Department of Civil Engineering

SCHEME OF INSTRUCTION & SYLLABUS
FOR

M.Tech - Geo Technical Engineering

(with effect from 2021-2022 Admitted Batch)

Department of Civil Engineering

A.U. College of Engineering (A)

Visakhapatnam

Program Outcomes POs

PO1: An ability to independently carry out research /investigation and development work to solve practical problems.

PO2: An ability to write and present a substantial technical report/document.

PO3: Students should be able to demonstrate a degree of mastery over the area as per the specialization of the program. The mastery should be at a level higher than the requirements in the appropriate bachelor program.

PO4: To apply in-depth knowledge gained during the PG Soil Mechanics and Foundation Engineering program in analysing and interpreting real life problems for providing the optimal and achievable solutions considering its technical, professional, and ethical aspects.

PO5:To enable him/ her in identifying &understanding the impact of Geotechnical Engineering problems and their solutions in global, economic, environmental, and social context.

PO6: To learn and unlearn throughout his professional career, and be willing to learn new techniques, methods and processes related to Geotechnical Engineering from simple to complex, with an understanding of the associated limitations.

Program Educational Objectives PEOs

PEO1. To impart students with strong knowledge base through theory courses &sessional in Soil Mechanics & Foundation Engineering that makes them suitable for industries, academics, research & consultancies.

PEO2. To enrich research and practices, by inspiring the leaders of tomorrow to take on the challenge with ease and confidence.

PEO3. To train the students on developing practical, efficient & cost-effective solutions on problems & challenges on Soil Mechanics & Foundation Engineering.

Department of Civil Engineering
M.Tech. (SOIL MECHANICS AND FOUNDATION ENGINEERING)
Scheme of Instruction and Examination
(with effect from 2019-20 Admitted Batch)

I – SEMESTER

Code No.	Course Title	Scheme of Instruction			Scheme of Examination			Total	Credits
		Lec.	Tut.	Total	Exam (hrs)	Ext.	Sess.		
SMFE1.1	Advanced Soil Mechanics	4	--	4	3	70	30	100	3
SMFE1.2	Advanced Foundation Engineering	4	--	4	3	70	30	100	3
SMFE1.3	Geosynthetics and Reinforced Soil Structures	4	--	4	3	70	30	100	3
Program Elective –I SMFE1.4	(a) Analysis and Design of Pavements (b) Rock Mechanics (c) Remote Sensing and GIS Applications	4	--	4	3	70	30	100	3
Program Elective–II SMFE1.5	(a) Advanced Concrete Technology (b) Subsurface Exploration	4	--	4	3	70	30	100	3
SMFE1.6	Soil and Rock Engineering Lab.	-	3	3	Viva	50	50	100	1.5
SMFE1.7	Geosynthetics Lab.	-	3	3	Viva	50	50	100	1.5
Total		**20**	**6**	**26**		**450**	**250**	**700**	**18**

II – SEMESTER

Code No.	Course title	Scheme of Instruction			Scheme of Examination			Total	Credits
		Lec.	Tut.	Total	Exam. (hrs)	Ext.	Sess.		
SMFE2.1	Soil Dynamics and Machine Foundations	4	--	4	3	70	30	100	3
SMFE2.2	Earth and Earth Retaining Structures	4	--	4	3	70	30	100	3
SMFE2.3	Geotechnical Earthquake Engineering	4	--	4	3	70	30	100	3
Program Elective –III SMFE2.4	(a) Disaster Management (b) Ground Improvement Techniques (c) Reliability Analysis and Design	4	--	4	3	70	30	100	3
Program Elective –IV SMFE2.5	(a) Geotechnics of Underground Structures (b) Finite Element Method of Analysis	4	--	4	3	70	30	100	3
SMFE2.6	Design Project	--	3	3	Viva	50	50	100	1.5
SMFE2.7	Case Studies	--	3	3	Viva	50	50	100	1.5
SMFE2.8	Seminar	--	3	3	Viva	50	50	100	2
Total		**20**	**9**	**29**		**500**	**300**	**800**	**20**

III – SEMESTER

Code No.	Course Title	Scheme of Instruction			Scheme of Examination			Total	Credits
		Lec.	Tut.	Total	Exam. (hrs)	Ext.	Sess		
Program Elective –V SMFE3.1	(a) Problematic Soils (b) Geotechnics of Industrial Wastes	4	--	4	3	70	30	100	3
Program Elective –VI SMFE3.2	(a) Forensic Geotechnical Engineering (b) Geoenvironmental Engineering	4	--	4	3	70	30	100	3
SMFE3.3	Dissertation (Preliminary)	--	--	--	Viva	-	100	100	8
Total		**8**	**--**	**8**		**140**	**160**	**300**	**14**

IV- SEMESTER

Code No.	Course Title	Scheme of Examination			Total	Credits
		Exam. (hrs)	Ext.	Sess.		
SMFE4.1	Dissertation (Final)	Viva	100	--	100	16
Total						**16**

Department of Civil Engineering

SCHEME OF INSTRUCTION & SYLLABUS
FOR

M.Tech. (SOIL MECHANICS AND FOUNDATION ENGINEERING)

(with effect from 2019-20 Admitted Batch)

Department of Civil Engineering

A.U. College of Engineering (A)

Visakhapatnam

Department of Civil Engineering
M.Tech. (SOIL MECHANICS AND FOUNDATION ENGINEERING)
Scheme of Instruction and Examination
(with effect from 2019-20 Admitted Batch)

I – SEMESTER

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		Exam. (hrs)	Ext.	Sess.		
SMFE4.1	Dissertation (Final)	Viva	100	--	100	16
Total						**16**

Department of Civil Engineering
M.Tech. (SOIL MECHANICS AND FOUNDATION ENGINEERING)
Syllabus

(with effect from 2019-20 Admitted Batch)

I – SEMESTER

SMFE1.1 ADVANCED SOIL MECHANICS

Elements of elasticity: State of stress at a point, stress function, equilibrium equation, compatibility equation, boundary conditions, Hooke's lay, two dimensional problems, principle stress and strain, octahedral stresses, stress invariants, Mohr's representation.

Elements of plasticity: Ideal plastic substance, strain hardening, yield criteria – Tresca, Hises and Mohr, Coulomb theories of failure and failure envelops in cohesionless and cohesive soils.

Rheological models–Hookean, Newtonian, rigid plastic, Elasto–plastic, Kelvin–Voigt and Maxwell models.

Soil strength: Effective stress law for saturated and partially saturated soil, pore pressure measurements in partially saturated soils, effective stress concept, effect of intermediate principal stress, effect of rate of stress, stress dilatancy theory, plane strain and stress path Hvorslov shear strength parameters

Clay Minerals: Classification, Structure, properties; Identification of clay minerals - X ray Diffraction, Electron Microscope and Differential Thermal Analysis.

Text book

1. *Soil Behaviour by James K Mitchell, John Wiley & Sons Inc*

Reference books

1. *Foundation of theoretical soil mechanics by M. E. Harr, Mc Graw Hill book co.*
2. *Selected topics in soil mechanics by I. K. Lee, Butler Warth*
3. *Rheological aspect of Soil Behaviour bySukhje,* Thomas *Telford Publishing*

Course objectives:

1. To determine the deformation and internal forces in elastic solids and in plastic solids.
2. To understand the theory of elasticity and plasticity is needed to understand behavior of materials which help in analysis of stress and strains.
3. To impart knowledge about different Rheological models.
4. To impart knowledge on soil strength at various interaction conditions.
5. To develop skills to identify clay minerals using techniques X ray diffraction, electron microscope and DTA.

Course outcomes:

1. Deriving general relationships between stress, strain and deformation, Plane stress and plane strain.
2. Determination of deformation in plastic solids, strain hardening and various yield criteria in elements of plasticity.
3. Understanding the methods of different rheological models.
4. Knowledge derived from the concepts of effective stress principal and stress dilatancy theories related to soil strength.
5. Helps in identification of clay minerals.

Course Learning outcomes:

1. Understanding equilibrium, compatibility equations, boundary conditions equations.
2. Understanding plane stress and strain and solve problems related to elements of elasticity.
3. Analysing the stress-strain behaviour and strain hardening for a plastic material.
4. Familiarize about various yield criteria tresca, vonmises and Mohr coulomb.
5. Knowledge about elementary rheological models such as Hookean and Newtonian.
6. Develop models connected to form Kelvin Voigt and Maxwell models.
7. Knowing effective stress principal for saturated and partially saturated soil, pore pressure measurements.
8. Theories related to stress dilatancy theory and Hvorslov shear strength parameters.
9. Understand the structure and properties of clay minerals.
10. Identification of various clay minerals.

SMFE 1.2 ADVANCED FOUNDATION ENGINEERING

Common Syllabus for SMFE1.2, CTPM1.4(a), TE1.4(a) and ST1.4(a)

Introduction

Principles of Design of Foundations, Types of shear failures in foundation soils, Types of foundations, Design Loads, Basic Concepts of safe and allowable bearing capacity.

Shallow Foundations

Bearing Capacity Analysis: Bearing capacity theories – Terzaghi, Meyerhof, Skempton, Hansen, Vesic and IS Methods, Bearing capacity evaluation from Standard Penetration test and Plate load test.

Settlement Analysis: Uniform and Differential Settlements, Elastic and Consolidation Settlements, Settlement analysis in cohesionless soils by Schemartmann and Hartman method, Penetration tests; Permissible settlements as per IS 1904-1978, causes of settlement, settlement Control.

Proportioning of footings: Isolated column footings, Strip, combined Footings and Strap Footing.

Raft Foundations: Bearing capacity of raft foundation, floating raft, Types of rafts, Beam on Elastic foundation and Conventional methods of Design, determination of modulus of subgrade reaction.

Deep Foundations

Pile Foundations: Types, load capacity- dynamic formulae, static formula; pile load tests- Vertical load test, lateral load test, Cyclic load test; settlement of piles and pile groups, negative skin friction on single pile and pile groups; laterally loaded piles - Broom's Analysis, IS Code method; Under reamed piles – Load capacity, design and construction.

Well Foundations: Types, Bearing Capacity of well foundations, Construction of pneumatic caissons, Tilts and Shifts: precautions, Remedial measures; Lateral stability analysis by Terzaghi's Method, Design aspects of Components of well foundation.

Foundations in Expansive Solis

Introduction, Identification of expansive soils, Swell potential and swelling pressure, Active depth, Foundation Problems, Foundation practices in expansive soils, Soil Replacement and 'CNS' concepts.

Foundations of Transmission Line Towers

Introduction, Necessary information, Forces on tower foundations, General design criteria, Choice and type of foundation, Design procedure.

Text Books

1. *Analysis and Design of Substructures by Swami Saran, Oxford & IBH Publishing Co. Pvt. Ltd.*
2. *Basic and Applied Soil Mechanics by Gopal Ranjan and A.S.R. Rao, New Age International Publications*

Reference Books

1. *Foundation Analysis and Design by J.E. Bowles, Mc Graw Hill Publishing Co.*
2. *Foundation Design by W.C. Teng, John Wiley, New York.*
3. *Analysis and Design of Substructures by Swami Saran, Oxford &IBH Publishing Co.*
4. *Foundation Engineering by P.C. Vargheese, Prentice Hall of India*

Course Objectives

1. To understand the basic principles of foundation design, bearing capacity and geotechnical design of shallow foundations.
2. To impart knowledge about the load capacity and behaviour of deep foundations when subjected to vertical and lateral loads.
3. To emphasize the latest techniques which aid in dealing with problems associated with expansive soils.
4. To interpret the concept of foundation design for Transmission Line Towers

Course Outcomes

Upon Completion of the course, the student will be able to

1. Decide the type of foundation to be adopted in the field for a given soil and loading conditions.

2. Evaluate the settlement, bearing capacity and load carrying capacity of the shallow and deep foundations respectively.
3. Identify the nature and potential problems of foundations over expansive soils and suggest suitable techniques to remediate them.
4. Analyse the critical condition of forces and the best type of foundation to be adopted in the geotechnical design of transmission line towers

Learning Outcomes

The course enables the students to learn the

1. Various methods for the evaluation of bearing capacity of Shallow Foundations.
2. Settlement Analysis and Proportioning of Shallow foundations.
3. Bearing Capacity and design of raft foundations.
4. Types and applicability of deep foundations
5. Vertical Load carrying capacity of Pile foundations from various methods and their validation through field tests.
6. Failure mechanisms and load capacity of laterally loaded piles.
7. Types of well foundations and problems encountered during well construction.
8. Lateral stability analysis and components of Well foundations
9. Characteristics and foundation alternatives in expansive soils
10. Design criteria and the types of foundations for transmission line towers.

SMFE1.3 GEOSYNTHETICS AND REINFORCED SOIL STRUCTURES

Reinforced Earth: Concept, Effects of Reinforcement on soils – Equal Confining and Psuedo Cohesion Concepts, Materials, Friction Coefficient – Definition, Laboratory determination, Factors affecting fiction coefficient; Application of Reinforced Earth

Geosynthetics: Types, Functions, Tests on Geosynthetics, Durability aspects, Applications

Reinforced Earth Retaining Walls: Introduction, Stability Mechanisms, Design of Reinforced Earth Retaining Wall, Advantages over conventional Retaining Walls

Reinforced Embankments: Introduction, Design of Reinforced Embankment, Foundation mattress below the embankment, Design of Reinforced Mattress

Reinforced Soil Beds: Introduction, Factors affecting the Behaviour of Reinforced Soil Beds, Analysis and Design

Reinforced Pavements: Benefits of placing reinforcement in flexible pavement layers, design of reinforced pavements by Giroud and Noiray approach and modified CBR Method.

