UNIVERSITY COLLEGE OF ENGINEERING KAKINADA (A)
JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY KAKINADA
Board of Studies (Soil Mechanics & Foundation Engineering)
Meeting : 3rd & 4th August 2019 (R19)

SEMESTER I

S.No	Course No	Category	Course Name	P.Os	L	T	P	C	Marks
1	MSFI-1	Core1	Advanced Soil Mechanics		3	0	--	3	100
2	MSFI-2	Core2	Foundation Engineering-I		3	0	--	3	100
3	MSFI-3	Elective I			3	0	--	3	100
			a) Ground Improvement Techniques						
			b) Soil-Foundation Interaction						
			c) Critical State Soil Mechanics						
4	MSFI-4	Elective II			3	0	--	3	100
			a) Design with Geosynthetics						
			b) Rock Mechanics						
			c) Remote Sensing & Geographical Information Systems						
5	MSFMC		Research Methodology and IPR		2	0	0	2	100
6	MSFPI-1	Laboratory 1	Geotechnical Engineering Lab-I		-	--	4	2	100
7	MSFPI-2	Laboratory 2	Geotechnical Engineering Lab-II		-	--	4	2	100
8	MSFA-1	Audit Course –1	Audit Course –1		2	0	0	0	100
			Total Credits /Marks					**18**	**800**

SEMESTER II

S.No.	Course No	Category	Course Name	P.Os	L	T	P	C	Marks
1	MSFII-1	Core 3	Foundation Engineering-II		3	0	--	3	100
2	MSFII-2	Core 4	Earth Retaining Structures		3	0	--	3	100
3	MSFII-3	Elective III			3	0	--	3	100
			a) Pavement Analysis Design & Evaluation						
			b) Construction Planning & Methods						
			c) Geotechnical Earthquake Engineering						
4	MSFII-4	Elective IV			3	0	--	3	100
			a) Earth Dams						
			b) Construction in Expansive Soils						
			c) Numerical Methods in Geotechnical Engineering						
5	MSFPII-1	Laboratory 3	Geotechnical Engineering Lab-III		--	--	4	2	100
6	MSFPII-2	Laboratory 4	Software Design Lab		--	--	4	2	100
7	MSFMP	Core	Mini Project With Seminar		0	0	4	2	100
8	MSFA-2	Audit Course -2	Audit Course -2		2	0	0	0	100
			Total Credits /Marks					**18**	**800**

SEMESTER III **

S.No	Course No	Category	Course Name	P.Os	L	T	P	C	Marks
1	MSFIII-1	Elective-V	Elective /MOOCS		3	0	--	3	100
			a) Geo-Environmental Engineering						
			b) Soil Dynamics & Machine Foundations						
			c) Finite Element Method						
2	MSFIII-2	Open Elective	Open Elective / MOOCS		3	0	--	3	100
3	DISSERTATION	Core	Dissertation Phase-I / Industrial Project (To be continued and Evaluated next Semester)*		--	--	20	10	
			Total Credits /Marks					**16**	**200**

*** Evaluated and displayed in 4th Semester marks list**
**** Students Going for Industrial Project / Thesis will complete these courses through MOOCS**

SEMESTER IV

S No.	Course No	Category	Course Name	P.Os	L	T	P	C	Marks
1	DISSERTATION	Core	Dissertation Phase II (Continued from III Semester)		0	0	32	16	100
			Total Credits /Marks					**16**	**200**

Total Credits : 18+18+16+16 = 68

Program Outcomes

The graduating student will be able to

PO1	Study the behavior of Soil under different conditions and different loadings
PO2	Analyze and design foundations for different structures in different sub soil conditions.
PO3	Expose to various ground improvement techniques to improve ground in different sub soil conditions by considering the environmental and social aspects.
PO4	Impart knowledge on geotechnical characterization of soils and research methods to carryout experiments, to analyze and interpret experimental data
PO5	Apply advanced materials and technologies to mitigate the problems posed by the ground in difficult soil conditions.

Program Educational Objectives

PEO1	To Impart advanced technical knowledge and skills for specialized careers in Geotechnical Engineering and related fields to cater to the Global needs.
PEO2	To provide expertise in executing complex geotechnical projects by using state - of -art computing, numerical and experimental techniques and to develop interdisciplinary research.
PEO3	To contribute for the development of the geotechnical engineering by effective field practice and quality research.

