UNIVERSITY OF PUNE

COURSE STRUCTURE FOR M.E. (For 2008 Course) (w.e.f. June – 2008)

SEMISTER I

CODE	SUBJECT	TEACHING SCHEME		EXAMINATION SCHEME					CREDITS
		Lect.	Pr	Paper	TW	Oral	Pr	Total	
8101	Mathematics	3	-	100	-	-	-	100	3
8102	Systems Approach to management and Development of Human Resources	3	-	100	-	-	-	100	3
8103	Engineering behaviour of Soils	3	-	100	-	-	-	100	3
8104	Elective I	3	-	100	-	-	-	100	3
8105	Elective II	3	-	100	-	-	-	100	3
8106	Lab Practice I	-	6	-	50	-		50	3
8107	Seminar I	-	4	-	50	-	-	50	2
Total of First Term		15	10	500	100	-	-	600	20

SEMISTER II

CODE	SUBJECT	TEACHING SCHEME		EXAMINATION SCHEME					CREDITS
		Lect.	Pr	Paper	TW	Oral	Pr	Total	
8208	Finite Element Methods in Geotechnical Engineering	3	-	100	-	-	-	100	3
8209	Reinforce Earth and Geosynthetics	3	-	100	-	-	-	100	3
8210	Foundation Design and detailing.	3	-	100	-	-	-	100	3
8211	Elective III	3	-	100	-	-	-	100	3
8212	Elective IV (Open)	3	-	100	-	-	-	100	3
8213	Lab Practice II	-	6	-	50	-		50	3
8214	Seminar II	-	4	-	50	-	-	50	2
Total of Second Term		15	10	500	100	-	-	600	20

SEMISTER III

CODE	SUBJECT	TEACHING SCHEME		EXAMINATION SCHEME					CREDITS
		Lect.	Pr	Paper	TW	Oral	Pr	Total	
8315	Seminar III	-	4	-	50	-	-	50	2
8316	Project Stage I	-	18	-	-	-		-	-
Total of Third Term		-	22	-	50	-	-	50	02

SEMISTER IV

CODE	SUBJECT	TEACHING SCHEME		EXAMINATION SCHEME					CREDITS
		Lect.	Pr	Project	TW	Oral	Pr	Total	
8316	Project Stage II	-	18	200	-	50		250	18
Total of Fourth Term		-	18	200	-	50	-	250	18

UNIVERSITY OF PUNE
SYLLABUS FOR
M.E.CIVIL (2008 course)

LIST OF ELECTIVES (SEMISTER-I)

8104-- Elective I

1. **Applied Soil Mechanics**
2. **Rock Mechanics and Tunnelling**
3. **Site Investigations and Ground Improvement**
4. **Shallow and Deep Foundations**

8105-- Elective II

1. **Soil Stabilization**
2. **Soil Structure Interaction**
3. **Geoenvironmental Engineering**
4. **Earth Pressure and Retaining Structures**

UNIVERSITY OF PUNE
SYLLABUS FOR

M.E.CIVIL (GEOTECHNICAL ENGINEERING)

SEMESTER I :

SUBJECT CODE 501201

Numerical Methods

Teaching scheme:

Lectures: 3 hrs/week

Examination Scheme:

Paper 100 marks

Credits: 3

Fundamentals of numerical methods, Error analysis, Differentiation, integration, interpolation & extrapolation, Solution of non-linear algebraic and transcendental equation, Solution of systems of linear & non-linear algebraic equations, Eigen value problems, Solution of partial differential equation, initial and boundary value problems, Computer oriented algorithms, Numerical solution of problems related to shallow and deep foundation, Flow through porous media., Settlement computations under different loading conditions & consolidation

Reference

1. **Numerical methods for Scientific and Engineering Computation by M.K. Jain, S.R.K Iyengar & R.K. Jain and published by Wiley Eastern Ltd.**
2. **Numerical methods for Engineering Computation byD.V. Griffiths and I.M.Smith published by Blackwell Scientific Publication.**
3. **Numerical methods in FORTRAN by John M.Mc & M.G.Salvadori Published by Prentice Hall of India**
4. **Numerical analysis Geotechnical Engg. By C.S.Desai**

