Geo-textiles as Filter Material.

Unit: 3

CONTROL OF SEEPAGE THROUGH FOUNDATIONS: General Considerations – different types of cutoff walls – Provision of d/s aprons – relief wells

SLOPE PROTECTION – Necessity with respect to u/s and d/s slopes – u/s slope protection by Dumped Riprap- Hand-placed Riprap – Soil -Cement Slope Protection – Downstream Slope Protection by providing berms - grass turfing.

Unit: 4

STABILITY ANALYSIS OF SLOPES OF EARTH DAMS: Slope stability analysis techniques – Methods of Slices, Fellinious Method, Simplified Bishop method, Taylor's method, Simplified Janbu's Method; Stability of earth dam slopes – u/s slope during sudden drawdown, d/s slope during steady seepage, stability of u/s and d/s slopes during and after construction.

Unit: 5

INSTRUMENTATION: – Purpose - Types of Instruments and Brief Description – Installation – piezometers --Casagrande and Vibration wire -- Settlement gauges – Inclinometers.

REFERENCE:

1. Earth Dams by HD Sharma
2. Earth and Rockfill Dams HD Sharma & Bharat Singh

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SOIL MECHANICS & FOUNDATION ENGINEERING

II Semester	GEO-ENVIRONMENTAL ENGINEERING	L	T	P	C
		3	0	0	3

Pre-Requisites: None

Course Outcomes: At the end of the course, the student will be able to

CO1	Understand various ground contaminations, pollution transport phenomena.
CO2	Understand the clay mineralogy and its interaction with water.
CO3	Understand the contaminant transport mechanisms
CO4	Understand the Soil pollutants interaction
CO5	Understand the Remediation and Pollution Mitigation

Unit: 1

Introduction- Ground water contamination, pollutant transport and ground water remediation. Sources and Types of ground water contamination – underground storage tanks, Land fills, surface impoundments, waste disposal injection wells, Septic system, Agricultural wastes, Land application, radioactive contamination, other sources of contamination.

Unit: 2

Clay Mineralogy, -Clay-water interaction, Electric Charges on Surfaces, Electric Double Layer, Diffuse Double-Layer (DDL) Models, Stern and Grahame Models, Interaction Energies, DLVO Model and Interaction Energies, Swelling Clays, Soil-Water Characteristics, Soil-Water Potentials, Measurement of Soil-Water Potentials, Soil water Characteristics Curves, Evaluation of Measured Soil-Water Potentials, Potentials and Swelling Soils, -Cation exchange capacity, Specific surface area measurements.

Unit: 3

Contaminant Transport Mechanisms: Introduction – Advection process – Diffusion – Dispersion process – Diffusion – Mass transport Equations : Derivation of advection dispersion equation for solute transport; One Dimensional Models – Continuous source in one dimension –

Instantaneous source in one dimension – Adsorption effects – Transport in one dimensional with first order decay – Sorption: The concept of sorption.
Factors influencing sorption – Contaminant characteristics, Soil characteristics, Fluid media characteristics. Sorption Isotherm: Linear sorption Isotherm – Freundlich Sorption isotherm – Langmuir Sorption Isotherm, Sorption effects on fate and transport of pollutants.

Unit: 4

-Soil-pollutant interactions, Soil-Water Characteristics, Soil-Water Potentials, Measurement of Soil-Water Potentials, Soil-water Characteristics Curves, Unsaturated Hydraulic conductivity, Governing equation for unsaturated flow, Evaluation of Measured Soil-Water Potentials, Potentials and Swelling Soils, -Cation exchange capacity, Specific surface area measurements.

Unit: 5

-Remediation and Pollution Mitigation, Pollutants and Site Contamination, Pollution Mitigation, Elimination, and Management, In situ and ex situ Remedial Treatment, Physico-chemical Techniques, Contaminated Soil Removal and Treatment, Vacuum Extraction: Water and Vapour, Electrokinetic Application, Solidification and Stabilization, - Inorganic Pollutants, Permeable reactive barriers, Organic Chemical Pollutants, Biological Techniques

TEXT BOOKS:

1. Ground water Contamination (Transport and Remediation) By Philip. B. Bedient, Hanadi, S. Rifai& Charles. J. Newell, Prentice Hall PTR, Upper Saddle River, NJ07458.
2. Geoenvironmental Engineering by Raymond N. Yong, CRC Press.
3. Barrier Systems for Waste Disposal Facilities by Rowe, R. K., Quigley, R. M., Brachman, R. W. I. and Booker, J. R. (2004), Taylor & Francis, London, UK.
4. Geotechnical and Geoenvironmental Engineering Hand Book by R. K. Rowe, Springer

REFERENCES

1. Geoenvironmental Engineering by R. Krishna Reddy - John Wiley & Sons, Inc.
2. Geoenvironmental engineering by Reddy, L.N and Inyang, I.H. – Marcel Drekker, 2000.
3. Environmental geotechniques by Sarsby, R. – Thompson Telford, 2000.Geotechnical Practices for Waste Disposal by Daniel, D.E., 199

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SOIL MECHANICS & FOUNDATION ENGINEERING

II Semester	NUMERICAL METHODS IN GEOTECHNICAL ENGINEERING	L	T	P	C
		3	0	0	3

Pre-Requisites: None

Course Outcomes: At the end of the course, the student will be able to

CO1	Apply various models to the soil mass to find out the behavior of the soil
CO2	Apply FD solution to homogeneous and layered soils, one, two and three Dimensional Consolidation problems
CO3	Apply the FD and FEM solutions for shallow foundations and Deep foundations

Detailed Syllabus:

Unit: 1

Introduction: Categories of Problems in Geo-technical Engineering, Finite Difference Method, Boundary Corrections for Grids. Accuracy, Convergence and Stability. Idealization of soil behaviour; Linear, Bilinear and multi-linear, Hyperbolic, Spline function, Ramberg – Osgood's Model, Polynomials, Higher order elastic models, perfect plasticity, frictional. Elastic models of soil behaviour – The winkler – Filenenko-boroditch – Pasternak – Ressiener models.

