

Scheme of teaching and examination for
Master of Engineering (Foundation Engineering)
Two Years Full Time Course

Semester I								
Subject Code	Subject	Hours per week			Scheme of Examination			
		L	T	P	Theory (Hrs)	Marks / Credits		
						Theory	TW/O	Total
MFE 1.1	Elective I	3	1	1	3	100 /4	50 /2	150 /6
MFE 1.2	Rock mechanics	3	--	2	3	100 /4	50 /2	150 /6
MFE 1.3	Shallow Foundations	3	1	1	3	100 /4	50 /2	150 /6
MFE 1.4	Ground Improvement	3	1	1	3	100 /4	50 /2	150 /6
MFE 1.5	Advance Soil Mechanics	3	--	2	3	100 /4	50 /2	150 /6
MFE 1.6	Model Studies	--	--	5	--		50 /2	50 /2
	Total	15	3	12		500 /20	300 /12	800 /32

Semester II								
Subject Code	Subject	Hours per week			Scheme of Examination			
		L	T	P	Theory (Hrs)	Marks / Credits		
						Theory	TW/O	Total
MFE 2.1	Elective II	3	1	1	3	100 /4	50 /2	150 /6
MFE 2.2	Deep Foundations	3	1	1	3	100 /4	50 /2	150 /6
MFE 2.3	Soil Dynamics & machine Foundations	3	1	1	3	100 /4	50 /2	150 /6
MFE 2.4	Foundations of Off-Shore Structures	3	1	1	3	100 /4	50 /2	150 /6
MFE 2.5	FEM in Geo-technical Engineering	3	--	2	3	100 /4	50 /2	150 /6
MFE 2.6	CAD Laboratory	--	--	5	--	--	50 /2	50 /2
	Total	15	4	11		500 /20	300 /12	800 /32

Semester III								
Subject Code	Subject	Hours per week			Scheme of Examination			
		L	T	P	Theory (Hrs)	Marks / Credits		
						Theory	TW/O	Total
MFE 3.1	Elective III	3	1	1	3	100 /4	50 /2	150 /6
MFE 3.2	Project	-	-	8	-	-	150* /6	150 /6
MFE 3.3	Seminar-I	-	-	8	-	--	150* /6	150 /6
MFE 3.4	Seminar-II	-	-	8	-	--	150* /6	150 /6
	Total	3	1	25		100 /4	500 /20	600 /24

Semester IV								
Subject Code	Subject	Hours per week			Scheme of Examination			
		L	T	P	Theory (Hrs)	Marks / Credits		
						Theory	TW/O	Total
MFE 4.1	Dissertation	-	-	28		--	450#/18	450 /18
	Total	-	-	28		--	450 /18	450 /18

Grand Total of all four semesters	33	8	76	-	1100 /44	1550/62	2650 /106	
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Note: * : 50 mks. (from guide for report) + 100 mks (from examination panel for defence) = 150 (examination panel shall be constituted of : guide and another examiner preferably from outside.)

#: 200mks (from guide for work and report)+ 250mks(from examination panel for defence) =450 (examination panel shall be constituted of: Chairman –Head of Civil Engg. Dept., or his nominee if Head is the guide or if the Head cannot be present, the guide and another examiner preferably from outside.)

The grade for seminars, projects an dissertations are to be awarded by the corresponding panel of examiners, on the basis of total marks.

List of Electives for Semesters I, II & III

Elective –I (for MFE 1.1):

- MFE 1.1.1 Soil Exploration & Field testing.
- MFE 1.1.2 Geotechnical Engineering for infrastructure
- MFE 1.1.3 Engineering Geology.

Elective – II (for MFE 2.1)

- MFE 2.1.1 Re-inforced soil structures
- MFE 2.1.2 Structural Design of Foundations
- MFE 2.1.3 Pavement Engineering
- MFE 2.1.4 Earthquake Geotechnical engineering.