Text Book

1. *An Introduction to Soil Reinforcement and Geosynthetics" By G.L. Siva Kumar Babu, University Press*

Reference Books

1. *Designing with Geosynthetics by Robert M Koerner,*
2. *Advances in Geosynthetics by G. Venkatapparao, Sai Master Geoenvironmental Services Pvt. Ltd. Publications*

Course objectives

1. To understand the concept of reinforced earth and its applications.
2. To impart knowledge on various types of geosynthetics, their functions and applications.
3. To learn about various reinforced soil structures.
4. To understand the advantages of reinforced soil structures over conventional soil structures.

Course outcomes

At the end of the course the student will be able to;

1. Identify different geosynthetic materials and their applications.
2. Determine various properties of geosynthetic materials.
3. Design various structures using geosynthetics.
4. Choose the right kind of geosynthetic material for various applications.

Learning outcomes

1. The concept of reinforced earth and the effect of reinforced earth on soils.
2. Definition of friction coefficient and applications of reinforced earth.

3. Types of geosynthetics, their functions and applications.
4. Tests and properties of geosynthetics.
5. Introduction to Reinforced Earth Retaining Wall and its stability mechanisms.
6. Design of Reinforced Earth Retaining Wall and advantages over conventional Retaining walls.
7. Design of Reinforced embankments.
8. Design of Reinforced soil mattresses.
9. Introduction to Reinforced soil bed and its design.
10. Design of Reinforced pavements by Giroud and Noiray approach and modified CBR method.

SMFE1.4(a) ANALYSIS AND DESIGN OF PAVEMENTS

Pavement Types, Design Factors: Definition, Comparison of pavements. Types of pavements based on structural behavior – Flexible and Rigid Pavements, Comparison, components and their functions, Soil subgrade, sub-base, Base course and wearing course. Design wheel loads – Equivalent Single Wheel Load (ESWL), Repetitions of loads. Strength characteristics of pavement materials – subgrade modulus, Elastic moduli of base course and sub-base materials, Traffic and Loading, Environment, Materials, Failure criteria. Climatic Variations

Stresses in Flexible Pavements: Layered System Concepts: One Layer System - Boussinesq 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 Wheel Load, Stresses due to temperature variation (temperature differential).

Pavement Design:
Design of Flexible pavements – Group-Index method, California Bearing Ratio(CBR) method, Mc leod method, Burmister Method, IRC Method of Flexible Pavement Design as

per IRC 37 –2001, AASHTO Method of Flexible Pavement. Design of Air field Pavements – Corps of Engineers method

Design of Rigid pavements – Design of Joints, Expansion Joints, Contraction Joints, Design of Dowel and Tie bars. IRC recommendations for Rigid pavements as per IRC 58-1988. Design of Airfield Rigid pavements– LCN System of Pavement design.

Pavement Failures: Flexible pavements – Alligator cracking, Longitudinal cracking, Frost heaving, lack of binder to lower course, formation of waveson corrugation, Reflection cracking.

Pavement Inventories: Serviceability Concepts, pavement serviceability index, Roughness for measuring unevenness, Profilograph, profilometer, road roughometer, Benkelman beam deflection method, Skid resistance measurement.

Pavement Evaluation: Structural Evaluation of Benkelman beam. Evaluationof Pavement surface measurement condition using instruments (Profilograph, bump Integrator)

Overlays: Types of overlays – Flexible overlay over Flexible Pavements, Rigid overlay over Flexible Pavements, Flexible overlay over Rigid Pavements, Rigid overlay over Rigid Pavements. Design of overlay using Benkelman beam using IRC 81-1997.

Concrete Block Pavements – Types and shapes, Construction and maintenance.

Text Books:

1. *PrinciplesofPavementDesign by Yoder and Witzorack,, John Willey and Sons.*
2. *Highway Engineering, S.K. Khanna and C.E.G Justo and A. Veeraragavan, Nemchand Brothers publications.*
3. *Airport Planning and Design by S.K. Khanna and S. Arora, Nemchand and brothers publications.*

Reference Books

1. *Yang, H. Huang, "Pavement Analysis and Design", Prentice Hall Publication, Englewood Cliffs, NewJersy.*

2. *Sargious, M.A. Pavements and Surfacings for Highways andAirports– Applied science Publishers limited*
3. *Ralps Hass and Hudson, W.R. "Pavement Management System" Mc-Graw Hill Book Company.*
4. *Guidelines for the use of Interlocking concrete block Pavement, IRC:SP:63-2004*
5. *IRC codes ofpractice.*
6. *Principles of Transportation Engineering, Partha Chakraborty and Animesh Das, PHI Learning.*

Course objectives:

1. To impart knowledge about types of payments, their behaviour and suitability etc.
2. To know the material characterization and criteria in pavement construction.
3. To analyse stress distribution under wheel loads.
4. To understand and design of pavements by various codes.
5. To study the types of failures and reasons.

Course outcomes:

1. Adoption of a suitable pavement based on material and functions.
2. Design of pavement based on the characterization of the materials and wheel load conditions, traffic intensity etc.
3. Comparison of stress transfer through layers of road pavements and make necessary design features.
4. Understanding the failures of pavements due to materials, stresses, design and other environmental conditions.

Course Learning outcomes:

1. Deriving knowledge about component layers of pavements.
2. Knowledge about suitability of material and their specifications about layers of pavements.
3. Analysis of stresses under various wheel load conditions.
4. Understanding deflection and flexibility parameters in the analysis and design of pavements.
5. Design of pavements by various approaches.
6. Understanding design of road and air-filled pavement by comparing from load distribution, material, functions etc.
7. Understanding of joints and other features in the analysis and design of rigid pavement.
8. Understanding reasons for failure of pavements.
9. Knowledge imparting on how to rectify various failure of pavements.
10. Suitability and verification of specifications related to pavement from case studies etc.

SMFE1.4(b) ROCK MECHANICS

Introduction: Geological formation of rocks, Structural Geology, classification of rocks, Defects in rock, Physical, mechanical properties of rocks, Exploration techniques – RQD and RMR, Laboratory tests for shear strength, tensile strength, flexural strength, elastic constants, Field tests – test for deformability, shear tests and strength tests

Engineering classification of Rock mass, Stress-strain behaviour, Failure criteria for rock masses - Yield criteria for failure theories: maximum stress theories, maximum elastic strain theories etc, and Griffith's theory of fracture initiation, stresses around open flaw and equation defining fracture

Tunnelling in rocks - different phases and methods of tunnelling, Instrumentation in tunnels, Rock freezing, Rock fall, Improvement techniques for rock – Grouting, Rock bolting

Rock reinforcement - Mechanism, types of reinforcement, steps involved in installation, Foundations on rock, Rock blasting- explosives, Selection criteria for explosives, steps involved in blasting

Text book

1. *Singh, B. and Goel, R. K. "Rock Mass Classification Systems – A Practical Approach in Civil Engineering "Elsevier Publisher*

Reference Books

1.Verma, B. P., "Rock Mechanics for Engineers" Khanna Publishers
2.Brown, E.T., "Rock Characterisation, Testing and Monitoring", Pergamon Press, London, U.K
3. Rock mechanics on the design of structures in rock by Oberti and Duvalk, W. L. John Wiley.

Course Objectives:

1) To develop basic knowledge related to geology of rocks and rock properties.
2) To impart knowledge about rock exploration techniques and data interpretation and classification.

3) To inculcate knowledge about methods of tunnelling, grouting and rock reinforcement in various constructions.
4) To use and adapt suitable foundations and their stability in rock mass.

Course outcomes:

1) Understanding the structural geology of rocks helps in classification of rocks.
2) Knowledge about lab tests and field tests on rocks described the quality and defects in rock mass.
3) Application of yield criteria for failure theories and Griffith's theory of fracture initiation.
4) Understanding the concepts of different phases and methods of tunnelling.
5) Application of rock grouting, rock blasting mechanism and types of rock reinforcement.

Course Learning outcomes:

1) Understand the geological formation and classification of rocks.
2) Familiarize about physical and mechanical properties of rocks.
3) Understand lab tests and field tests, deformability, shear tests and strength tests.
4) Analyse the stress-strain behaviour and different failure theories, maximum stress theory, maximum elastic strain theory etc.
5) Familiarize about instrumentation and methods of tunnelling.
6) Input knowledge about improvement techniques for rock masses such as grouting and rock bolting.
7) Input knowledge about rock blasting.
8) Understand the steps involved in blasting.
9) Familiarize about rock fall and rock freezing.
10) Mechanism and types of rick reinforcement.

SMFE1.4(c) REMOTE SENSING AND GIS APPLICATIONS

Common Syllabus for HCH1.4(c), SMFE1.4(c) and EEM1.4(c)

Introduction - Definition- Principle of Remote Sensing- History of Development of Remote Sensing- Stages in Remote Sensing- Electromagnetic Radiation and the Electromagnetic Spectrum- Interactions With the Atmosphere- Atmospheric Scattering- Atmospheric Absorption- Atmospheric Windows- Refraction- Interaction of EMR with the Earth's Surface- Reflection- Transmission- Spectral Signature.

Platforms & Sensors- Remote Sensing Systems- Remote Sensing from Space- Remote Sensing Sensors- Resolution- Imaging Sensors- Optical Infrared (OIR) Imagers- Optical Sensors- Thermal Sensors- Microwave Sensors- Active Microwave Sensors- Data Preprocessing- Remote Sensing in India.

Introduction to Image Interpretation- Basic Principles of Image Interpretation- Elements of Image Interpretation- Techniques of Image Interpretation- Interpretation Keys- Introduction to Digital Image Processing- Digital Image- Image Rectification and Registration- Geometric Correction- Image Enhancement Techniques (Only Concepts)- Image Classification - Unsupervised Classification and Supervised Classification- Digital Photogrammetry - Stereo Images from Satellites - Data Merging.

Geographic Information Systems (GIS)- Definitions and Related Technology- GIS Operations- GIS Elements- GIS Concepts and Practice- Map Projection and Coordinate System.

Vector Data Model- Introduction- Vector Data Representation- Geometric Objects- Topology.

Vector Data Analysis- Introduction- Buffering- Applications of Buffering- Map Overlay- Feature Type and Map Overlay- Map Overlay Methods- Slivers- Error Propagation in Map - Overlay- Distance Measurement- Map Manipulation-

Raster Data Analysis- Introduction- Analysis Environment- Local Operations- Local Operations With a Single Grid- Local Operations With Multiple Grids- Neighborhood Operations- Zonal Operations.

Terrain Mapping and Analysis- Introduction- Data for Terrain Mapping and Analysis- Surface Models-DEM- TIN.

GIS Models and Modeling- Introduction- GIS Modeling- Binary Models- Index Models

Remote Sensing & GIS Application in Civil Engineering – Some Case Studies from Literature.

Text Books

1. *Fundamentals of Remote Sensing 2nd Ed by George Joseph- University Press- New Delhi.*
2. *Introduction to Geographic Information Systems by Kang Tsung Chang- Tata Mc.G.H. Publications- New Delhi.*
3. *Remote Sensing and Image Interpretation by Lillesand- T.M. and Kieffer- Joh Wiley and Sons- New York- 1987.*

Reference Books

1. *Remote Sensing of the Environment – An Earth Resource Prespective by John R. Jensen- Pearson Education- New Delhi.*
2. *Geographic Information Systems: A Management Perspective by Aronoff- S. Ottawa: Wdl Publications- 1989.*
3. *Geographic Information Systems For Geoscientists: Modeling with GIS by Bonham Carter- G-F.- New York: Pergamon Press- 1994.*
4. *Principles Of Geographical Information Systems by Burrough- P.A And R.A. Mcdonnell.. Oxford: Oxford University Press- 1998.*
5. *Concepts and Technologies of Geographic Information Systems by Lo- C.P.- and Albert K.W. Young- Prentice Hall Of India (Pvt) Ltd- New Delhi.*
6. *Introductory Digital Image Processing by John R Jensen- Prentice Hall- New Jersey.*
7. *Application of Remote Sensing to Hydrology Including Groundwater by Farsworth- R.K.- Bawetl- E.C. & Dhanju- M.S.-- IHP- UNESCO- 1984.*

Course objectives:

1. To introduce the basic concept and principles of Remote Sensing
2. To illustrate solar energy interactions with atmosphere and with earth surface features

3. To Know about different types of satellite and sensors.
4. To Learn image analysis and apply for interpretation of satellite images
5. To understand data types, data inputs and data analysis in GIS and Learning about map projection and coordinate system.
6. To develop knowledge on RS and GIS applications in civil engineering.

Course outcomes:

After completing this course the student will have acquired the ability on the following.

1. Understand the principle of remote sensing, develop ability to comprehend the energy interactions with atmosphere and earth surface features, spectral properties of various natural and cultural features.
2. Understand types of satellite images and their characteristics and develop ability to choose appropriate sensor products for various remote sensing applications.
3. Ability to perform image analysis and image interpretation.
4. Understand spatial and non-spatial data features in GIS and know vector and raster data representation in GIS.
5. Understand the map projections and coordinates systems and able to create thematic layers.
6. Understand the integration of Remote Sensing and GIS and apply the knowledge to work in various application fields through spatial analysis.

Learning outcomes:

1. Understand the principle of remote sensing and its basic components.
2. Understand the electromagnetic radiation and its interactions with atmosphere and earth surface features.
3. Know about spectral properties of various natural and cultural features.
4. Know about types of satellite images and their characteristics.
5. Understand types of remote sensing such as active and passive remote sensing. and develop ability to choose appropriate sensor products for various remote sensing applications.
6. Understand spatial and non-spatial data features in GIS and learning about vector and raster data representation in GIS.
7. Understanding data input, editing and creating base map and thematic layers using GIS.
8. Understand the map projections and coordinates systems and able to create thematic layers.
9. Develop ability to perform image analysis and image interpretation.
10. Know GIS analysis and Digital Elevetion Model.
11. Understand the integration of Remote Sensing and GIS.