Program Specific Objectives

The graduates must be able to

PSO1	Analyze field geotechnical problems and solve them through techniques such as geosynthetic reinforcement and reinforced earth
PSO2	Solve geotechnical problems through numerical modeling
PSO3	Assess field geotechnical problems through extensive specialized lab/field inestigations.

SEMESTER-I

MSFI-1- Advanced Soil Mechanics
Common for M.Tech.
(Soil Mechanics & Foundation Engineering and Geotechnical Engineering)

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 Engineering problems
CO5	Understand shear strength behavior of soils and its applications in Geotechnical Engineering

Mapping of Course Outcomes with Outcomes:

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

1. Slightly 2. Moderately 3. Substantially

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.

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 behaviour – 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.

UNIVERSITY COLLEGE OF ENGINEERING KAKINADA (A)
JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY KAKINADA
Board of Studies (Soil Mechanics & Foundation Engineering)
Meeting : 3rd & 4th August 2019 (R19)

MSFI-2 - Foundation Engineering – I
Common for M.Tech.
(Soil Mechanics & Foundation Engineering and Geotechnical Engineering)

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. Substantially**

Detailed 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 – Bore–Hole Shear Test – Dilatometer Test – Pressure Meter test – Planning of exploration -- Preparation of Soil Report – Bore log.

Unit: 3
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: 4

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.

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 footing 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

MSFI-3-a) GROUND IMPROVEMENT TECHNIQUES
(ELECTIVE-I)

Common for M.Tech.

(Soil Mechanics & Foundation Engineering and Geotechnical Engineering)

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
CO2	Prefer suitable ground improvement techniques based on the Soil conditions and local available Materials
CO3	Understand the principles and suitability of various stabilization techniques
CO4	Select suitable stabilization techniques based on the Soil conditions and local available materials
CO5	Understand the Principles of dewatering techniques and to apply suitable 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

Mapping of Course Outcomes with Outcomes:

Course Out Comes	PO1	PO2	PO3	PO4	PO5
CO1	1	--	3	1	--
CO2	1	--	3	1	2
CO3	--	1	3	1	2
CO4	1	--	3	1	2
CO5	--	--	3	1	1
CO6	--	--	3	1	--

1. Slightly 2. Moderately 3. Substantially

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

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

Unit: 4

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

MSFI-3-b) – Soil Foundation Interactions
(ELECTIVE-I)
Common for M.Tech.
(Soil Mechanics & Foundation Engineering and Geotechnical Engineering)

Pre-Requisites: Soil Mechanics, Mathematics
Course Outcomes: At the end of the course, the student will be able to

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

Mapping of Course Outcomes with Outcomes:

Course Out Comes	PO1	PO2	PO3	PO4	PO5
CO1	3	--	--	1	1
CO2	1	3	--	1	1

1. Slightly 2. Moderately 3. Substantially

Detailed Syllabus:
Unit: 1
Introduction to Soil – Foundation Interaction Problems – Contact Pressure Distribution – Idealized Soil Behaviour, 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

MSFI-3-c) - Critical State Soil Mechanics
(ELECTIVE-I)

Common for M.Tech.

(Soil Mechanics & Foundation Engineering and Geotechnical Engineering)

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

Mapping of Course Outcomes with Program Outcomes:

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

1. Slightly 2. Moderately 3. Substantially

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.

MSFI-4-a) – Designing with Geosynthetics
(ELECTIVE-II)

Common for M.Tech.
(Soil Mechanics & Foundation Engineering and Geotechnical Engineering)

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
CO5	Design reinforced earth retaining walls, gabions, pond liners, covers for reservoirs, 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

Mapping of Course Outcomes with Outcomes:

Course Out Comes	PO1	PO2	PO3	PO4	PO5
CO1	--	1	3	2	2
CO2	--	1	2	3	1
CO3	--	1	2	2	1
CO4	--	1	2	2	1
CO5	--	1	3	1	1
CO6	--	1	2	1	1

1. Slightly 2. Moderately 3. Substantially

Detailed Syllabus:

UNIT-I

Geosynthetics and Properties and Testing Methods: Introduction to Geosynthetics – Basic description – History – Manufacturing methods – Uses and Applications. Properties and Testing methods of Geotextiles – Geogrids – Geomembranes – Geocomposites.