Elective –III (for MFE 3.1)

- MFE 3.1.1 Earthdam Engineering
- MFE 3.1.2 FEM and constitutive modeling in geo-mechanics
- MFE 3.1.3 Soil Foundation Structure Interaction

MFE 1.1.1 SOIL EXPLORATION AND FIELD TESTING

Principles of Exploration, Geophysical and sounding methods, Modern methods of boring and sampling, Preservation and transportation of samples, Sampling records, Soil profiles, Various types of Field Tests, Instrumentation, Investigation below sea/ river bed, Offshore Investigation, Interpretation of exploration data and report preparation.

References:

Hanna T.H., "Field Instrumentation In Geotechnical Engg." Trans Tech. Publications, Germany, 1988.

McKinsky et al," Mining Geology", Prentice Hall India, New Delhi, 1992.

MFE 1.1.2 GEOTECHNICAL ENGINEERING FOR INFRASTRUCTURE

Types of Foundations for Industrial Structures, Design of Deep foundations for heavy Structures and Railway and highway bridges, Foundations for Transmission line Towers, Storage tanks, silos, Chimneys etc. Site Investigation for infrastructure projects, Excavation scheme, Sheet piles and Cofferdams, Design od dewatering Systems, Construction equipments.

References:

Patrick H. Mc Donalds,"Fundamentals of Infrastructure Engineering in Civil Engg. Systems " , Wiley Eastern, New Delhi, 1987.

C. Gomes, "Geotechniques for Roads, Rail tracks and Earth Structures", Mc-Graw Hill Publishing Co. Ltd., New Delhi, 1991.

MFE 1.1.3

ENGINEERING GEOLOGY

Site investigation:

Preliminary reconnaissance survey, surface and subsurface explorations and logging of boreholes for engineering purposes.

Rocks in geotechnical studies:

A) rock excavations: types of rock excavations, rock reinforcement and stability of rock slopes. B) construction materials and aggregates.

C) discontinuities in rock masses. D) rock weathering.

Groundwater and geotechnical problems

Influence of groundwater on dams, tunnels, failure of landmasses and instability of slopes. Underground storage of oil, gas and water, disposal of waste materials, groundwater contamination.

Remote sensing and gis: principles, electromagnetic energy, sources, radiation and its interaction with various materials. Types of remote sensing and their advantages and limitations.

Case histories on engineering geological investigations.

Practical work:

Problems on structural geology. Completion of outcrops, Electrical resistivity survey.

References:

F.G. Bell, "Fundamentals of Engineering Geology" , Aditya Books Pvt. Ltd., New Delhi, 1992.

F.G. Bell, "Engineering Geology and Geotechnics", Butter Worth and Co. Ltd., London, 1980.

Franklin & Dusseault, "Rock Engineering Applications", McGraw Hill Publishing Co., New Delhi, 1992.

Freeze and Cherry, "Ground water", Prentice Hall Inc., Eaglewood Cliffs, New Jersey, 1979.

Floyd F. Sabins, "Remote Sensing, Principles and interpretations", Second Edition, W.H. Freeman and Co. Ltd., New York, 1986.

MFE 1.2 ROCK MECHANICS

Introduction - Definition, scope, applications.

Properties of Rock and Rock Masses - Porosity, void index, permeability, ultrasonic, electrical resistivity, seismic, uniaxial compressive strength, elastic and dynamic constants, tensile strength, shear strength, I.S. approach, modes of failures, failure criteria - Griffiths, Navier-Coulomb, Mohr, behavior of rock mass.

Engineering Classification of Rocks and Rock Masses - Objects, intact rock classification on basis of strength, rock mass classification based on rock fabric, rating concept - RQD, NGI, CSIR system, comparison and application of classification systems.

Stability of Rock Slopes - Methods of analysis, limit equilibrium method, slope design charts, circular failure in heavily fissured rock slopes, wedge method of analysis.

In-Situ State of Stress - Introduction, stress measurement, bore hole deformation meters, bore hole inclusion stress meters, bore hole strain gauge devices, methods of improving properties of rock masses, pressure grouting, rock reinforcement, cable anchorages.