12. Develop awareness about various applications of remote sensing and GIS in civil engineering through spatial analysis.

SMFE1.5(a) ADVANCED CONCRETE TECHNOLOGY

Common Syllabus for ST1.5(a), CTPM1.5(a) and SMFE1.5(a)

Durability of concrete and concrete construction: Durability concept, pore structure and transport processes, reinforcement corrosion, fire resistance, frost damage, sulphate attack, alkali silica reaction, delayed ettringite formation, methods of providing durable concrete, short-term tests to assess long-term behavior.

Mix design: Review of methods and philosophies of IS, BS and ACI methods, mix design for special purposes. Acceptance criteria for compressive strength of concrete

Special concretes: Lightweight concrete, autoclaved aerated concrete, no-fines concrete, lightweight aggregate concrete and foamed concrete, High strength concrete, refractory concrete, high density and radiation-shielding concrete, polymer concrete, fibre-reinforced concrete, mortars, renders, recycled concrete, Ferro Cement, Self-Compacting Concrete.

Special processes and technology for particular types of structure: Sprayed concrete, underwater concrete, grouts, grouting and grouted concrete, mass concrete, slip form construction, pumped concrete, concrete for liquid retaining structures, vacuum process, concrete coatings and surface treatments.

Test methods: Analysis of fresh concrete, accelerated testing methods, tests on hardened concrete, Core cutting and testing, partially destructive testing, Non-destructive testing of concrete structures

Text Book

1. *Properties of Concrete, A.M.Neville, Longman 1995.*
2. *Concrete Technology Theory and Practice, M.S.Shetty, S.Chand & Company Ltd, New Delhi.*

Reference Book

1. *Concrete micro-structure, Properties and Materials, P.K.Mehta, J.M.Monteiro, Printice Hall INC & McGraw Hill, USA.*

Course objectives:

1. To familiarize the students about the durability of concrete and concrete construction.
2. To impart knowledge about the mix design of different methods.
3. To impart knowledge about special concretes.
4. To impart skills of special processes and technology for particular types of structure.
5. To develop skills on test methods on fresh and hardened concrete.

Course outcomes:

Students will be able to

1. Understand about the concept of durability of concrete and its characteristics.
2. Understand about IS, BS and ACI methods and also mix design for special concretes.
3. Understand about special processes and technology for particular types of structures.
4. Understand about the testing methods of fresh concrete and destructive and non-destructive methods on hardened concrete.

Learning outcomes:

The students will be able to

1. Understand about the concept of durability and its mechanism.
2. Understand about the reinforcement corrosion, sulphate attack and alkali silica reaction.
3. Understand about the methods of providing durable concrete, short-term tests to assess long-term behaviour.
4. Understand about the philosophies of IS, BS and ACI methods to design the concrete mix.
5. Classify the different types of concrete based on chemical composition and the types of structures for which they are applied.

6. Understand about the sprayed concrete, underwater concrete, grouted concrete, mass concrete, pumped concrete and concrete for liquid retaining structures.
7. Understand about the special technology like grouts, grouting, slip form construction, vacuum process, concrete coatings and surface treatments.
8. Understand about the analysis of fresh concrete and accelerated testing methods.
9. Understand about the analysis of hardened concrete.
10. Understand about the destructive, partially destructive and Non-destructive testing of concrete structures.

SMFE1.5(b) SUBSURFACE EXPLORATION

Objectives of Soil Exploration, Methods of Soil Exploration, Depth and Extent of Soil Exploration in Different Civil Engineering Projects

Problems and phases of foundation investigations. Geophysical, sounding, drilling and accessible explorations. Sample requirements, sampling methods and equipment. Handling, preservation and transportation of samples.

Sample preparation, laboratory tests – Triaxial (UU/CU), Consolidation, Swelling pressure. Analysis of results and interpretation, importance of in-situ testing. Performing various in situ tests – File Vane Shear Test, Plate load test, Pile load test, SPT, SCPT, DCPT. Precautions and interpretation. Site evaluation and reporting.

Exploration in Rock and Marine Soil Exploration

Text Book

1. *Basic and Applied Soil Mechanics by Gopal Ranjan and A.S.R. Rao, New Age International Publications*

Reference books

1. *Head, K. H., Manual of Soil Laboratory Testing, volume 1 to 3, 1981*
2. *Compendium of Indian Standards on Soil Engineering Parts I and II, 1987 – 1988*

Course objectives:

1) To understand the nature of the ground from data source.

2) To apply the appropriate method of exploration in evaluation of subsurface and surface of a ground.
3) To impart knowledge in understanding the soil stratification and properties of a ground with field and laboratory techniques.
4) To create assessment report of a given ground to make it suitable and economic construction.
5) To understand the soil strata and suggest further necessary methods in verification of the ground.

Course outcomes:

1) Use of methods of exploration of soil strata and its relevance in evaluation of a ground.
2) Analysis of data obtained from field and laboratory tests to propose a suitable improvement method for a ground.
3) Suggesting the type of foundation and its application of this techniques during construction.
4) Creation of bore log data and complete report for economic design and construction aspects.

Course learning outcomes:

1) Using the relevant data sources in exploring a ground.
2) Understand and analyse a ground by number of exploration methods.
3) Appropriate field method in assessing soil properties.
4) Appropriate laboratory test to understand the soil properties of a given strata or ground.
5) Analysis and assessment of the ground with respect to strength, seepage consistency etc.
6) Analysis and interpretation of test data in proposing choice of foundations.
7) Create the type of shallow and deep foundation and their termination in hard strata.
8) Analysis and estimation of the quantities of settlements during and post construction.
9) Understanding the development of models or samples at various conditions to study the behaviour of soils.
10) Helps in understanding the quality of hard strata like Rock surface of a ground by interpretation of test data.

SMFE1.6. SOIL AND ROCK ENGINEERING LAB

Experiments on Soil

1. Index and Engineering Properties Of soils
2. Quick Determination of Water content – Rapid Moisture Meter, Proctor's Needle.
3. Determination of Compression Index, Coefficient of consolidation of clays
4. Determination of Swell Parameters – Differential Free Swell, Swell Pressure Tests.
5. Determination of Shear Parameters – Tri-axial Test, Direct Shear Test, Vane Shear test, Unconfined Compression Test.

6. Determination of Relative Density of granular soils.

Experiments on Rock

1. Determination of Specific Gravity.
2. Determination of Unconfined Compression Strength.
3. Determination of Porosity.
4. Determination of Water absorption.
5. Determination of point load Index of Rocks.

Demonstration Tests:

1. Plate Load Test.
2. Pile Load Test.
3. Standard Penetration Test.

Reference Book: Relevant IS Codes of Practice

Course objectives:

1. To impart knowledge about soil composition and related properties.
2. To understand about various lab and field test about soil characterization.
3. To derive knowledge about quality assessment of Rock.
4. To inculcate knowledge about data interpretation in understanding and predicting the behaviour of soil and rock masses.
5. To apply the knowledge of data and tests on soil and rocks in the construction activities.

Course outcomes:

1. Understanding the behaviour of coarse grained and fine-grained soil by their characterization in lab and field.
2. Assessment and characterization of soils and rocks subjected to various environment.
3. Obtaining the suitability of soil and rock mass in civil engineering construction.
4. Suggesting alternatives for modifications of existing soils as construction or foundation material.

Course learning outcomes:

1. Deriving knowledge about fundamental and basic properties related to composition of soils.
2. Describing the soils and their uses in classification of soils as per code provisions.
3. Understanding the consistency of coarse grained and fine-grained soils.
4. Deriving knowledge about compressibility and volume change characteristics of soil.
5. Deriving knowledge about field behaviour of a soil with respect to environment
6. Method of application and data interpretation of various field resistance tests.
7. Knowledge about application of lab and field tests in assessing seepage in soils and rocks.

8. Explaining the suitability of soil in the field by knowing their characterization.
9. Understanding about quality control tests on soil and rock mass in the field application.
10. Understanding the rock quality assessment in the application of foundation layers.

SMFE1.7 GEOSYNTHETICS LAB

1. Determination of physical properties of Geotextiles, Geogrids and Geomembranes
2. Determination of Grab and wide width tensile strengths of geotextiles
3. Determination of Tensile strength of Geogrids and Geomembranes
4. Determination of Interfacial frictional characteristics of Geotexiles with Fill material
5. Determination of in plane and cross plane permeability of geotextiles
6. Determination of Puncture Resistance of geotextiles
7. Determination of A.O.S of geotextiles
8. Evaluation of long term flow ability of geotextiles by Gradient ratio test
9. Cone Drop Test on geotextiles

Reference Books: Relevant ASTM Standards

Course objectives:

1. To impart knowledge about composition of geosynthetic materials.
2. To understand about various laboratory tests about characterization of geotextile, geogrids, geomembrane etc.
3. To inculcate knowledge about data interpretation in understanding geosynthetic materials.
4. To derive knowledge about durability of geosynthetic materials in construction aspects.
5. To understand about test and applications related to functions of geotextiles and others in construction projects.

Course outcomes:

1. Understanding the behaviour of geotextiles and geogrids etc with respect to physical properties.
2. Assessment of strength characteristics and durability characteristics of geosynthetic materials.
3. Obtaining suitability of types of geosynthetic materials in various construction activities.
4. Suggesting alternative and modifications related to interaction of soils and geo synthetic materials.

Course learning outcomes:

1. Deriving knowledge about fundamental or basic properties related to composition of geosynthetics.
2. Describing a geosynthetic materials and uses.
3. Understanding the properties of geosynthetic materials.
4. Deriving knowledge about compressibility and volume change characteristics of geosynthetics materials.
5. Deriving knowledge about field behaviour of geosynthetics with respect to environment.
6. Method of application and data interpretation of various field resistance test.
7. Knowledge about application of lab and field tests in assessing seepage in geosynthetics.
8. Explaining the suitability of geosynthetics in field by knowing their characteristics.
9. Understanding about quality control test on geosynthetics in the field.
10. Understanding the geosynthetics quality assessment and application in effective performance w.r.t foundation and construction layers.

Department of Civil Engineering
M.Tech. (SOIL MECHANICS AND FOUNDATION ENGINEERING)
Syllabus

(with effect from 2019-20 Admitted Batch)

II – SEMESTER

SMFE2.1 SOIL DYNAMICS AND MACHINE FOUNDATIONS

Theory of Vibration: Free and forced vibrations with and without damping for single mass system with single degree freedom, Logarithmic Decrement and Damping Ratio, Principles of Design of Vibration measuring Devices, Transmissibility of force, vibrations of Two degree freedom system, vibrations of Systems under transient loads.

Natural frequency of foundation soil system- Barkan's Method, Pressure Bulb Concept, Pauw's Analogy, Tschebetorioff's concept of reduced natural Frequency.

Dynamic Soil Properties: Tests for determination of dynamic soil properties - Cyclic Plate load test, Block vibration test, Up Hole, down Hole and Cross Hole wave Propagation tests, Hammer Test, Resonant Column Test, Seismic Reflection and Refraction tests.

Design of Machine Foundation: Types of Machine Foundations, design criteria, Degrees of Freedom of Block foundation, Analysis of Block foundations under sliding, rocking, yawing and Coupled motions, Design Aspects and Construction details of foundations for reciprocating and Impact, vibration isolation: active and passive isolation, vibration isolation materials.

Text Book

1. *Soil Dynamics by Shamsher Prakash, Shamsher Prakash Foundation*

Reference books

1. *Hand Book of Machine Foundations by P. Srinivasulu and C.V. Vaidyanathan, Tata Mc Graw Hill Book Co.*
2. *Dynamics of Bases and Foundation by Barken, Mc Graw Hill Book Co.*
3. *Vibration of soil and Foundation by Richart F.E., Hall J.A., Woodes R.E., Prentice Hall*

Course objectives:

1. To familiarize with free and forced vibrations with and without damping.
2. To impart knowledge on natural frequency of foundation soil system.
3. To impart knowledge on different tests for determination of dynamic soil properties.
4. To impart knowledge on design aspects and constructions details of foundations for impact and reciprocating machines.

Course outcomes:

1. Understanding about the mechanism of vibrations under dynamic loading.
2. Use of Barkan's method, Pauws analogy in computation of natural frequency etc.
3. Analysis of test results for determination of dynamic soil properties.
4. Analysis and use of dynamic properties in the design of machine foundations.

Course Learning outcomes:

1. Understand free and forced vibrations with and without damping for single mass system with single degree freedom.
2. Use of logarithmic decrement and damping ratios in vibration system.
3. Helps in understanding and computation of natural frequency of soil foundation system.
4. Estimation of natural frequencies and other frequency parameters using Barkan's method and Pauws analogy.
5. Understanding about various lab and field tests used to determine dynamic soil properties.
6. Knowledge about adapting the types and design of machine foundation.
7. Analysis of various machine foundations under sliding, rocking, yawing & coupled motions.
8. Deriving knowledge about types of vibration isolation materials and methods.
9. Comparison of design and performance aspects of various machine foundations.
10. Knowledge about field tests and their interpretation in quality assessment of machine foundation.

SMFE2.2 EARTH AND EARTH RETAINING STRUCTURES

Earth Pressure:

Basic concepts, Rankine and Coulomb earth pressure theories, Determination of active and passive pressures: Culmann's Graphical method, logarithmic spiral methods, friction circle method. Consideration of surcharge, seepage, earth quack, wave effect, stratification, type of backfill, wall friction and adhesion.

Retaining structures:

a. Uses, types, stability and design principles of retaining walls, backfill drainage, settlement and tilting.
b. Sheet Pile Walls: Types, Design of cantilever sheet pile walls in granular and Cohesive soils; Design of anchored sheet pile walls by free and fixed earth support methods, Rowe's theory of moment Reduction, Design of anchors.
c. Braced excavations: Types of sheeting and Bracing systems, lateral earth pressure on sheeting in sand and clay, Design components of braced cuts.
d. Cellular cofferdams: Types – Diaphragm and Circular type, Design by TVA method. Stability of cellular cofferdams, cellular cofferdams in rocks and soils.