UNIVERSITY OF PUNE
SYLLABUS FOR

M.E. CIVIL (GEOTECHNICAL ENGINEERING)

SEMESTER - I

SUBJECT CODE 501202

Systems Approach to Management and Development of Human Resources

Teaching scheme:

Lectures: 3 hrs/week

Examination Scheme:

Paper 100 marks

Credits: 3

Overview of marketing, finance, personnel and production functions. Basic concepts & Principles, Commonality of planning, organizing and control across functions, System theories, integrated management decisions, system dynamics and control theory applications in management Organization design and restructuring. Strategic management issues Strategic, Issues in Marketing, Finance, and Production functions New Issues in contemporary management. Global Organizations / Technology Driven Enterprises. Nature and scope of Human Resource Development, Training and Development, Human Process Intervention; T-Group, Team Building, Survey Feedback, Intergroup Relations, Quality of Work Life, HR Interventions: Goal Setting, Career Development, Stress Management, Time Management; Contemporary Issues in HRD: Quality Circle, Total Quality Management, ISO 9000, empowerment, Business Process Re-engineering.

UNIVERSITY OF PUNE
SYLLABUS FOR

M.E.CIVIL (GEOTECHNICAL ENGINEERING)

SEMESTER I

SUBJECT CODE 501203

Engineering behaviour of Soils

Teaching scheme:

Lectures: 3 hrs/week

Examination Scheme:

Paper 100 marks

Credits: 3

Origin, nature and distribution of soils. Description of individual particle. Clay mineralogy, clay-water-electrolytes. Soil fabric and structure and behaviour. Interaction of clay particles, identification of clay minerals by D.T.A. and X-ray diffraction. Identification and classification of soil, soil weight volume relationship, index properties of soils, surface tension and capillary phenomenon. measurement of capillary rise in soil, soil moisture, soil-water potential, Buckingham's concept, component potential, measurement of soil-water potential, Tentiometer, pressure-plate apparatus, mechanism of swelling potential and pressure. Soil compaction, standard and modified Proctor compaction, theories of soil compaction. Compaction control in field. Effective stress principle. Steady state flow in soils. Effect of flow on effective stress. Determination of coefficient of permeability.Consolidation, one, two, three and radial consolidation. Variation of effective stress during consolidation. Various consolidation tests and determination of parameters.Stress-path. Triaxial and direct shear tests. Shear behaviour of granular soils. Factors affecting shear behaviour. Determination of parameters. Shear behaviour of fine grained soils. Pore pressure parameters. UU, CU, CD tests. Total and effective stress-strength parameters. Total and effective stress-paths. Water content contours. Factors affecting strength: stress history, rate of testing, structure and temperature. Anisotropy of strength, thixotropy, creep. Determination of in-situ undrained strength.Stress-strain characteristics of soils. Determination of modulus values. Critical state model. Engineering Behaviour of soils of India: Black cotton soils, alluvial silts and sands, laterites, collapsible and sensitive soils, aeolin deposits.

Texts/References

- **Karl Terzaghi, Theoretical Soil Mechanics, Chapman and Hall, 1954.**
- **R.F. Scott, Principles of soil Mechanics, Addison Wesley, World Student Edition, 1963.**
- **Proceedings of the International Conference on Soil Mechanics of Foundation Engineering.**
- **Proceedings of the Conference on Shear Strength of Cohesive Soils, ASCE, 1960.**
- **Physical & geotechnical properties of soils – Joseph E.Bowels, Tata Mc.- Grawhill**
- **Advanced soil mechanics- Braja M.Das, Tata Mc.- Grawhill**
- **Indian standards compendium in soil engineering, SP 36(Part I) 1987, Bureau of Indian standards**
- **Soil physics by Baver.**

UNIVERSITY OF PUNE
SYLLABUS FOR

M.E.CIVIL (GEOTECHNICAL ENGINEERING)