In-Situ-Tests - Necessity, plate bearing test - principle, techniques, dynamic methods, shear and permeability tests.

Geological Aspects of Rocks: Blasting ,quarrying operations for construction works, Graphical Representation - Equal area and stereographic projections, pi- diagrams, uses, applications to stability of slopes, Remote Sensing

Rock Improvement Techniques:Rock bolting.cable anchorages, rock reinforcement, reticulated piles, etc..

References :

Richard E. Goodman, " Rock Mechanics", John Wiley And Sons, London, 1986.

Alfreds R. Jumikis, " Rock Mechanics", Trans Tech Publications. Germany, 1982.

Vutukuri V.S. ,Lama R.D. , "Hand Book Of Mechanical Properties Of Rocks", Vol.1.2,3 & 4, Trans Tech Publications, Germany, 1978.

MFE 1.3 SHALLOW FOUNDATIONS

Bearing Capacity of Shallow Foundations - Modes of failure, theories, effects of inclination, eccentricity of load, base tilt, sloping ground, shape, roughness of base, ground water, adjacent footings and non-homogeneous soil conditions.

Settlement of Shallow Foundations - Types, calculation of initial distortion settlements, consolidation settlement, secondary compression settlement, permissible settlements.

Spread Footings - Location, proportioning for equal settlement, contact pressure, design principles.

Combined Footings - Types, design principles of rectangular, trapezoidal, strap footings, modulus of subgrade reaction, continuous footings on elastic foundation, special footings, construction practices.

Mat Foundations - Types, stability and settlement, design principles, elements of design and construction of shell foundation.

Floating Foundations - Concept, types, problems to be considered in design, design principles.

Retaining Walls - Influence of soil properties, earth and foundation Pressures, stability, design principles.

Land Slides - Mechanism, movements associated, causes and consequences, classification, monitoring.

References:

Bowles.J.F., " Foundation Analysis And Design", Mc.Grawhill Int. Students Edition, New York, 1966.

Brahma.S.P., " Foundation Engineering", Tata Mcgraw Hill Publishing Company, N. Delhi, 1992.

Hans F.Winterkorn , Hsai-Yang Fang, "Foundation Engg. Handbook", Galgotia Book Source, New-Delhi, 1986.

Naik N.V. " Fondation Design Manual", Dhanpatrai And Sons, New Delhi, 1994.

Nainan P.Kurian, "Design of Foundation Systems", Narosa Publisher, New Delhi, 1992.

Kaniraj,"Design Aids in Soil Mechanics and Foundation Engineering", Tata-Mc-Graw Hill, Ltd. Bombay, 1991.

MFE 1.4 GROUND IMPROVEMENT

Introduction - Ground improvement by geotechnical processes, principles of soil compaction.

Stabilization - Soil-cement mixtures, soil-asphalt mixtures, Intrusion grouting, vibrofloatation, well-pointing, electro-osmosis, stone column and drains, chemical admixtures.

Grouting - Chemical grouting, grouting equipment, grout volumes and grout pressures, grouting methods.

Geotextiles in soil engineering, geo-fabrics used and reinforced earth.

Ground water in excavations and methods of ground water control, ground water under artisan conditions beneath excavations, selection of appropriate method, special type of equipments employed in foundation investigations and construction.

Laterite soil - Special problems.

Black Cotton Soils - Special problems and remedies.

References:

Bell. F.G. " Engineering Treatment of Soils", E&FN SPON, Chapman and Hall India, Madras, India, 1993.

Hans F.Winterkorn & Hsai-Yang Fang, "Foundation Engg. Handbook", Galgotia Book Source, New-Delhi, 1986.

MFE 1.5 ADVANCED SOIL MECHANICS

Idealised Concept of Soil - Darcy's law, Steady state 3-D flow in an isotropic soil, continuity equation, equation of state, governing differential equation, solution by numerical methods, matrix method, FEM for 2-D, Methods for reducing flow.

Transient Flow - 3-D flow through anisotropic soil of compressible fluid, through partially saturated soil, Terzaghi-Rendulic and Biot's equations, solution by numerical methods.