Text Books

1. *Basic and Applied Soil Mechanics by Gopal Ranjan and A.S.R. Rao, New Age International Publications*
2. *Foundation design by W. C. Teng, Prentice Hall*

Reference books

1. *Theoretical soil mechanics by Karl Terzaghi, John Willey 1965*
2. *Soil mechanics in engineering and practice by K. Terzaghi. And R.B. Peck 2nd edition, John Wiley 1968.*
3. *Analysis and design of foundations by J.E. Bowles, McGraw Hill, 4th edition 1955.*

Course objectives:

1. To understand the type and distribution of Earth pressure on retaining structures.
2. To impart knowledge in the stability of retaining structures subjected to loading.
3. To analyse the suitability of materials for the construction of earth dams with respect to construction and quality control of a dam section.

4. To choose and create solution to avoid various failures of embankment and foundation of a dam.
5. To analyse the suitability of materials and techniques for the construction of retaining structures.

Course outcomes:

1) Use of knowledge in choosing materials in dam construction.
2) Apply appropriate concept in estimation of earth pressures on retaining structures.
3) Assessment of a suitable retaining structure for protecting a ground, slope or barrier etc.
4) Creation of knowledge in assessing the construction of earth and Earth retaining structure in designing and post construction periods.
5) Understanding the methods and techniques related to implementation of design principles in maintaining durability of the earth and Earth retaining structures.

Course learning outcomes:

1) Understanding in various empirical and graphical approaches in computation of Earth pressure.
2) Creation of seepage provisions in retaining wall by understanding the type of backfill and retaining wall.
3) Analysis and design of braced cut and sheet pile wall for pressure distribution in soil.
4) Choosing of appropriate cofferdam in terms of stability related to construction of earth dams, bridges etc.
5) Understanding factors required for selection of dam site locations.
6) Analysis of soils and their suitability for construction of components of earthen dams.
7) Analysis and creation of models in analysis and design of various components of earthen dams.
8) Understanding the materials and techniques in assessing the quality control of dams.
9) Understanding the section cofferdam could create necessary measures to arrest its failures.
10) Helps in imparting knowledge related to maintenance and durability of earth and Earth retaining structures.

SMFE2.3 GEOTECHNICAL EARTHQUAKE ENGINEERING

Seismology and Earth Quakes: Introduction, Seismic Hazards, seismic waves, internal structure of earth, Continental Drift and plate tectonics, faults, elastic rebound theory, geometric notations, location of earthquakes, size of earthquakes.

Strong Ground Motion: Strong ground motion measurement, Ground motion parameters, Estimation of ground motion parameters.

Seismic Hazard Analysis: Identification and evaluation of earthquake sources, Deterministic Seismic Hazard Analysis, Probabilistic seismic Hazard analysis.

Wave Propagation: Waves in Rods, one dimensional wave equation, Effect of end condition on wave propagation, Mode vibrations of rods of finite length, Wave propagation through elastic infinite medium, Waves in Semi-infinite elastic medium.

Dynamic Soil Properties: Measurement of Dynamic Soil Properties using field and laboratory tests (overview), Strength and Stress-strain behavior of cyclically loaded soils.

Ground Response Analysis: One dimensional ground response analysis – Linear and Non-linear approaches.

Local Site Effects: Effect of local site conditions on ground motion, Design parameters, Development of design parameters.

Liquefaction: Flow liquefaction, cyclic mobility, liquefaction hazards, liquefaction susceptibility, Initiation of liquefaction, Effects of liquefaction, liquefaction Control measures

Text Book

1. *Geotechnical Earthquake Engineering by Steven L. Kramer, Prentice Hall*

Reference Book

1. *Geotechnical Earthquake Engineering Handbook by Robert W. Day, McGraw-Hill Publishing Co., New York*

Course objectives:

1. To impart knowledge about seismic activities, seismic hazard, origin and distribution.
2. To analyse and assess the strong ground motion.
3. To understand liquefaction phenomena and consequences.
4. To inculcate the knowledge of dynamic properties in understanding seismicity on soils.
5. To apply the concept of wave propagation and wave characterization in soils due to seismic activities.

Course outcomes:

1. Use of knowledge about generation of seismic activities on ground shaking related to soils and structures.
2. By understanding structure of the earth, how the waves propagate with varying characterization with respect to magnitude, intensity etc.
3. Understanding of various spectra in analysing the effect of earthquakes.
4. Understanding how the soils are affected by ground shaking and the rectification measures.

Course learning outcomes:

1. Reasons about seismic hazard and how the structure of earth influences.
2. Analysis and comparison of various theories related to earthquake activities.
3. Knowledge related to assessment of frequency, amplitude and velocity parameters related to strong ground motion due to earthquakes.
4. Understanding the concepts of various spectral analysis related to ground motion.
5. Idea about how the local site condition effects the ground shaking due to earthquake.
6. Knowledge about various field and laboratory tests in assessing dynamic properties of soils which are to be influenced by seismic activities.
7. Seismic activities related characterization with respect to analysis and understanding of liquefaction phenomenon and its consequences on structures.
8. Knowledge about understanding the concept of plate boundaries, faults in developing seismic activities.
9. Deriving knowledge about seismic waves in their velocities in earth crust, etc.
10. Creation of idea about soil profiling for deeper depths related to seismic hazard analysis.

SMFE2.4(a) DISASTER MANAGEMENT

Types of Disasters:

Disaster - concept and definitions of disaster, causes of disasters, types – natural disasters – floods, droughts, cyclones, earthquakes, landslides, avalanches, volcanic eruptions, heat and cold wave, global warming, sea level rise, ozone depletion. Man-made disasters: Sociological – political – industrial and human disasters.

Risk Assessment and Analysis

Concept and elements of Hazards, Risks and Vulnerability – Policies of Disaster Management, Identification of Crisis Situation, strategic developments, roles and responsibilities of recovery team, importance of team building in disaster management.

Disaster Preparedness:

Prevention and Preparedness – Plan, Action and Accountability, Concept and Nature of Disaster Preparedness, Plan of Disaster Preparedness for People with Special Needs/Vulnerable Groups, with Relevance to Housing, Infrastructure and Livestock, Community Based Disaster Preparedness Plan, Role of Information technology, Education, Communication and training. Medical and health preparedness plan.

Disaster Damage Assessment and Response:

Needs and Damage Assessment– Control process and measurement – modern and traditional methods of response, Disaster Response Plan – roles of response teams and forces. Epidemiological Study of Disasters - Medical and Health Response to Different Disasters - Role of Information and Communication Technology in Health Response

Disaster Mitigation and Recovery:

Disaster Mitigation – meaning and concept – structural mitigation and non-structural mitigation – mitigation strategies and emerging trends. Reconstruction and rehabilitation for development, Medium and long-term recovery aspects, Participative Rehabilitation Process: Community involvement and development of infrastructure.

Reference Books:

1. *Disaster Management by Dr. Mrinalini Pandey, Wiley India Pvt. Ltd.*
2. *Natural Hazards & Disaster Management by R.B.Singh*
3. *Disaster Management: Future Challenges and opportunities by Jagbir Singh4*
4. *Natural Disaster Management, Jon Ingleton*
5. *Disaster Management, Rajib Shaw and RR Krishnamurthy, Universities Press, Hyderabad.*

Course objectives:

1. To impart knowledge about various disasters.
2. To develop knowledge on risk assessment and analysis of disasters and their management.
3. To inculcate knowledge on various methods about prevention and preparedness of disasters.
4. To understand the amount of disaster damage and response methods.
5. To derive knowledge on types of disaster mitigation methods.

Course outcomes:

1. Understanding various manmade disasters their risks and vulnerability.
2. Obtained knowledge on strategies, policies and management of various disasters.
3. Assessing the quality and quantity of damage and various response methods in disaster management.
4. Suggesting various mitigation strategies related to long-term and short-term benefits.

Course Learning outcomes:

1. Deriving knowledge on disasters related to exo-genetic and endo-genetic origin of disaster.
2. Understanding the consequences and effects of various disasters on human environment.
3. Deriving knowledge about policies and management of disasters about their amount of risks and damage.
4. Describing the role of recovery teams, development strategies in disaster management.
5. Explaining the role of action plan and accountability in prevention and preparedness of disasters.
6. Knowledge about evacuation programmes various vulnerable groups in disaster management.

7. Understanding the importance of institutional agencies like IT, education, medical and health in disaster preparedness.
8. Imparting knowledge about disaster mitigation measures related to various types disasters.
9. Explaining the role of participation of community involvement and infrastructures in the mitigation of disasters.
10. Understanding various case studies and action plan related to pre and post periods of various disasters.

SMFE2.4(b) GROUND IMPROVEMENT TECHNIQUES

Common Syllabus for SMFE2.4(b), CTPM2.4(b), ST2.4(b) and TE2.4(a)

Compaction: Theory of compaction, Shallow Surface Compaction - Equipment, Placement water content, factors affecting shallow compaction; Deep compaction: Methods - Vibrofloatation, Terra probe method, Pounding, Blasting, Compaction piles; Compaction Control.

Vertical Drains: Sand drains, Sand wicks, Rope drains, Design of vertical drains, Stone columns, application of the techniques to Marine clays.

Stabilization: Introduction, objectives, Methods of stabilization – Mechanical, Cement, Lime, Bituminous, Calcium chloride; construction methods, factors affecting stabilization of soils; Deep Mixing methods – Soil lime Columns and Cement Lime Columns, applications

Dewatering: Definition, necessity, Methods of dewatering – Interceptor ditch, Single, Multistage and Vacuum well points, Horizontal wells, Electro-osmosis. Permanent drainage by Foundation drains and Blanket drains.

Grouting: Definition, Objectives of grouting, Grouts and their properties, Categories of Grouting, Grouting methods: Asending, Descending and Stage Grouting in Soils, Hydrofracture, Grouting Equipment, Post grouting tests.

In-situ Reinforcement: Ground Anchors, Tiebacks and Soil Nailing, Micropiles.

Text Book

1. Ground Improvement Techniques by P. Purushothama Raj, Laksmi Publications, New Delhi.

Reference Books

1. *Engineering Principles of Ground Modification by Monfred R Hausmann, Mc Graw Hill Publishing Co.*
2. *Reinforced Soil and Its Engineering Applications by Swami Saran, I.K. International Pvt. Ltd.*

Course objectives

1. To understand the need for ground improvement techniques.
2. To explain various ground improvement techniques and their applications.
3. To understand the suitability of different ground improvement techniques under various circumstances.
4. To know the design of ground improvement techniques for actual field situation.

Course outcomes

At the end of the course the student will be able to;

1. Identify problematic behaviour of soils
2. Gain knowledge of different geotechnical engineering practices at site.
3. Choose the right kind of ground improvement technique required for the actual field situation.
4. To design the ground improvement techniques appropriately.

Learning outcomes

1. Need for ground improvement techniques and classification.
2. Different compaction techniques, factors affecting compaction and field compaction control.
3. Types of soil stabilization and their suitability.
4. Soil lime columns, soil cement columns and their applications.
5. Types of vertical drains and their design.
6. Stone columns and their applications to marine clays.
7. Introduction to dewatering and different methods of dewatering.
8. Objectives of grouting, type of grouts and their suitability.
9. Categories of grouting and different grouting materials.
10. In situ reinforcement such as micro piles, ground anchors, soil nails and their suitability.

SMFE2.4(c) RELIABILITY ANALYSIS AND DESIGN

Common Syllabus for ST2.4(c) and SMFE2.4(c)

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.

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.

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

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

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.*

Course objectives:

1. To understand the concepts of structural reliability as applied to civil engineering.

2. To discuss probability theory and resistance distributions.
3. To develop gravity and wind loads probabilistically.
4. To know basic structural reliability and Monte Carlo method of simulation method.
5. To understand reliability estimation methods for individual elements and systems.
6. To develop reliability based design criteria as per IS codes.

Course outcomes:

Students will be able to

1. Learns basic concepts of structural safety and statistics.
2. Gets familiar with probability theory and resistance distributions and parameters.
3. Learns various distributions and their relevance.
4. Estimates basic structural safety and Monte Carlo study of structural safety.
5. Able to apply reliability for structural reliability of systems.
6. Develop reliability based design criteria and summarize the results of study as per IS codes.

Learning outcomes:

1. Understand concepts of structural safety and design methods.
2. Able to reduce lot of data for probabilistic insights including histograms, sample correlation.
3. Studies random events, random variables, functions of random variables, moments and expectation, common probability distribution, external distribution.
4. Understand the statistical properties of concrete, steel, bricks and dimension variations.
5. Understands characterization of variables, allowable stresses based on specified reliability.
6. Learns how to model gravity loads and wind loads probabilistically.
7. Structural reliability evaluation exercises helps students to design system.
8. Generation of random members and Monte Carlo Study of Structural Safety and its applications are learned.

9. Learns Reliability Methods considering Basic variables and failure surface, First-order second-moment methods (FOSM) understood.
10. Understands how partial safety factors and safety of structures are arrived.
11. Technique of reliability based design criteria and optimal safety factors learned.
12. Preliminary concepts as applied to simple structures from reliability perspective understood.
13. Preliminary reliability analysis and design methods as per IS code learned.

SMFE2.5(a) GEOTECHNICS OF UNDERGROUND STRUCTURES

Arching in soils, prerequisites and features of arching, Theory of arching in soils, Application of arching in cohesive frictional and cohesive-frictional soils.

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

Stresses in Vicinity of Vertical Shafts, Tunnels, Construction of Erath Tunnels

Retaining Systems for Underground Excavations

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

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 and Retaining Structures", Sarita prakasha.*

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.*

Course Objectives

1. Understand the various types of underground structures
2. Application of these structures in the field,
3. Design of various underground structures.