UNIT-II

Geotextiles: Designing for Separation – Reinforcement – Stabilization – Filtration – Drainage and Moisture barriers.

UNIT-III

Geogrids: Designing for Reinforcement – Stabilization – Designing Gabions – Construction methods – Design of retaining walls.

UNIT-IV

Geomembranes: Survivability Requirements – Pond Liners – Covers for Reservoirs – Canal Liners – Landfill Liners – Caps and Closures – Dams and Embankments.

Unit-V

Geocomposites: Geocomposites – Overview -- An added advantage – Geocomposites in Separation – Reinforcement – Filtration – Geocomposites as Geowebs and Geocells – Sheet drains – Strip drains and Moisture barriers.

REFERENCE:

1. "Designing with Geosynthetics" by Robert M. Koerner Prantice 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.

MSFI-4-b) - Rock Mechanics
(ELECTIVE-II)

Common for M.Tech.

(Soil Mechanics & Foundation Engineering and Geotechnical Engineering) 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

Mapping of Course Outcomes with Program Outcomes:

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

1.Slightly 2. Moderately 3.Substantially

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 discussion 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 Structures in Rock.

MSFI-4-c) - Remote Sensing and Geographical Information System

(ELECTIVE-II)

Common for M.Tech.

(Soil Mechanics & Foundation Engineering and Geotechnical Engineering)

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.
CO2	Select and apply appropriate data manipulation and visualization methods for a 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.

Mapping of Course Outcomes with Outcomes:

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

1. Slightly 2. Moderately 3. Substantially

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.

MSFPI-1- Geotechnical Engineering Lab-I

common for M.Tech.

(Soil Mechanics & Foundation Engineering and Geotechnical Engineering)

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

Able to.
Mapping of Course Outcomes with Program Outcomes:

Course Out Comes	PO1	PO2	PO3	PO4	PO5
CO1	2	--	--	3	--

1. Slightly 2. Moderately 3. Detailed

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

MSFPI-2 - Geotechnical Engineering Lab-II

common for M.Tech.

(Soil Mechanics & Foundation Engineering and Geotechnical Engineering)

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

Able to.

Mapping of Course Outcomes with Outcomes:

Course Out Comes	PO1	PO2	PO3	PO4	PO5
CO1	2	--	--	3	--

1. Slightly 2. Moderately 3. Detailed

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

SEMESTER-II

UNIVERSITY COLLEGE OF ENGINEERING KAKINADA (A)
JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY KAKINADA
Board of Studies (Soil Mechanics & Foundation Engineering)
Meeting : 3rd & 4th August 2019 (R19)

MSFII-1 - Foundation Engg. – II

Common for M.Tech.

(Soil Mechanics & Foundation Engineering and Geotechnical Engineering)

Pre-Requisites: Soil Mechanics, Advanced Soil Mechanics, Foundation Engineering -I

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

CO1	Understand classification of piles and determine the load carrying capacity of piles by various methods
CO2	Determine the load carrying capacity of pile groups
CO3	Evaluate the pull-out capacity of piles and down drag forces on piles due to negative skin friction
CO4	Determine the load carrying capacity of laterally loaded piles
CO5	Determine the load carrying capacity of piers and caissons

Mapping of Course Outcomes with Outcomes:

Course Out Comes	PO1	PO2	PO3	PO4	PO5
CO1	1	3	1	2	1

1. Slightly 2. Moderately 3. Detailed

Syllabus:

Unit: 1

Pile Foundations-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 Formulae-Limitations-Monotonic and Cyclic Pile Load Tests.-

Unit: 2

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.

Unit: 3

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: 4

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.

Unit: 5

Drilled pier and Caisson Foundations – Types of Drilled piers – Load carrying capacity of piers in clays and sands, Uplift capacity of piers, Caissons – Types – Pneumatic Caisson – Well Foundations – Design of components – Design of wells – Lateral stability of well foundations – Terzaghi's analysis.

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 – Sarita Prakasan, 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.