Introduction to Scharf-Christoffel method and drains.

Stress Distribution in Soil - Application of theory of elasticity, Boussinesq, Mindlin, Westergaard's theories.

Contact Pressure - Factors affecting, effect of rigidity of footing and/ or superstructure, simplified elastic-plastic analysis, thin plate theory, numerical methods, use of FEM, and rafts on consolidating soil layer.

3-D stress representation. Octahedral stresses, Stress invariants.

Shear Strength of Soil - Pore pressure parameters, total and effective stress parameters, effect of intermediate principal stress, rate of strain etc.

Yield Criteria - Failure envelopes for soils, 3-D representation.

References :

Alam Singh, "Modern Geotechnical Engineering", International

Book Traders, New Delhi, 1988.

Braja.M.Das." Advanced Soil Mechanics", Mc.Grawhill Int. Students Edition, Singapore, 1985.

Karl Terzhagi And Ralph B. Peck, " Soil Mechanics In Engineering Practice, John Willey and Sons, London, 1965.

Scott R.F., "Principles Of Soil Mechanics", Addison-Wesley Publishing Company, London, 1965.

MFE 1.6 MODEL STUDIES

Study in developing and analysing models related to foundation engineering. Instrumentation and interpretation of results. Model and prototype studies.

MFE 2.1.1 REINFORCED SOIL STRUCTURES

Historical background, Principles, Concepts and mechanism of Reinforced Earth, Design considerations for reinforced Earth and reinforced soil structures, geosynthetics- their manufacture, properties, functions, testing and their applications in reinforced earth structures, Design of Reinforced soil structures like retaining walls, embankments, foundation beds, landfills etc, Case histories of applications.

References:

C. Gomes,"Geotechniques for Roads, Rail tracks and Earth Structures", W. Eastern Pub., 1976.

G.V. Rao,"Geosynthetics in Geotechnical engg.", Tata-McGraw Hill Publishing Company Ltd. New Delhi, 1998.

MFE 2.1.2 STRUCTURAL DESIGN OF FOUNDATIONS

Introduction to Limit State Design of reinforced Concrete in Foundations, Soil pressure for structural design, Conventional Structural design of Continuous footings, Individual footings, Combined footings and rafts of various types subjected to vertical and lateral loads and moments, Design of circular rafts, Soil structure Interaction and 'flexible' approach to the design of foundations, structural design of piles including pile caps, under-reamed piles, piers and caissons, Structural design of Retaining walls, Special Foundations, Introduction to Shell foundations.

Reference:

Gupta,"Raft Foundations Design & Analysis with a practical approach ", Dhanpat Rai and Sons, Delhi, 1991.

IS:456 and other relevant IS codes.

B.C.Punmia et al, "Comprehensive Re-inforced concrete structures", Laxmi Publications (P)Ltd., 1998.

Unnikrishnan Pillai, "Re-inforced Concrete Design", S.Chand & Co.Ltd., Delhi, 1984.

MFE 2.1.3 PAVEMENT ENGINEERING

Pavement types, Stress distribution in pavements – theoretical and actual, Subgrade condition and traffic loadings, Design principle and methods for flexible and rigid pavements, Design of heavy duty pavements, Concrete block pavements

Evaluation of pavement condition, pavement Instrumentation, Types of pavement distress, their origins and remedy, Roughness and skid resistance, Environmental influences and effects, pavement maintenance, overlays, pavement Management Systems.

References:

Alam Singh, "Modern Geotechnical Engineering", International , Book Traders, 1995.

Shembaga R.Kaniraj, "Design In Soil Mechanics & Foundation Engg." Tata Mc Grawhill Publication Co. Ltd., New Delhi, 1992.

B.C. Punmia,"Soil Mechanics", Laxmi Publications Pvt. Ltd., New Delhi, 1990.

MFE 2.1.4 EARTH QUAKE GEOTECHNICAL ENGINEERING

Original mechanism of earth quakes, recording and analysis of accelleragrams.