Course Outcomes

At the completion of the course, the student will be able to:

1. Understand arching in soils, it's theory and applications.
2. Determine the soil pressure on various underground structures such as conduits
3. Understand and compute the stresses coming on to earth tunnels
4. Design braced cuts.
5. Gain knowledge on various reinforcement systems for underground structures such as Tie-backs and soil nailing.

Learning Outcomes

The following are the learning outcomes for this course:

1. Learn about Arching in soils.
2. Understand the theory of Arching in soils and its application on various soils.
3. Compute soil pressures on various types of conduits
4. Understand various theories for soil pressure
5. Compute the stresses on vertical shafts and earth tunnels
6. Design and construction of earth tunnels.
7. Compute the lateral earth pressure coming onto the sheeting of a braced cut.
8. Design a braced cut.
9. Understand the components and design features of Tie-backs
10. Design a soil nailing system
11. Understand various anchorage systems and their design.

SMFE2.5(b) FINITE ELEMENT METHOD OF ANALYSIS

Common Syllabus for ST2.2, SMFE2.5(b), WRE2.5(b), HCH2.5(b) and TE2.5(b)

Introduction: A brief history of F.E.M. Need of the method, Review of basic principles of solid mechanics- Equations of equilibrium, Boundary conditions, Compatibility, Strain displacement relations, Constitutive relationship in matrix form, plane stress & plane strain and axisymmetric

bodies of revolution with axi-symmetric loading, Energy principles - Raleigh - Ritz method of functional approximation.

Theory relating to the formulation of the finite element method, Coordinate system (local and global), generalized coordinates, Concept of the element, Various element shapes, Discretisation of a structure, Mesh refinement Vs. Higher order element, Interconnections at nodes of displacement models, inter element compatibility, -shape functions.

Basic component – One dimensional FEM single bar element, Beam element: Derivation of stiffness matrix, Assembly of stiffness, Matrix boundary conditions, shape functions for 1 D elements, Initial strain and temperature effects, and trusses under axial forces.

Two dimensional FEM**:** Different types of elements for plane stress and plane strain analysis – Displacement models Generation of element stiffness and nodal load matrices –static condensation.

Isoparametric representation and its formulation for 2d analysis. Formulation of 4-noded and 8-noded isoparametric quadrilateral elements – Lagrangian elements-serendipity elements.

Text Books

1. *Finite Element Analysis by C.S.Krishnamoorthy, (2002), Tata McGraw Hill Publishing Co. Ltd.*
2. *Introduction to Finite Element Method by Desai,C.S.and Abel, J.F.,Van Nostrand, 1972.*

Reference Books

1. *Introduction to Finite element Method by Tirupathi chandra Patla and Belugundu*
2. *The Finite Element Method in Engineering Science" by Zienkiewicz, P., McGraw Hill, 1971.*

Course objectives:

1. To impart knowledge about force and displacement matrices.
2. To explain the students about the concepts of stiffness and flexibility of structural systems.
3. To train the students on basic principles of solid mechanics.
4. To explain the necessity of FEM for solving huge and complicated structures.
5. To train the students about the implementation of computer programming in FEM.

Course outcomes:

1. Students will able to understand concepts of FEM like discretization and nodal points.
2. Can implement FEM to solve problems on different fields of civil engineering.
3. To will understand the advantage of this method in the aspects convergence and compatibility of solution in solving problems.
4. Will able to understand and implement boundary conditions to obtain the solutions.

Learning outcomes:

1. Will able to write equations of equilibrium that can be used in FEM.
2. Can solve problems on plane stress and plane strain analysis.
3. Can implement principle of virtual work to derive important relations of FEM.
4. Can use geometric invariance to write different polynomial equations of FEM.
5. Will understand about natural co-ordinate system and shape functions of the method.
6. Can write element stiffness matrix for different structural elements.
7. Can solve problems on curved boundaries using iso parametric representation.
8. Can analysis bar elements under axial force.
9. Can solve problems on trusses of different types.
10. Can solve problems of beams for different loadings.

SMFE2.6 DESIGN PROJECT

The students should carry out typical foundation design under varying soil conditions or revision of IS codes & IRC guidelines or any project suggested by course instructor. The design project may consist of

1. Soil and Structural Design of Combined footings, rafts
2. Design of Pile Groups
3. Design of Laterally loaded Piles
4. Design of well Foundations
5. Landfill Design
6. Reinforced Soil Structures
7. Design of Bulk heads
8. Case studies.

SMFE2.7 CASE STUDIES

Students should select a case study in any of the following areas and prepare a comprehensive report and present the case study

1. Foundation design
2. site characterization
3. ground improvement
4. Slope Instability
5. Soil Contamination and remediation
6. Foundation failures
7. Embankment construction on weak subgrades.

SMFE2.8 SEMINAR

Each student has to select a topic and collect about 10 papers with at least 5 journal papers and prepare a report and give a seminar at the end of the semester

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III – SEMESTER

SMFE3.1(a) PROBLEMATIC SOILS

Expansive Soils: Geology, engineering properties, swelling, swelling pressure, strength and compressibility, permeability stabilization methods, foundation types.

Soft Clays: Geology of soft marine clays, mineralogy, physical properties, shear strength and compressibility, foundation types.

Organic and Peaty Soils, Collapsible soils: Geotechnical properties, foundation types

Liquefiable Soils: Identification, Factors affecting Liquefaction, Methods for improving resistance of soils to Liquefaction

Filled up Soils: Characterization, Methods for Strengthening Filled up material for supporting structures, Foundation practices in Filled up areas.

Soil Stabilization: Principles of soil stabilization; Role of admixtures; Purpose based classification of soils; Methods of stabilization – Lime, cement, bitumen and special chemicals – Mechanisms, uses and limitation; use of fly ash and other waste materials

Text Book:

1. *Ground Improvement Techniques by P. Purushothama Raj, Lakshmi Publications*

Reference Books

1. *Tropical soils in engineering practice by S. A. Ola, Balkema publications, Holland*
2. *Soil stabilization principles and practice by Ingles, O. G. and Metcalf, J. B., Butterworth,1972*

Course objectives:

1. To understand the methods for identification and classification of problematic soils.
2. To analyse the properties of problematic soils and propose appropriate foundations and practices.
3. To impart knowledge in choosing the choice of stabilization methods.
4. To create knowledge in proposing the improvement method and type of structures are to be found on problematic soils.
5. To create models for structures related to its strength and settlements founded on these soils.

Course outcomes:

1. Analysing the soil characterization helps in predicting the quality and quantity of damage to structures.
2. Creation of alternative foundations and practices.
3. Suggesting appropriate field methods and test for characterization of problematic soils.
4. Develop or create or alternatives for appropriate ground improvement methods or techniques.

Course learning outcomes:

1. Understanding the laboratory and field tests and procedures for classification of expansive soils or black cotton soils.
2. Assessment of collapse ground by understanding the conventional model test.
3. Understanding field and laboratory test in assessing consistency of soft clays.
4. Analysis of liquefiable grounds helps in assessing their potentiality.
5. Helps in evaluation of type of foundation and their choice such as shallow or deep foundations.
6. Analysis and design of friction and end bearing piles in various strata.
7. Create alternative in choice of improvement techniques.
8. Analysis in proportioning of suitable admixture and its dosage and method of application etc are administrated.
9. Evaluation of a particular method of foundation which helps in controlling initial cost and maintenance cost.
10. Understanding the behaviour of various soils under loading subjected to different environmental conditions.

SMFE3.1(b) GEOTECHNICS OF INDUSTRIAL WASTES

Wastes from Thermal Power Plants: Fly ash, bottom ash and Pond Ash, availability, Properties, classification, scope for use in civil engineering projects, Present applications

Agriculture Waste: Rice Husk Ash, Physical, Chemical and Engineering Properties, Potential uses based on its properties.

Wastes from Steel Plants: Blast Furnace Slag, Granulated Blast Furnace Slag and Ground Granulated Blast Furnace Slag, Material properties, potential applications.

Quarry Dust: Production, Properties, comparison with sand, potential uses.

Potential for use of Industrial wastes in stabilization of soils.

Underground Pollution Risk of using Industrial wastes as construction materials and Mitigation. Evaluation methods for studying the leaching effect of industrial wastes on underground.

Text Book

1. *Ground Improvement Techniques by P. Purushothama Raj, Lakshmi Publications, New Delhi.*

Reference Book

1. *A. Sridharan and K. Prakash (2009), "Geotechnical Engineering Characterization of Coal Ashes", CBS Publishers*

Course objective:

1. To impart knowledge about industrial solid waste, characterization and utilization.
2. Analysis of characterization particularly suited to geotechnical construction activities.
3. To inculcate the idea about waste utilization individually, combinations and using admixtures.
4. To analyse their usage for construction aspects in terms of strength, settlement, stability etc.
5. To reduce their impact on the environment and usage in eco-friendly way.

Course outcomes:

1. Understanding and characterization of industrial waste provide various disposal and remediation methods.
2. Creation of knowledge about usage of industrial waste in road, embankment, fills, liners and other ways of waste utilization.

3. Deriving knowledge about types of uses of wastes as a stabilizer, filter, as a seepage controller etc.
4. Analyzing of industrial waste in terms of physical, mechanical, chemical and particularly geotechnical aspect derives cost economic constructions as well as durability and stability concerns in various geotechnical applications.

Course learning outcomes:

1. Knowledge about understanding different types of industrial waste.
2. Analysis about the characterization of industrial waste.
3. Understanding the test laboratory and field for effective disposal.
4. Driving knowledge about various method of use of industrial waste.
5. Knowledge imparting in understanding the waste utilization with respect to the requirements of various code provisions.
6. Evaluation of industrial waste as construction material in road, embankments etc.
7. Evaluation of industrial waste as pozzolanic material with respect to its chemical and mineral characterization.
8. Create and develop models for the use of industrial waste in civil engineering applications.
9. Knowledge about making hazardous industrial waste to non-hazardous.
10. Create ideas about cost economics, reduction of stress on natural resources and reduction of environmental pollution etc.

SMFE3.2(a) FORENSIC GEOTECHNICAL ENGINEERING

Concept of Forensic Investigation, Necessity, Objectives of Forensic Geotechnical Investigation, Methods of Forensic Investigation.

Project reconnaissance and characterization of the distress, including document search such as plans, codes, and other technical specifications followed in the original design.

Diagnostic tests – Analysis of field data – selection of laboratory tests based on actual field parameters to evaluate the behaviour of soil/ground.

Scope and extent of application of Forensic Engineering techniques in geotechnical and foundation failure investigations, settlement of structures, expansive soils, lateral movement, other geotechnical and foundation problems, groundwater and moisture problems.

Back analysis: Selection of theoretical model - methods of analysis, Instrumentation and Monitoring Development of the most probable failure hypothesis - cross-check with original design.

Performing reliability checks, Legal issues involving jurisprudence system, insurance, repairs, reducing potential liability, responsibility of geotechnical engineers and contractors.

Text Book

1. *Forensic Geotechnical and Foundation Engineering by Robert W. Day, Mc Graw Hill*

Reference Book

1. *Malcolm D. Bolton, "A Guide to Soil Mechanics "Universities Press.*
2. *Saxena, D.S., "Technical, Ethical, and Legal Issues with Forensic Geotechnical Engineering - A Case History", Proceedings, 13th Asian Regional Conference on Soil Mechanics and Geotechnical Engineering, Kolkata, India, 11 December 2007.*

Course Objectives

1. To understand the scope of a forensic geotechnical engineering
2. To understand the types of damages and investigation techniques for failure analysis
3. To understand and apply reverse-engineering of design and analysis to establish the cause of failure.
4. To inculcate the ability to prepare report on failure investigation causes as deduced and suggest the appropriate repair/ rehabilitation measures.

Course Outcomes

At the end of the course students will be able

1. To understand the roles of a Forensic Engineer.
2. To classify the types of damage and plan the investigation accordingly based on the knowledge obtained from case studies and relatable issues.
3. To apply design and analysis principles to investigate the cause of failure.
4. To suggest mitigation or rehabilitation measures according to the site conditions.

Learning Outcomes:

The student will be able to

1. Understand the objectives of forensic geotechnical engineering
2. Learn the phases involved in forensic investigations related to geotechnical engineering
3. Learn the various foundation soil related failures of structures in different soil conditions.

4. Understand the significance of failure analysis
5. Acquire knowledge on investigations required in forensic study of geotechnical failure problems
6. Plan necessary field and laboratory investigations for forensic investigation of geotechnical failures.
7. Learn and apply back analysis in failure investigation studies
8. Understand the sequence of activities involved in establishing the cause for geotechnical failure of structures
9. Appreciate the useful outcome of forensic geotechnical engineering which help civil engineers to avoid such failures in future constructions
10. Gain knowledge in preparation of forensic geotechnical Investigation report for a given failure of structure.

SMFE3.2(b) GEOENVIRONMENTAL ENGINEERING

Common Syllabus for SMFE3.2(b) and TE3.2(b)

Wastes: source, production and classification of wastes, soil pollution processes, waste characterization.

Waste disposal facilities: Landfills and impoundments, Slurry walls, Types of landfills, Landfill planning and design; Barrier systems – Basic concepts, Design and construction; Stability, compatibility and performance contaminant transformation and transport in subsurface, Monitoring surface contamination, Stabilization and modification of wastes. Reuse of waste materials, contaminated site remediation, Case studies in waste handling.

Soil erosion and conservation: Causes of soil erosions, Factors contributing to erosion – climatic factors, Topographical factors, Vegetation factors. Erosion control – Cropping systems, Gullies, Check dams, Contouring, Wind striping, Ridging, Bank protection, Erosion control with vegetation mats and Silt fences.