MSFII-2- Earth Retaining structures

Common for M.Tech.

(Structural Engineering, Soil Mechanics & Foundation Engineering and Geotechnical Engineering)

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.
CO4	Select the most technically appropriate type of retaining wall for the application from a thorough knowledge of available systems
CO5	Design of retaining structures using appropriate design methods, factors of safety, 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

Mapping of Course Outcomes with Outcomes:

Course Out Comes	PO1	PO2	PO3	PO4	PO5
CO1	1	--	2	3	1
CO2	1	--	2	1	1
CO3	3	--	1	1	--
CO4	1	1	2	2	3
CO5	--	2	3	1	--
CO6	--	2	--	--	--
CO7	1	2	1	2	1

1. **Slightly 2. Moderately 3.Substantially**

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.

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

Soil reinforcement – Reinforced earth - Different components – their functions – Design principles of reinforced earth retaining walls.

Unit: 5

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.

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 2nd Edn. – John Wiley & Co.,
4. Analysis and Design of Foundations and Retaining Structures, Prakash, S – Saritha Prakashan, Mearut.

MSFII-3 a)- Pavement Analysis, Design and Evaluation
(Elective-I)

Common for M.Tech.

(Soil Mechanics & Foundation Engineering and Geotechnical Engineering)

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

Mapping of Course Outcomes with Program Outcomes:

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

1.Slightly 2. Moderately 3. Detailed

Syllabus:

<u>Unit: 1</u>

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.

<u>Unit: 2</u>

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.

<u>Unit: 3</u>

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.

MSFII-3 b)- - Construction Planning and Methods

(Elective-I)

Common for M.Tech.

(Soil Mechanics & Foundation Engineering and Geotechnical Engineering)

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

Mapping of Course Outcomes with Outcomes:

Course Out Comes	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**
CO1	1	1	--	--	--
CO2	--	--	2	--	1
CO3	--	--	2	--	--

1. **Slightly 2. Moderately 3. Detailed**

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”, Cenage Lerraning.

MSFII-3 c) - Geotechnical Earth Quake Engineering

(Elective-I)

Common for M.Tech.

(Soil Mechanics & Foundation Engineering and Geotechnical Engineering)

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

Mapping of Course Outcomes with Outcomes:

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

1.Slightly 2. Moderately 3. Substantially

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

MSFII-4 a) - Earth Dams

(Elective-II)

Common for M.Tech.

(Soil Mechanics & Foundation Engineering and Geotechnical Engineering)

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
CO2	Identify basic design requirements and causes of failures of dams, distinguish foundation types and the different fill materials
CO3	Estimate seepage through dam sections, foundations and select core and shell materials
CO4	Understand and design the methods to control seepage through different units of dams
CO5	Able to undertake slope stability analysis of dams
CO6	distinguish different types of instruments like piezometers, settlement gauges and inclinometers to install for performance studies of dams

Mapping of Course Outcomes with Outcomes:

Course Out Comes	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**
CO1	1	1	1	1	1
CO2	1	--	2	2	3
CO3	1	2	2	2	2
CO4	--	1	--	3	3
CO5	2	1	1	2	2
CO6	--	1	--	2	3

1. Slightly 2. Moderately 3.Substantially

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

MSFII-4 b) - - Construction in Expansive Soils

(Elective-II)

Common for M.Tech.

(Soil Mechanics & Foundation Engineering and Geotechnical Engineering)

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

Mapping of Course Outcomes with Program Outcomes:

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

1. Slightly 2. Moderately 3. Substantially

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.

MSFII-4 c) - - Numerical Methods in Geotechnical Engineering

(Elective-II)

Common for M.Tech.

(Soil Mechanics & Foundation Engineering and Geotechnical Engineering)

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

Mapping of Course Outcomes with Program Outcomes:

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

1. **Slightly 2. Moderately 3. Substantially**

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.

MSFPII-1 - Geotechnical Engineering Lab-III

common for M.Tech.