Seismic regionalization, behaviour of various vibration system, earthquake excitation, forced vibration.

Inelastic systems, permissible stress and load factors. Behaviour of tall structures, common buildings, bridges.

Hydrodynamic pressures on earth and rock fill dams, concrete and machinery dams, retaining walls, seismic design.

Tsunamis (tidal) waves during earthquake on offshore structures.

References:

Donald P. Coduto, "Geotechnical Engineering, Principles and Practices", Wiley Eastern Co. Ltd., Singapore, 1988.

James L. Stratta ,"Manual of Seismic design", Thomson Asia Pvt. Ltd., Singapore, 1994.

Hans F.Winterkorn & Hsai-Yang Fang, "Foundation Engg. Handbook", Galgotia Book Source, New-Delhi, 2001.

IS:1893 and other relavant codes.

MFE 2.2 DEEP FOUNDATIONS

Installation of piles - Types of piles, construction practices, effects of pile driving in clays and sands, effects of installing bored piles.

Load Capacity of Piles - Single piles, pile groups, piles to rock, SPT and static cone penetrometer, uplift resistance, negative friction, special types of piles, pile driving formulas, dynamic loads on piles, influence of earthquake forces.

Settlement Analysis of Single Piles - Methods of analysis, solutions for settler-lent and load distribution, simplified method to constructing load settlement curve, determination of soil parameters, validity of methods.

Settlement Analysis of Pile Groups - Analysis of group settlement, solutions for free standing groups, design charts, validity of methods.

Laterally Loaded Piles - Lateral resistance of single piles, conventional statical approach, Brom's and Brinch Hansen's methods, I.S. approach, socketed piles, battered piles, pile groups, methods of increasing lateral resistance, load deflection behaviour, modulus of subgrade reaction approach, pile groups, I.S. approach.

Special Piles - Piles in swelling and shrinking soils, lateritic soils, piles in soils undergoing lateral movement, micro piles, simple design and construction practices.

Pile Load Tests - Maintained loading test, constant rate of penetration test, method of equilibrium, I.S. approach, errors in measurements, lateral load test.

Design and construction aspects of well foundations, underpinning techniques.

References:

Braja M.Das, "Principles of Foundation Engineering", Thomson Books/ Cole, ISE, Mexico, 2003.

Hans F.Winterkorn & Hsai-Yang Fang, "Foundation Engg. Handbook", Galgotia Book Source, New-Delhi.1986.

Poulos H.G., And Davis E.H. " Pile Foundation Analysis And Design", John Willey And Sons.1984

Shembaga R.Kaniraj, "Design In Soil Mechanics & Foundation Engg." Tata Mc Grawhill Publication Co. Ltd.1989

Tomlinson M.J., "Foundation Design & Constructions",E.L.B.S & Pitman.1986.

Tomlinson M.J., "Pile Design & Construction Practice", A View Point Of Publication" & Pitman1986.

MFE 2.3 SOIL DYNAMICS AND MACHINE FOUNDATION

Introduction: Types of machine foundations, General requirement, Types of motion, General limits of amplitude, Dynamic loads due to machines, Earthquake loading.

Theory of vibration: Modes of vibration, Vibration of single degree of freedom system, Vibration of multiple degree of freedom system

Dynamic soil properties: Evaluation of Natural frequency, Mass parameter, Soil stiffness, Dynamic elastic constants, Damping constant and damping factor, Coefficient of elastic uniform compression of soil – Barken's method, Dynamic bearing capacity – pseudo-static and dynamic analysis.

Wave propagation: Longitudinal and torsional vibrations in finite and infinite medium, Wave propagation in elastic half space.

Analysis and design of machine foundations: Reciprocating, Rotary, Impact and other types of machines.

Vibration isolation and control: Isolation techniques, Active and passive isolation, Force and motion isolation, Methods of isolation machine foundation, Vibration isolation materials.

References:

Barken D. D. "Dynamics of Bases and Foundations" Mc. Graw Hill Book Co. Inc., 1979.