Note:

1. Student is expected to give at least one seminar on the subject from journal.
2. Preparation of paper involving case studies where the topics covered were incorporated in practice.

Text Book

1. *Geoenvironmental Engineering – principles and applications by L.N. Reddiand H.F. Inyang, Marcel Dekker, 2000*

Reference books

1. *Geotechnical practice for waste disposal by D.E. Daniel, Chapman and Hall, London 1993*
2. *Clay barrier systems for waste disposal facilities by R.K. Rowe, R.M. Quigleyand J.R. Booker,E & FN Spon, London, 1995*
3. *Design, construction and monitoring of landfillsby Bagchi, A, John Wiley & Sons, New York 1994*
4. *Waste containment systems, Waste stabilization and landfillsDesign and evaluation by H.D. Sharma, H. D. and S.P. Lewis,John Wiley & Sons, New York 1994*

Course objective:

1. To impart knowledge about solid wastes and MSW.
2. To understand about soil pollution and remedies.
3. To inculcate the ideas about waste containment and waste disposal facilities.
4. To analyze the reasons for soil erosion and its effect on human activities.
5. To describe the preventive measures including structure to control soil erosion and consequences.

Course outcomes:

1. Understanding characterization of wastes provides various disposal and remediation measures.
2. Creation of knowledge about landfill and its components for waste containment.
3. Analysis of pollutants and their characterization helps in study of soil pollution and to propose various environment protective measures.
4. Deriving knowledge about types of erosions and their controlling measures extends to various erosional features related to geological and geomorphological concern.

Course learning outcomes:

1. Knowledge about understanding the concept of solid waste, MSW, waste characterization etc.
2. Analysis about soil pollutants, soil remediation etc.
3. Understanding the types and method of waste disposal techniques and their relevance.
4. Deriving knowledge about waste contamination and its effects.
5. Knowledge imparting in understanding control of waste contamination, soil pollution and environmental concern.
6. Evaluation of landfills for waste contaminant.
7. Knowledge about relevance of soil erosion related climate, environmental, geological and geomorphological perspectives.
8. Impart knowledge about structures related to soil erosion control.

9. Deriving knowledge about appropriate soil erosion control measures related to various weathering agents.
10. Creation of ideas about blend of erosion control measures related to coastal, geological flood and other areas of ground subjected to erosion.

SMFE3.3 DISSERTATION (Preliminary)

The student shall submit a brief report on the selected topic of his/her thesis work and attend for a formal viva-voce examination before a Committee comprising the Chairman, BOS, Head of the Department and the Guide.

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IV – SEMESTER

SMFE4.1 DISSERTATION (Final)

The student shall submit his/her thesis work and attend for a formal viva-voce examination before a Committee comprising the Chairman, BOS, Head of the Department, the Guide and the External Examiner.

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SCHEME OF INSTRUCTION & SYLLABUS FOR

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Department of Civil Engineering

A.U. College of Engineering (A)

Visakhapatnam

Department of Civil Engineering
M.Tech. (SOIL MECHANICS AND FOUNDATION ENGINEERING)
Scheme of Instruction and Examination
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I – SEMESTER

Code No.	Course Title	Scheme of Instruction			Scheme of Examination			Total	Credits
		Lec.	Tut.	Total	Exam (hrs)	Ext.	Sess.		
SMFE1.1	Advanced Soil Mechanics	4	--	4	3	70	30	100	3
SMFE1.2	Advanced Foundation Engineering	4	--	4	3	70	30	100	3
SMFE1.3	Geosynthetics and Reinforced Soil Structures	4	--	4	3	70	30	100	3
Program Elective –I SMFE1.4	(a) Analysis and Design of Pavements (b) Rock Mechanics (c) Remote Sensing and GIS Applications	4	--	4	3	70	30	100	3
Program Elective–II SMFE1.5	(a) Advanced Concrete Technology (b) Subsurface Exploration	4	--	4	3	70	30	100	3
SMFE1.6	Soil and Rock Engineering Lab.	-	3	3	Viva	50	50	100	1.5
SMFE1.7	Geosynthetics Lab.	-	3	3	Viva	50	50	100	1.5
Total		**20**	**6**	**26**		**450**	**250**	**700**	**18**

II – SEMESTER

Code No.	Course title	Scheme of Instruction			Scheme of Examination			Total	Credits
		Lec.	Tut.	Total	Exam. (hrs)	Ext.	Sess.		
SMFE2.1	Soil Dynamics and Machine Foundations	4	--	4	3	70	30	100	3
SMFE2.2	Earth and Earth Retaining Structures	4	--	4	3	70	30	100	3
SMFE2.3	Geotechnical Earthquake Engineering	4	--	4	3	70	30	100	3
Program Elective –III SMFE2.4	(a) Disaster Management (b) Ground Improvement Techniques (c) Reliability Analysis and Design	4	--	4	3	70	30	100	3
Program Elective –IV SMFE2.5	(a) Geotechnics of Underground Structures (b) Finite Element Method of Analysis	4	--	4	3	70	30	100	3
SMFE2.6	Design Project	--	3	3	Viva	50	50	100	1.5
SMFE2.7	Case Studies	--	3	3	Viva	50	50	100	1.5
SMFE2.8	Seminar	--	3	3	Viva	50	50	100	2
Total		**20**	**9**	**29**		**500**	**300**	**800**	**20**

III – SEMESTER

Code No.	Course Title	Scheme of Instruction			Scheme of Examination			Total	Credits
		Lec.	Tut.	Total	Exam. (hrs)	Ext.	Sess		
Program Elective –V SMFE3.1	(a) Problematic Soils (b) Geotechnics of Industrial Wastes	4	--	4	3	70	30	100	3
Program Elective –VI SMFE3.2	(a) Forensic Geotechnical Engineering (b) Geoenvironmental Engineering	4	--	4	3	70	30	100	3
SMFE3.3	Dissertation (Preliminary)	--	--	--	Viva	-	100	100	8
Total		**8**	**--**	**8**		**140**	**160**	**300**	**14**

IV- SEMESTER

Code No.	Course Title	Scheme of Examination			Total	Credits
		Exam. (hrs)	Ext.	Sess.		
SMFE4.1	Dissertation (Final)	Viva	100	--	100	16
Total						**16**

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I – SEMESTER

SMFE1.1 ADVANCED SOIL MECHANICS

Elements of elasticity: State of stress at a point, stress function, equilibrium equation, compatibility equation, boundary conditions, Hooke's lay, two dimensional problems, principle stress and strain, octahedral stresses, stress invariants, Mohr's representation.

Elements of plasticity: Ideal plastic substance, strain hardening, yield criteria – Tresca, Hises and Mohr, Coulomb theories of failure and failure envelops in cohesionless and cohesive soils.

Rheological models–Hookean, Newtonian, rigid plastic, Elasto–plastic, Kelvin–Voigt and Maxwell models.

Soil strength: Effective stress law for saturated and partially saturated soil, pore pressure measurements in partially saturated soils, effective stress concept, effect of intermediate principal stress, effect of rate of stress, stress dilatancy theory, plane strain and stress path Hvorslov shear strength parameters

Clay Minerals: Classification, Structure, properties; Identification of clay minerals - X ray Diffraction, Electron Microscope and Differential Thermal Analysis.

Text book

1. *Soil Behaviour by James K Mitchell, John Wiley & Sons Inc*

Reference books

1. *Foundation of theoretical soil mechanics by M. E. Harr, Mc Graw Hill book co.*
2. *Selected topics in soil mechanics by I. K. Lee, Butler Warth*
3. *Rheological aspect of Soil Behaviour bySukhje,* Thomas *Telford Publishing*

SMFE 1.2 ADVANCED FOUNDATION ENGINEERING

Common Syllabus for SMFE1.2, CTPM1.4(a), TE1.4(a) and ST1.4(a)

Introduction

Principles of Design of Foundations, Types of shear failures in foundation soils, Types of foundations, Design Loads, Basic Concepts of safe and allowable bearing capacity.

Shallow Foundations

Bearing Capacity Analysis: Bearing capacity theories – Terzaghi, Meyerhof, Skempton, Hansen, Vesic and IS Methods, Bearing capacity evaluation from Standard Penetration test and Plate load test.

Settlement Analysis: Uniform and Differential Settlements, Elastic and Consolidation Settlements, Settlement analysis in cohesionless soils by Schemartmann and Hartman method, Penetration tests; Permissible settlements as per IS 1904-1978, causes of settlement, settlement Control.

Proportioning of footings: Isolated column footings, Strip, combined Footings and Strap Footing.

Raft Foundations: Bearing capacity of raft foundation, floating raft, Types of rafts, Beam on Elastic foundation and Conventional methods of Design, determination of modulus of subgrade reaction.

Deep Foundations

Pile Foundations: Types, load capacity- dynamic formulae, static formula; pile load tests- Vertical load test, lateral load test, Cyclic load test; settlement of piles and pile groups, negative skin friction on single pile and pile groups; laterally loaded piles - Broom's Analysis, IS Code method; Under reamed piles – Load capacity, design and construction.

Well Foundations: Types, Bearing Capacity of well foundations, Construction of pneumatic caissons, Tilts and Shifts: precautions, Remedial measures; Lateral stability analysis by Terzaghi's Method, Design aspects of Components of well foundation.

Foundations in Expansive Solis

Introduction, Identification of expansive soils, Swell potential and swelling pressure, Active depth, Foundation Problems, Foundation practices in expansive soils, Soil Replacement and 'CNS' concepts.

Foundations of Transmission Line Towers

Introduction, Necessary information, Forces on tower foundations, General design criteria, Choice and type of foundation, Design procedure.

Text Books

1. *Analysis and Design of Substructures by Swami Saran, Oxford & IBH Publishing Co. Pvt. Ltd.*
2. *Basic and Applied Soil Mechanics by Gopal Ranjan and A.S.R. Rao, New Age International Publications*

Reference Books

1. *Foundation Analysis and Design by J.E. Bowles, Mc Graw Hill Publishing Co.*
2. *Foundation Design by W.C. Teng, John Wiley, New York.*
3. *Analysis and Design of Substructures by Swami Saran, Oxford &IBH Publishing Co.*
4. *Foundation Engineering by P.C. Vargheese, Prentice Hall of India*

SMFE1.3 GEOSYNTHETICS AND REINFORCED SOIL STRUCTURES

Reinforced Earth: Concept, Effects of Reinforcement on soils – Equal Confining and Psuedo Cohesion Concepts, Materials, Friction Coefficient – Definition, Laboratory determination, Factors affecting fiction coefficient; Application of Reinforced Earth

Geosynthetics: Types, Functions, Tests on Geosynthetics, Durability aspects, Applications

Reinforced Earth Retaining Walls: Introduction, Stability Mechanisms, Design of Reinforced Earth Retaining Wall, Advantages over conventional Retaining Walls

Reinforced Embankments: Introduction, Design of Reinforced Embankment, Foundation mattress below the embankment, Design of Reinforced Mattress

Reinforced Soil Beds: Introduction, Factors affecting the Behaviour of Reinforced Soil Beds, Analysis and Design

Reinforced Pavements: Benefitsof placing reinforcement in flexible pavement layers, design of reinforced pavements by Giroud and Noiray approach and modified CBR Method.

Text Book

1. *An Introduction to Soil Reinforcement and Geosynthetics" By G.L. Siva Kumar Babu, University Press*

Reference Books

1. *Designing with Geosynthetics by Robert M Koerner,*
2. *Advances in Geosynthetics by G. Venkatapparao, Sai Master Geoenvironmental Services Pvt. Ltd. Publications*

SMFE1.4(a) ANALYSIS AND DESIGN OF PAVEMENTS

Pavement Types, Design Factors: Definition, Comparison of pavements. Types of pavements based on structural behavior – Flexible and Rigid Pavements, Comparison, components and their functions, Soil subgrade, sub-base, Base course and wearing course. Design wheel loads – Equivalent Single Wheel Load (ESWL), Repetitions of loads. Strength characteristics of pavement materials – subgrade modulus, Elastic moduli of base course and sub-base materials, Traffic and Loading, Environment, Materials, Failure criteria. Climatic Variations

Stresses in Flexible Pavements: Layered System Concepts: One Layer System - Boussinesq 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 Wheel Load, Stresses due to temperature variation (temperature differential).

Pavement Design:
Design of Flexible pavements – Group-Index method, California Bearing Ratio(CBR) method, Mc leod method, Burmister Method, IRC Method of Flexible Pavement Design as per IRC 37 –2001, AASHTO Method of Flexible Pavement. Design of Air field Pavements – Corps of Engineers method

Design of Rigid pavements – Design of Joints, Expansion Joints, Contraction Joints, Design of Dowel and Tie bars. IRC recommendations for Rigid pavements as per IRC 58-1988. Design of Airfield Rigid pavements– LCN System of Pavement design.

Pavement Failures: Flexible pavements – Alligator cracking, Longitudinal cracking, Frost heaving, lack of binder to lower course, formation of waveson corrugation, Reflection cracking.

Pavement Inventories: Serviceability Concepts, pavement serviceability index, Roughness for measuring unevenness, Profilograph, profilometer, road roughometer, Benkelman beam deflection method, Skid resistance measurement.

Pavement Evaluation: Structural Evaluation of Benkelman beam. Evaluationof Pavement surface measurement condition using instruments (Profilograph, bump Integrator)

Overlays: Types of overlays – Flexible overlay over Flexible Pavements, Rigid overlay over Flexible Pavements, Flexible overlay over Rigid Pavements, Rigid overlay over Rigid Pavements. Design of overlay using Benkelman beam using IRC 81-1997.

Concrete Block Pavements – Types and shapes, Construction and maintenance.