(Soil Mechanics & Foundation Engineering and Geotechnical Engineering)

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

Mapping of Course Outcomes with Program Outcomes:

Course Out Comes	PO1	PO2	PO3	PO4	PO5
CO1	2	--	--	3	--

1.Slightly 2. Moderately 3. Substantially

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

UNIVERSITY COLLEGE OF ENGINEERING KAKINADA (A)
JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY KAKINADA
Board of Studies (Soil Mechanics & Foundation Engineering)
Meeting : 3rd & 4th August 2019 (R19)

MSFPII-2 - Software Design Lab

Common for M.Tech.

(Soil Mechanics & Foundation Engineering and Geotechnical Engineering)

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 Problems
CO2	Use different Geotechnical software to solve various geotechnical s

Mapping of Course Outcomes with Program Outcomes:

Course Out Comes	PO1	PO2	PO3	PO4	PO5
CO1	1	2	--	1	1
CO2	1	2	--	1	1

1. Slightly 2. Moderately 3. Substantially

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.

SEMESTER-III

MSFIII-1 a) - Geo – Environmental Engineering

(Elective-V)

Common for M.Tech.

(Soil Mechanics & Foundation Engineering and Geotechnical Engineering)

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	Collect pollutant data
CO3	Apply principles to get the information about the transport through the unsaturated soil
CO4	Develop various models for contamination transport.

Mapping of Course Outcomes with Program Outcomes:

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

1. **Slightly 2. Moderately 3. Substantially**

Detailed Syllabus:

Unit: 1

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

Unit: 2

Data Collection methods: Introduction, Geological data acquisition – Drilling methods – Solid flight auger drilling – Hollow stem auger drilling – Wet rotating drilling – Hand auger soil boring – sample collection – Soil core logging – Cone penetration testing – Geophysical methods; Hydrologic data acquisition – monitoring well construction – well material – Screen interval selection – Installation procedure – Survey specification – Protective casing requirements – Well development procedures; Acquisition of soil and Ground water quality data.

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

Flow and Transport of Pollutants in Unsaturated zone: Capillarity, soil-water characteristic curves, Unsaturated Hydraulic conductivity, Governing equation for unsaturated flow, measurement of soil properties.

Unit: 5

Non – Aqueous Phase Liquids (NAPLs): Introduction – Comparison of fate of dissolved mass versus NAPL mass- Types of NAPLs – LNAPL – DNAPL; NAPL Transport – general process – NAPL transport at the pore level - Downward Migration of DNAPLs in saturated zone – NAPL movement through Vadose zone – LNAPL behaviour at the water table – NAPL Transport at the site level – LNAPL conceptual models – DNAPL conceptual models, NAPL transport.

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.

REFERENCES

1. Geoenvironmental Engineering by R. Krishna Reddy - John Wiley & Sons, Inc.
2. Geotechnical Engineering by Gulahati, S.K. and Datta, M. – Tata McGraw Hill Publishing Company
3. Geotechnical Engineering Principles and Practices by Coduto – Pearson Education (PHI)
4. Geoenvironmental engineering by Reddy, L.N and Inyang, I.H. – Marcel Drekker, 2000.
5. Environmental geotechniques by Sarsby, R. – Thompson Telford, 2000.Geotechnical Practices for Waste Disposal by Daniel, D.E., 1993

MSFIII-1 b) - Soil Dynamics & Machine Foundations

(Elective-V)

Common for M.Tech.

(Soil Mechanics & Foundation Engineering and Geotechnical Engineering)

Pre-Requisites: None

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

CO1	Use theory of vibrations to find the behavior of soil under dynamic loading
CO2	Design machine foundations under different loads and soil conditions
CO3	Understand the liquefaction phenomina
CO4	Conduct various laboratory and filed tests to determine the dynamic soil prosperities and its Interpretation
CO5	Design vibration isolators under any vibratory machines

Mapping of Course Outcomes with Program Outcomes:

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

1. Slightly 2. Moderately 3. Substantially

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.

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

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 D Barkar

MSFIII-1 c) - Finite Element Method

(Elective-V)

Common for M.Tech.

(Structural Engineering, Soil Mechanics & Foundation Engineering and Geotechnical Engineering)

Pre-Requisites: None

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

CO1	Develop finite element formulations of 1 degree of freedom problems and solve 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

Mapping of Course Outcomes with Program Outcomes:

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

1. **Slightly 2. Moderately 3. Substantially**

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.