Bowles J. F. "Foundation Analysis and Design" Mc. Graw Hill Inc Student Edition. 1982.

Kasmalkar B. J. "Foundation Engineering" Pune Vidyarthi Prakasan, Pune 1975.

Sreenivasulu P. and Vaidhyanathan C. V.: "Handbook of Machine Foundations" Tata Mc. Graw Hill, New Delhi, 1987.

Swami Saran "Soil Dynamics and Machine Foundation" Galgotia Book House, New Delhi, 1990.

Winterkorn H. F. and Fang H. Y. "Foundation Engineering Handbook" Galgotia Book House, New Delhi, 1986.

MFE 2.4 FOUNDATIONS OF OFF-SHORE STRUCTURES

Marine Deposits - Ocean environment, nature, origin, formation of marine deposits, classification, carbonate sediments, coral reef deposits.

Site Investigation Techniques - Shallow and deep penetration sampling techniques, submersible drilling and sampling techniques, sample disturbances, in-situ testing of soils, laboratory testing techniques, interpretation problems and applications.

Engineering Properties of Marine Deposits - Strength and deformation behaviour, influence of cementation and crushing on engineering behaviour.

Foundations For On-Shore Structures - Wave action on breakwaters and piles, stability of rock-mound and vertical wall breakwaters, on-shore piles design principles, anchored bulkhead, types, methods of analysis, design principles, anchorages, construction practices.

Off-Shore Structures - Introduction, classification, forces acting, submarine pipe lines, stability, installation techniques, ocean bed anchors, geotechnical considerations, sulphate action on concrete piles in marine environment.

Gravity Structures - Types, installation techniques, forces acting, design principles, bearing capacity, sliding, overturning, settlement, liquefaction and scour.

Jacket Type Structures - Types, forces acting, dynamic stresses, axial capacity, wave equation. Smith's idealization, basic equations, soil parameters, effect of set up, solutions from wave equation analysis, reliability, lateral capacity, p-y curves construction practices.

References:

Byerrum.L. " Geotechnical Problems Involved In Foundation Of Structure In The North Sea", Geotechnical Volume 23, N0.3.1989

College Of Engg., Goa(1980), Winter School On Design & Construction Of Offshore Structures, Jan, 1980

George P.. & Wood D., "Offshore Soil Mechanics" Cambridge University Press.1978

Noorany L , " Classification Of Marine Sediments", Sd. Geotechnical Engineers Series.1987.

Noorany Grizffinsky S.F. " Engineering Properties Of Submarine Soil", State Of Art Review, Journal Of SMFE, Volume 96, Sm.5., 1982.

Noorany I. " Under Water Soil Sampling And Testing- A State Of Art Review, Ascm-Stp 501.,1982.

Quinn A.D. " Design And Construction Of Ports And Marine Structures", McGrawhill Int. Students Edition ., 1978.

MFE 2.5 Finite Element Methods In Geotechnical Engineering

Theory : Finite difference and numerical integration techniques. Application to stresses, contact pressure, and settlement of rafts, piles, and pile raft systems.

Soil as Winkler's model and elastic continuum. Application to foundations and pile interaction. Soil as simplified elastic-plastic material. Raft as thin plate. Method of characteristics.

Finite element method. Derivation of required matrices for CST elements. Isoparametric and interface elements. Assembly and solution techniques, computerization. Beam element with 3 degree of freedom. Sub-structuring. Introduction to application of FEM to soil-foundation-structure interaction. Introduction to non-linear problems. 2-D seepage through porous media.

Yield line theory applied to foundation, beams and rafts.

References:

C.S. Desai & John F. Abel, "Introduction To F.E.M.", East West Edition, 1992.

Kalus Jurgon Bathe And Edward L. Wilson, " Numerical Methods In Finite Element Analysis", Prentice Hall Indian Private Limited, 1989.

Krishnamurthy C.S., " Finite Element Analysis", Tata Mcgrawhill. Student Edition, 1991.