Text Books:

1. *PrinciplesofPavementDesign by Yoder and Witzorack,, John Willey and Sons.*
2. *Highway Engineering, S.K. Khanna and C.E.G Justo and A. Veeraragavan, Nemchand Brothers publications.*
3. *Airport Planning and Design by S.K. Khanna and S. Arora, Nemchand and brothers publications.*

Reference Books

1. *Yang, H. Huang, "Pavement Analysis and Design", Prentice Hall Publication, Englewood Cliffs, NewJersy.*
2. *Sargious, M.A. Pavements and Surfacings for Highways andAirports– Applied science Publishers limited*
3. *Ralps Hass and Hudson, W.R. "Pavement Management System" Mc-Graw Hill Book Company.*
4. *Guidelines for the use of Interlocking concrete block Pavement, IRC:SP:63-2004*
5. *IRC codes ofpractice.*
6. *Principles of Transportation Engineering, Partha Chakraborty and Animesh Das, PHI Learning.*

SMFE1.4(b) ROCK MECHANICS

Introduction :Geological formation of rocks, Structural Geology, classification of rocks, Defects in rock, Physical, mechanical properties of rocks, Exploration techniques – RQD and RMR, Laboratory tests for shear strength, tensile strength, flexural strength, elastic constants, Field tests – test for deformability, shear tests and strength tests

Engineering classification of Rock mass, Stress-strain behaviour, Failure criteria for rock masses - Yield criteria for failure theories: maximum stress theories, maximum elastic strain theories etc, and Griffith's theory of fracture initiation, stresses around open flaw and equation defining fracture

Tunnelling in rocks - different phases and methods of tunnelling, Instrumentation in tunnels, Rock freezing, Rock fall, Improvement techniques for rock – Grouting, Rock bolting

Rock reinforcement - Mechanism, types of reinforcement, steps involved in installation, Foundations on rock, Rock blasting- explosives, Selection criteria for explosives, steps involved in blasting

Text book

1. *Singh, B. and Goel, R. K. "Rock Mass Classification Systems – A Practical Approach in Civil Engineering "Elsevier Publisher*

Reference Books

1.Verma, B. P., "Rock Mechanics for Engineers" Khanna Publishers
2.Brown, E.T., "Rock Characterisation, Testing and Monitoring", Pergamon Press, London, U.K
3. Rock mechanics on the design of structures in rock by Oberti and Duvalk, W. L. John Wiley.

SMFE1.4(c) REMOTE SENSING AND GIS APPLICATIONS

Common Syllabus for HCH1.4(c), SMFE1.4(c) and EEM1.4(c)

Introduction - Definition- Principle of Remote Sensing- History of Development of Remote Sensing- Stages in Remote Sensing- Electromagnetic Radiation and the Electromagnetic Spectrum- Interactions With the Atmosphere- Atmospheric Scattering- Atmospheric Absorption- Atmospheric Windows- Refraction- Interaction of EMR with the Earth's Surface- Reflection- Transmission- Spectral Signature.

Platforms & Sensors- Remote Sensing Systems- Remote Sensing From Space- Remote Sensing Sensors- Resolution- Imaging Sensors- Optical Infrared (OIR) Imagers- Optical Sensors- Thermal Sensors- Microwave Sensors- Active Microwave Sensors- Data Preprocessing- Remote Sensing in India.

Introduction to Image Interpretation- Basic Principles of Image Interpretation- Elements of Image Interpretation- Techniques of Image Interpretation- Interpretation Keys- Introduction to Digital Image Processing- Digital Image- Image Rectification and Registration- Geometric Correction- Image Enhancement Techniques (Only Concepts)- Image Classification -

Unsupervised Classification and Supervised Classification- Digital Photogrammetry - Stereo Images from Satellites - Data Merging .

Geographic Information Systems (GIS)- Definitions and Related Technology- GIS Operations- GIS Elements- GIS Concepts and Practice- Map Projection and Coordinate System.

Vector Data Model- Introduction- Vector Data Representation- Geometric Objects- Topology.

Vector Data Analysis- Introduction- Buffering- Applications of Buffering- Map Overlay- Feature Type and Map Overlay- Map Overlay Methods- Slivers- Error Propagation in Map - Overlay- Distance Measurement- Map Manipulation-

Raster Data Analysis- Introduction- Analysis Environment- Local Operations- Local Operations With a Single Grid- Local Operations With Multiple Grids- Neighborhood Operations- Zonal Operations.

Terrain Mapping and Analysis- Introduction- Data for Terrain Mapping and Analysis- Surface Models-DEM- TIN.

GIS Models and Modeling- Introduction- GIS Modeling- Binary Models- Index Models

Remote Sensing & GIS Application in Civil Engineering – Some Case Studies from Literature.

Text Books

1. *Fundamentals of Remote Sensing 2nd Ed by George Joseph- University Press- New Delhi.*
2. *Introduction to Geographic Information Systems by Kang Tsung Chang- Tata Mc.G.H. Publications- New Delhi.*
3. *Remote Sensing and Image Interpretation by Lillesand- T.M. and Kieffer- Joh Wiley and Sons- New York- 1987.*

Reference Books

1. *Remote Sensing of the Environment – An Earth Resource Prespective by John R. Jensen- Pearson Education- New Delhi.*
2. *Geographic Information Systems: A Management Perspective by Aronoff- S. Ottawa: Wdl Publications- 1989.*

3. *Geographic Information Systems For Geoscientists: Modeling with GIS by Bonham Carter- G-F.- New York: Pergamon Press- 1994.*
4. *Principles Of Geographical Information Systems by Burrough- P.A And R.A. Mcdonnell.. Oxford: Oxford University Press- 1998.*
5. *Concepts and Technologies of Geographic Information Systems by Lo- C.P.- and Albert K.W. Young- Prentice Hall Of India (Pvt) Ltd- New Delhi.*
6. *Introductory Digital Image Processing by John R Jensen- Prentice Hall- New Jersey.*
7. *Application of Remote Sensing to Hydrology Including Groundwater by Farsworth- R.K.- Bawetl- E.C. & Dhanju- M.S.-- IHP- UNESCO- 1984.*

SMFE1.5(a) ADVANCED CONCRETE TECHNOLOGY

Common Syllabus for ST1.5(a), CTPM1.5(a) and SMFE1.5(a)

Durability of concrete and concrete construction: Durability concept, pore structure and transport processes, reinforcement corrosion, fire resistance, frost damage, sulphate attack, alkali silica reaction, delayed ettringite formation, methods of providing durable concrete, short-term tests to assess long-term behavior.

Mix design: Review of methods and philosophies of IS, BS and ACI methods, mix design for special purposes. Acceptance criteria for compressive strength of concrete

Special concretes: Lightweight concrete, autoclaved aerated concrete, no-fines concrete, lightweight aggregate concrete and foamed concrete, High strength concrete, refractory concrete, high density and radiation-shielding concrete, polymer concrete, fibre-reinforced concrete, mortars, renders, recycled concrete, Ferro Cement, Self Compacting Concrete.

Special processes and technology for particular types of structure: Sprayed concrete, underwater concrete, grouts, grouting and grouted concrete, mass concrete, slip form construction, pumped concrete, concrete for liquid retaining structures, vacuum process, concrete coatings and surface treatments.

Test methods: Analysis of fresh concrete, Accelerated testing methods, Tests on hardened concrete, Core cutting and testing, partially destructive testing, Non-destructive testing of concrete structures

Text Book

1. *Properties of Concrete, A.M.Neville, Longman 1995.*
2. *Concrete Technology Theory and Practice, M.S.Shetty, S.Chand & Company Ltd, New Delhi.*

Reference Book

1. *Concrete micro-structure, Properties and Materials, P.K.Mehta, J.M.Monteiro, Printice Hall INC & McGraw Hill, USA.*

SMFE1.5(b) SUBSURFACE EXPLORATION

Objectives of Soil Exploration, Methods of Soil Exploration, Depth and Extent of Soil Exploration in Different Civil Engineering Projects

Problems and phases of foundation investigations. Geophysical, sounding, drilling and accessible explorations. Sample requirements, sampling methods and equipment. Handling, preservation and transportation of samples.

Sample preparation, laboratory tests – Triaxial (UU/CU), Consolidation, Swelling pressure. Analysis of results and interpretation, importance of in-situ testing. Performing various in situ tests – File Vane Shear Test, Plate load test, Pile load test, SPT, SCPT, DCPT. Precautions and interpretation. Site evaluation and reporting.

Exploration in Rock and Marine Soil Exploration

Text Book

1. *Basic and Applied Soil Mechanics by Gopal Ranjan and A.S.R. Rao, New Age International Publications*

Reference books

1. *Head, K. H., Manual of Soil Laboratory Testing, volume 1 to 3, 1981*
2. *Compendium of Indian Standards on Soil Engineering Parts I and II, 1987 – 1988*

SMFE1.6. SOIL AND ROCK ENGINEERING LAB

Experiments on Soil

1. Index and Engineering Properties Of soils
2. Quick Determination of Water content – Rapid Moisture Meter, Proctor's Needle.
3. Determination of Compression Index, Coefficient of consolidation of clays
4. Determination of Swell Parameters – Differential Free Swell, Swell Pressure Tests.
5. Determination of Shear Parameters – Tri-axial Test, Direct Shear Test, Vane Shear test, Unconfined Compression Test.
6. Determination of Relative Density of granular soils.

Experiments on Rock

1. Determination of Specific Gravity.
2. Determination of Unconfined Compression Strength.
3. Determination of Porosity.
4. Determination of Water absorption.
5. Determination of point load Index of Rocks.

Demonstration Tests:

1. Plate Load Test.
2. Pile Load Test.
3. Standard Penetration Test.

Reference Book: Relevant IS Codes of Practice

SMFE1.7 GEOSYNTHETICS LAB

1. Determination of physical properties of Geotextiles, Geogrids and Geomembranes
2. Determination of Grab and wide width tensile strengths of geotextiles
3. Determination of Tensile strength of Geogrids and Geomembranes
4. Determination of Interfacial frictional characteristics of Geotexiles with Fill material
5. Determination of in plane and cross plane permeability of geotextiles
6. Determination of Puncture Resistance of geotextiles
7. Determination of A.O.S of geotextiles
8. Evaluation of long term flow ability of geotextiles by Gradient ratio test
9. Cone Drop Test on geotextiles

Reference Books: Relevant ASTM Standards

Department of Civil Engineering
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II – SEMESTER

SMFE2.1 SOIL DYNAMICS AND MACHINE FOUNDATIONS

Theory of Vibration: Free and forced vibrations with and without damping for single mass system with single degree freedom, Logarithmic Decrement and Damping Ratio, Principles of Design of Vibration measuring Devices, Transmissibility of force, vibrations of Two degree freedom system, vibrations of Systems under transient loads.

Natural frequency of foundation soil system- Barkan's Method, Pressure Bulb Concept, Pauw's Analogy, Tschebetorioff's concept of reduced natural Frequency.

Dynamic Soil Properties: Tests for determination of dynamic soil properties - Cyclic Plate load test, Block vibration test, Up Hole, down Hole and Cross Hole wave Propagation tests, Hammer Test, Resonant Column Test, Seismic Reflection and Refraction tests.

Design of Machine Foundation: Types of Machine Foundations, design criteria, Degrees of Freedom of Block foundation, Analysis of Block foundations under sliding, rocking, yawing and Coupled motions, Design Aspects and Construction details of foundations for reciprocating and Impact, vibration isolation: active and passive isolation, vibration isolation materials.

Text Book

1. *Soil Dynamics by Shamsher Prakash, Shamsher Prakash Foundation*

Reference books

1. *Hand Book of Machine Foundations by P. Srinivasulu and C.V. Vaidyanathan, Tata Mc Graw Hill Book Co.*
2. *Dynamics of Bases and Foundation by Barken, Mc Graw Hill Book Co.*
3. *Vibration of soil and Foundation by Richart F.E., Hall J.A., Woodes R.E., Prentice Hall*

SMFE2.2 EARTH AND EARTH RETAINING STRUCTURES

Earth Pressure:

Basic concepts, Rankine and Coulomb earth pressure theories, Determination of active and passive pressures: Culmann's Graphical method, logarithmic spiral methods, friction circle method. Consideration of surcharge, seepage, earth quack, wave effect, stratification, type of backfill, wall friction and adhesion.

Retaining structures:

a. Uses, types, stability and design principles of retaining walls, backfill drainage, settlement and tilting.
b. Sheet Pile Walls: Types, Design of cantilever sheet pile walls in granular and Cohesive soils; Design of anchored sheet pile walls by free and fixed earth support methods, Rowe's theory of moment Reduction, Design of anchors.
c. Braced excavations: Types of sheeting and Bracing systems, lateral earth pressure on sheeting in sand and clay, Design components of braced cuts.
d. Cellular cofferdams: Types – Diaphragm and Circular type, Design by TVA method. Stability of cellular cofferdams, cellular cofferdams in rocks and soils.

Text Books

1. *Basic and Applied Soil Mechanics by Gopal Ranjan and A.S.R. Rao, New Age International Publications*
2. *Foundation design by W. C. Teng, Prentice Hall*

Reference books

1. *Theoretical soil mechanics by Karl Terzaghi, John Willey 1965*
2. *Soil mechanics in engineering and practice by K. Terzaghi. And R.B. Peck 2nd edition, John Wiley 1968.*
3. *Analysis and design of foundations by J.E. Bowles, McGraw Hill, 4th edition 1955.*

SMFE2.3 GEOTECHNICAL EARTHQUAKE ENGINEERING

Seismology and Earth Quakes: Introduction, Seismic Hazards, seismic waves, internal structure of earth, Continental Drift and plate tectonics, faults, elastic rebound theory, geometric notations, location of earthquakes, size of earthquakes.

Strong Ground Motion: Strong ground motion measurement, Ground motion parameters, Estimation of ground motion parameters.

Seismic Hazard Analysis: Identification and evaluation of earthquake sources, Deterministic Seismic Hazard Analysis, Probabilistic seismic Hazard analysis.