Unit: 2

Seepage: Finite Difference Solution to Laplace equation for Homogeneous and Layered Soils.

Unit: 3

Consolidation: Finite Difference Solution for One Dimensional, Two and three dimensional consolidations.

Multi layered systems. Consolidation of Ground for Construction Load and Static Load.

Unit: 4

Shallow Foundations: Beams on Elastic foundations, solution by Finite Difference and – Finite Element Method (Direct Approach) Limit analysis, Lower Bound and Upperbound theories Method of Finite difference solution of Raft foundations.

Unit: 5

Pile Foundation: Pile Stresses – Static loading – Finite Element Method Solution (Direct approach) of the pile static pile capacity- wave equation -- Lateral piles by Finite Element Method (Direct Approach) and Finite Difference method.

REFERENCE:

1. Numerical methods in Geotechnical Engineering by C.S. Desai and J.T. Christian McGraw Hill publications.
2. Analytical and computer methods in foundation engineering, JE Bowles, McGraw Hill publications.
3. Foundation analysis and design, JE Bowles, McGraw Hill publications
4. Foundation analysis by RF Scott, Printice Hall
5. Hytenyi, Beams on Elastic Foundations – university of Michigan Press.
6. Elastic Analysis of Soil – Foundation Interaction, APS Selvadurai – Elsevier
7. Pile Foundation Analalysis& Design by Poulos and Davis.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY: KAKINADA

KAKINADA – 533 003, Andhra Pradesh, India

R25 M.Tech CIVIL ENGINEERING

SOIL MECHANICS & FOUNDATION ENGINEERING

II Semester	RELIABILITY ANALYSIS AND DESIGN	L	T	P	C
		3	0	0	3

UNIT 1

Concepts of Structural Safety: General, Design methods.

Basic Statistics: Introduction, Data reduction, Histograms, Sample correlation.

Probability Theory: Introduction, Random events, Random variables, Functions of random variables, Moments and expectation, Common probability distribution, Extremal distribution.

UNIT 2

Resistance Distributions and Parameters: Introduction, Statistics of properties of concrete, Statistics of properties of steel, Statistics of strength of bricks and mortar, Dimensional variations, Characterization of variables, Allowable stresses based on specified reliability.

Probabilistic Analysis of Loads: Gravity loads, Wind load.

UNIT 3

Basic Structural Reliability: Introduction, Computation of structural reliability. Monte Carlo Study of Structural Safety: General, Monte Carlo method, Applications.

UNIT 4

Level 2 Reliability Methods: Introduction, Basic variables and failure surface, First-order second-moment methods (FOSM).

UNIT 5

Reliability Based Design: Introduction, Determination of partial safety factors, Safety checking formats, Development of reliability based design criteria, Optimal safety factors, Summary of results of study for Indian standard – RCC design. Reliability of Structural Systems: Preliminary concepts as applied to simple structures.

Text Book

1. Structural Reliability Analysis and Design by R.Ranganatham, Jaico Publishing House.

Reference Book

1. Structural Reliability by R.EMelchers, John Wiley and Sons Ltd.

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SOIL MECHANICS & FOUNDATION ENGINEERING

II Semester	GEOTECHNICAL ENGINEERING LABORATORY -III	L	T	P	C
		0	1	2	2

Pre-Requisites: None

Course Outcomes: At the end of the course, the student will be able to

CO1	conduct various filed tests on soils, analyze and the interpretation of results

Detailed Syllabus:

List of Experiments:

1. Auger boring
2. Standard penetration test
3. Dynamic cone penetration test
4. Plate load test
5. Field CBR test
6. Pile load test
7. Electrical resistivity of soil

II Semester	SOFTWARE DESIGN LABORATORY	L	T	P	C
		0	1	2	2

Pre-Requisites: None

Course Outcomes: At the end of the course, the student will be able to

CO1 Develop Computer s for solution of various geotechnical engineering Problems

CO2 Use different Geotechnical software to solve various geotechnical engineering problems

Detailed Syllabus:

1. Ultimate, Net and Safe Bearing Capacity Using Terzaghi and IS Code Methods.
2. Net Settlement Pressure
3. Hyperbolic Curve Fitting of Tri-axial Compression Data
4. Terzaghi One dimensional consolidation solution by FDM (perform analysis of substructures by packages)
5. Beam on Elastic Foundation by FDM
6. FDM Solution for Raft Foundation
7. Axial Loaded Piles by Direct FEM
8. Laterally Loaded Piles by FDM & FEM
9. Stability Analysis by Bishop theory
10. Stability Analysis by Method of Slices.

The Student Can able to write atleast any Eight Programs listed above.