G.Gudehus, "Finite Element in Geomechanics", Wiley Eastern Publications, London, 1999.
Bowles J. F. , "Foundation Analysis and Design" Mc. Graw Hill Inc Student Edition, 2000.

MFE 2.6 CAD Laboratory

Development of computer programmes to solve typical problems such as in slope stability analysis, bearing capacity problems, load capacity of piles/ pile groups, permeability and stability analysis for earthen dams, re-inforced earth, etc. and any other relevant areas in Geotechnical engineering.

Use and familiarisation of already available geotechnical and related proprietary softwares.

MFE 3.1.1 EARTHDAM ENGINEERING

Factors influencing design of earth dams, types of earth dams, control of pore pressures within the dam and foundation, critical study of earth dam failures, embankment settlement during and after construction, differential settlement and cracks, construction pore pressures and control, seepage analysis, various methods of constructing flow nets, methods of foundation treatment, critical evaluation of methods of stability analysis, dams with impervious membranes of manufactured materials like reinforced concrete, steel plate and asphaltic concrete, embankment construction procedures, equipment, methods of quality control, measuring instruments, performance observations, seismic design, slope protection, rock fill construction.

References:

J.L. Sherard et. al., "Earth and Earth-rock Dam", John Wiley, 1963.

W.P. Creager, J.D. Justin and J. Hinds, "Engineering for Dams", John Wiley, 1945.

Geotechnical features of major dams in India -Special publication on the occasion of IV International Association of Engineering Geology , 1982.

MFE 3.1.2 FEM AND CONSTITUTIVE MODELLING IN GEO-MECHANICS

Introduction to 1-D systems; Isoparametric 2-dimensional elements; Numerical integration techniques; Infinite Elements; Assembly and solution of finite element matrices; sky-line and frontal methods.

Stress-strain relations; Constitutive modelling of granular and clay soils; Non-linear and elasto-plastic models; Critical state and Cam-Clay models for soils; Linear and Non-linear solution techniques.

Modelling of in situ earth pressures; modelling of construction and excavation sequences of soil layers.

Finite element analysis of soil consolidation; Application of finite element techniques for geotechnical designs.

Case studies of finite element applications. Design of foundations by FEM.

Reference:

C.S. Desai & John F. Abel "Introduction To F.E.M.", East West Edition,1971

Kalus Jurgon Bathe And Edward L. Wilson, " Numerical Methods In Finite Element Analysis", Prentice Hall Indian Private Limited, 1983.

Krishnamurthy C.S., " Finite Element Analysis", Tata Mcgrawhill. Student Edition, 1992.

Zienkiewicz O.C. "The Finite Element Method", Tata McGrawhill Publishing Co.Ltd., 1985

MFE 3.1.3 SOIL FOUNDATION STRUCTURE INTERACTION

Contact pressure distribution, soil-foundation, models. Nature and complexity of soil structure interaction.

Analysis of rafts and foundations, soil foundation structures interaction pertaining to various types of foundation.

Applications of numerical methods, effect of a stratification, time effects.

Application of FEM, types of finite elements.

References:

Desai C.S., "Soil Structure Interaction & Simulation Problems". Finite Elements In Geomechanics", John Wiley & Sons, 1971.

Selvadurai A.P.S., "Elastic Analysis Of Soil Foundation-Interaction", Elsevier Scientific Publication Co. Amsterdam., 1987.

MFE 3.2 Project

This shall include a detailed compilation of work leading to formulation of researchwork topic for dissertation in Semester IV.

MFE 3.3 Seminar I

This shall be a comprehensive study on any one topic of interest and current relevance in the field of geotechnical engineering, especially designed to encourage study on recent advances in the field. The seminar report shall be submitted for TW/ Oral examination.

MFE 3.4 Seminar II

This shall be a comprehensive study on field testing / design aspects for foundations. The seminar report shall be submitted for TW/ Oral examination.

MFE 4.1 Dissertation

This shall include a detailed and exhaustive research and study on any one specific topic that shall contribute more towards the field of geotechnical engineering. Typed and bound project report shall be submitted for TW/ Oral examination.