Wave Propagation: Waves in Rods, one dimensional wave equation, Effect of end condition on wave propagation, Mode vibrations of rods of finite length, Wave propagation through elastic infinite medium, Waves in Semi infinite elastic medium.

Dynamic Soil Properties: Measurement of Dynamic Soil Properties using field and laboratory tests (overview), Strength and Stress-strain behavior of cyclically loaded soils.

Ground Response Analysis: One dimensional ground response analysis – Linear and Non-linear approaches.

Local Site Effects: Effect of local site conditions on ground motion, Design parameters, Development of design parameters.

Liquefaction: Flow liquefaction, cyclic mobility, liquefaction hazards, liquefaction susceptibility, Initiation of liquefaction, Effects of liquefaction, liquefaction Control measures

Text Book

1. *Geotechnical Earthquake Engineering by Steven L. Kramer, Prentice Hall*

Reference Book

1. *Geotechnical Earthquake Engineering Handbook by Robert W. Day, McGraw-Hill Publishing Co., New York*

SMFE2.4(a) DISASTER MANAGEMENT

Types of Disasters:

Disaster - concept and definitions of disaster, causes of disasters, types – natural disasters – floods, droughts, cyclones, earthquakes, landslides, avalanches, volcanic eruptions, heat and cold wave, global warming, sea level rise, ozone depletion. Man-made disasters: Sociological – political – industrial and human disasters.

Risk Assessment and Analysis

Concept and elements of Hazards, Risks and Vulnerability – Policies of Disaster Management, Identification of Crisis Situation, strategic developments, roles and responsibilities of recovery team, importance of team building in disaster management.

Disaster Preparedness:

Prevention and Preparedness – Plan, Action and Accountability, Concept and Nature of Disaster Preparedness, Plan of Disaster Preparedness for People with Special Needs/Vulnerable Groups, with Relevance to Housing, Infrastructure and Livestock, Community Based Disaster Preparedness Plan, Role of Information technology, Education, Communication and training. Medical and health preparedness plan.

Disaster Damage Assessment and Response:

Needs and Damage Assessment– Control process and measurement – modern and traditional methods of response, Disaster Response Plan – roles of response teams and forces. Epidemiological Study of Disasters - Medical and Health Response to Different Disasters - Role of Information and Communication Technology in Health Response

Disaster Mitigation and Recovery:

Disaster Mitigation – meaning and concept – structural mitigation and non-structural mitigation – mitigation strategies and emerging trends. Reconstruction and rehabilitation for development, Medium and long-term recovery aspects, Participative Rehabilitation Process: Community involvement and development of infrastructure.

Reference Books:

1. *Disaster Management by Dr. Mrinalini Pandey, Wiley India Pvt. Ltd.*
2. *Natural Hazards & Disaster Management by R.B.Singh*
3. *Disaster Management: Future Challenges and opportunities by Jagbir Singh4*
4. *Natural Disaster Management, Jon Ingleton*
5. *Disaster Management, Rajib Shaw and RR Krishnamurthy, Universities Press, Hyderabad.*

SMFE2.4(b) GROUND IMPROVEMENT TECHNIQUES

Common Syllabus for SMFE2.4(b), CTPM2.4(b), ST2.4(b) and TE2.4(a)

Compaction: Theory of compaction, Shallow Surface Compaction - Equipment, Placement water content, factors affecting shallow compaction; Deep compaction: Methods - Vibrofloatation, Terra probe method, Pounding, Blasting, Compaction piles; Compaction Control.

Vertical Drains: Sand drains, Sand wicks, Rope drains, Design of vertical drains, Stone columns, application of the techniques to Marine clays.

Stabilization: Introduction, objectives, Methods of stabilization – Mechanical, Cement, Lime, Bituminous, Calcium chloride; construction methods, factors affecting stabilization of soils; Deep Mixing methods – Soil lime Columns and Cement Lime Columns, applications

Dewatering: Definition, necessity, Methods of dewatering – Interceptor ditch, Single, Multistage and Vacuum well points, Horizontal wells, Electro-osmosis. Permanent drainage by Foundation drains and Blanket drains.

Grouting: Definition, Objectives of grouting, Grouts and their properties, Categories of Grouting, Grouting methods: Asending, Descending and Stage Grouting in Soils, Hydrofracture, Grouting Equipment, Post grouting tests.

In-situ Reinforcement: Ground Anchors, Tiebacks and Soil Nailing, Micropiles.

Text Book

1. Ground Improvement Techniques by P. Purushothama Raj, Laksmi Publications, New Delhi.

Reference Books

1. *Engineering Principles of Ground Modification by Monfred R Hausmann, Mc Graw Hill Publishing Co.*
2. *Reinforced Soil and Its Engineering Applications by Swami Saran, I.K. International Pvt. Ltd.*

SMFE2.4(c) RELIABILITY ANALYSIS AND DESIGN

Common Syllabus for ST2.4(c) and SMFE2.4(c)

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.

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.

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

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

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.*

SMFE2.5(a) GEOTECHNICS OF UNDERGROUND STRUCTURES

Arching in soils, prerequisites and features of arching, Theory of arching in soils, Application of arching in cohesive frictional and cohesive-frictional soils.

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

Stresses in Vicinity of Vertical Shafts, Tunnels, Construction of Erath Tunnels

Retaining Systems for Underground Excavations

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

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 and Retaining Structures", Sarita prakasha.*

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.*

SMFE2.2 FINITE ELEMENT METHOD OF ANALYSIS

Common Syllabus for ST2.2, SMFE2.5(b), WRE2.5(b), HCH2.5(b) and TE2.5(b)

Introduction: A brief history of F.E.M. Need of the method, Review of basic principles of solid mechanics- Equations of equilibrium, Boundary conditions, Compatibility, Strain displacement relations, Constitutive relationship in matrix form, plane stress & plane strain and axisymmetric bodies of revolution with axi-symmetric loading, Energy principles - Raleigh - Ritz method of functional approximation.

Theory relating to the formulation of the finite element method, Coordinate system (local and global), generalized coordinates, Concept of the element, Various element shapes, Discretisation of a structure, Mesh refinement Vs. Higher order element, Interconnections at nodes of displacement models, inter element compatibility, -shape functions.

Basic component – One dimensional FEM single bar element, Beam element : Derivation of stiffness matrix, Assembly of stiffness, Matrix boundary conditions, shape functions for 1 D elements, Initial strain and temperature effects, and trusses under axial forces.

Two dimensional FEM**:** Different types of elements for plane stress and plane strain analysis – Displacement models Generation of element stiffness and nodal load matrices –static condensation.

Isoparametric representation and its formulation for 2d analysis. Formulation of 4-noded and 8-noded isoparametric quadrilateral elements – Lagrangian elements-serendipity elements.

Text Books

1. *Finite Element Analysis by C.S.Krishnamoorthy, (2002), Tata McGraw Hill Publishing Co. Ltd.*
2. *Introduction to Finite Element Method by Desai,C.S.and Abel, J.F.,Van Nostrand, 1972.*

Reference Books

1. *Introduction to Finite element Method by Tirupathi chandra Patla and Belugundu*
2. *The Finite Element Method in Engineering Science" by Zienkiewicz, P., McGraw Hill, 1971.*

SMFE2.6 DESIGN PROJECT

The students should carry out typical foundation design under varying soil conditions or revision of IS codes & IRC guidelines or any project suggested by course instructor. The design project may consist of

1. Soil and Structural Design of Combined footings, rafts
2. Design of Pile Groups
3. Design of Laterally loaded Piles
4. Design of well Foundations
5. Landfill Design
6. Reinforced Soil Structures
7. Design of Bulk heads
8. Case studies.

SMFE2.7 CASE STUDIES

Students should select a case study in any of the following areas and prepare a comprehensive report and present the case study

1. Foundation design
2. site characterization
3. ground improvement
4. Slope Instability
5. Soil Contamination and remediation
6. Foundation failures
7. Embankment construction on weak subgrades.

SMFE2.8 SEMINAR

Each student has to select a topic and collect about 10 papers with at least 5 journal papers and prepare a report and give a seminar at the end of the semester

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III – SEMESTER

SMFE3.1(a) PROBLEMATIC SOILS

Expansive Soils:Geology, engineering properties, swelling, swelling pressure, strength and compressibility, permeability stabilization methods, foundation types.

Soft Clays:Geology of soft marine clays, mineralogy, physical properties, shear strength and compressibility, foundation types.

Organic and Peaty Soils, Collapsible soils:Geotechnical properties, foundation types

Liquefiable Soils: Identification, Factors affecting Liquefaction, Methods for improving resistance of soils to Liquefaction

Filled up Soils: Characterization, Methods for Strengthening Filled up material for supporting structures, Foundation practices in Filled up areas.

Soil Stabilization:Principles of soil stabilization; Role of admixtures; Purpose based classification of soils; Methods of stabilization – Lime, cement, bitumen and special chemicals – Mechanisms, uses and limitation; use of fly ash and other waste materials

Text Book:

1. Ground Improvement Techniques by P. Purushothama Raj, Lakshmi Publications

Reference Books

1. *Tropical soils in engineering practice by S. A. Ola, Balkema publications, Holland*
2. *Soil stabilization principles and practice by Ingles, O. G. and Metcalf, J. B., Butterworth,1972*

SMFE3.1(b) GEOTECHNICS OF INDUSTRIAL WASTES

Wastes from Thermal Power Plants: Fly ash, bottom ash and Pond Ash, availability, Properties, classification, scope for use in civil engineering projects, Present applications

Agriculture Waste: Rice Husk Ash, Physical, Chemical and Engineering Properties, Potential uses based on its properties.

Wastes from Steel Plants: Blast Furnace Slag, Granulated Blast Furnace Slag and Ground Granulated Blast Furnace Slag, Material properties, potential applications.

Quarry Dust: Production, Properties, comparison with sand, potential uses.

Potential for use of Industrial wastes in stabilization of soils.

Underground Pollution Risk of using Industrial wastes as construction materials and Mitigation. Evaluation methods for studying the leaching effect of industrial wastes on underground.

Text Book

1. *Ground Improvement Techniques by P. Purushothama Raj, Lakshmi Publications, New Delhi.*

Reference Book

1. *A. Sridharan and K. Prakash (2009), "Geotechnical Engineering Characterization of Coal Ashes", CBS Publishers*

SMFE3.2(a) FORENSIC GEOTECHNICAL ENGINEERING

Concept of Forensic Investigation, Necessity, Objectives of Forensic Geotechnical Investigation, Methods of Forensic Investigation.

Project reconnaissance and characterization of the distress, including document search such as plans, codes, and other technical specifications followed in the original design.

Diagnostic tests – Analysis of field data – selection of laboratory tests based on actual field parameters to evaluate the behaviour of soil/ground.

Scope and extent of application of Forensic Engineering techniques in geotechnical and foundation failure investigations, settlement of structures, expansive soils, lateral movement, other geotechnical and foundation problems, groundwater and moisture problems.

Back analysis: Selection of theoretical model - methods of analysis, Instrumentation and Monitoring Development of the most probable failure hypothesis - cross-check with original design.

Performing reliability checks, Legal issues involving jurisprudence system, insurance, repairs, reducing potential liability, responsibility of geotechnical engineers and contractors.

Text Book

1. *Forensic Geotechnical and Foundation Engineering by Robert W. Day, Mc Graw Hill*

Reference Book

1. *Malcolm D. Bolton, "A Guide to Soil Mechanics "Universities Press.*
2. *Saxena, D.S., "Technical, Ethical, and Legal Issues with Forensic Geotechnical Engineering - A Case History", Proceedings, 13th Asian Regional Conference on Soil Mechanics and Geotechnical Engineering, Kolkata, India, 11 December 2007.*

SMFE3.2(b) GEOENVIRONMENTAL ENGINEERING

Common Syllabus for SMFE3.2(b) and TE3.2(b)

Wastes: source, production and classification of wastes, soil pollution processes, waste characterization.

Waste disposal facilities: Landfills and impoundments, Slurry walls, Types of landfills, Landfill planning and design; Barrier systems – Basic concepts, Design and construction; Stability, compatibility and performance contaminant transformation and transport in subsurface, Monitoring surface contamination, Stabilization and modification of wastes. Reuse of waste materials, contaminated site remediation, Case studies in waste handling.

Soil erosion and conservation: Causes of soil erosions, Factors contributing to erosion – climatic factors, Topographical factors, Vegetation factors. Erosion control – Cropping systems, Gullies,

Check dams, Contouring, Wind striping, Ridging, Bank protection, Erosion control with vegetation mats and Silt fences.

Note:

1. Student is expected to give at least one seminar on the subject from journal.
2. Preparation of paper involving case studies where the topics covered were incorporated in practice.

Text Book

1. *Geoenvironmental Engineering – principles and applications by L.N. Reddiand H.F. Inyang, Marcel Dekker, 2000*

Reference books

1. *Geotechnical practice for waste disposal by D.E. Daniel, Chapman and Hall, London 1993*
2. *Clay barrier systems for waste disposal facilities by R.K. Rowe, R.M. Quigleyand J.R. Booker,E & FN Spon, London, 1995*
3. *Design, construction and monitoring of landfillsby Bagchi, A, John Wiley & Sons, New York 1994*
4. *Waste containment systems, Waste stabilization and landfillsDesign and evaluation by H.D. Sharma, H. D. and S.P. Lewis,John Wiley & Sons, New York 1994*

SMFE3.3 DISSERTATION (Preliminary)

The student shall submit a brief report on the selected topic of his/her thesis work and attend for a formal viva-voce examination before a Committee comprising the Chairman, BOS, Head of the Department and the Guide.

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IV – SEMESTER

SMFE4.1 DISSERTATION (Final)

The student shall submit his/her thesis work and attend for a formal viva-voce examination before a Committee comprising the Chairman, BOS, Head of the Department, the Guide and the External Examiner.