SEMESTER I

SUBJECT CODE 501204 (ELECTIVE I)

Applied Soil Mechanics

Teaching scheme: **Examination Scheme:**

Lectures: 3 hrs/week **Paper 100 marks**

Credits: 3

Role of soil testing in Geotechnical engineering. Basic concept of stress path and its representation in various spaces, and its simulation to practical problems. Analysis of soil behaviour, Kondner's hyperbolic stress-strain response and its application. Parabolic stress-strain formulation. Evaluation of various elastic constants for practical use. Stability of embankments on clayey soils. Design of berms. Stage construction. Design of sand-drain system. Stress distribution under earth embankments and evaluation of settlement profile. Landslides and their classification. Stability analysis of natural slopes. Different stability analysis models. Culmann, friction circle, Swedish, modified Bishop and limit state analysis of slopes. Earthquake loading considerations. Use of design charts in practice. Deep excavations, dewatering operations, drainage, methods of stabilizing slopes. Erosion, design of filter, rock toe. Seepage control through the dam body and foundation; Curtain walls, Relief wells and sudden drawdown condition. Instrumentation, field problems to monitor movement of slopes, foundations, etc.

- **Proceedings of the Conference on Soil Stabilization, Massachusetts Institute of Technology, June 18-30, 1959.**
- **K.B. Woods, D.S. Berry and W.H. Goetz, Highway Engineering Handbook, 1960.**
- **Physical & geotechnical properties of soils – Joseph E.Bowels, Tata Mc.- Grawhill**
- **Advanced soil mechanics- Braja M.Das, Tata Mc.- Grawhill**
- **Indian standards compendium in soil engineering, SP 36(Part I) 1987, Bureau of Indian standards**
- **Soil physics by Baver.**

UNIVERSITY OF PUNE
SYLLABUS FOR

M.E.CIVIL (GEOTECHNICAL ENGINEERING)

SEMESTER I

SUBJECT CODE 501204 (ELECTIVE I)

Rock Mechanics and Tunnelling

Teaching scheme: **Examination Scheme:**

Lectures:3 hrs/week **Paper 100 marks**

Credits: 3

Introduction. Objective, scope and problems of Rock Mechanics. Classification by origin, Lithological Engineering. Rock exploration, rock coring, geophysical methods. Laboratory testing of rocks -compressive strength, tensile strength and flexural strength tests. Strength and failure of rocks. Griffith's theory, Coulombs theory, rheological methods. In-situ tests on rock mass. Deformation characteristics of rocks, instrumentation and measurement of deformation of rocks. Permeability characteristics- interstitial water in rocks, unsteady flow of water through jointed rock mass. Mechanical, thermal and electrical properties of rock mass. Correlation between laboratory and field properties. Analysis of stresses. Thick wall cylinder, formulae, Kreish equation, Green span method. Openings in rock mass and stresses around openings. Pressure tunnels, development of plastic zone. Rock support needed to avoid plastic deformation. Lined and unlined tunnels. Underground excavation and subsidence. Rock mechanics applications. Bearing capacity of homogeneous as well as discontinuous rocks. Support pressure and slip of the joint. Delineation of types of rock failure. Unsupported span of underground openings, pillars. Rock slopes. Rock bolting. Plastic mechanics. Tunnels, shapes, usages, Methods of Construction, Problems associated with tunnels. Tunnelling in various subsoil conditions and rocks.

Reference:

1. **Rock Mechanics for Engineers: B.P.Varma, Khanna Publishers**
1. **Rock Mechanics and Design of Structures: Obert and Duvall, John Willey & Sons**
2. **Rock Mechanics in Engineering Practice: Stag and Zienkiewez, John Willey & Sons**
3. **J.C. Jagger and N.G.W. Cook, Fundamentals of Rock Mechanics, Methuen and Co., London, 1971.**
4. **Obert, Leonard and W.I. Duvall, Rock Mechanics and Design Structures of Rock, 1967.**

5. **J.A. Hudson et. al. (Ed), Comprehensive Rock Mechanics, in 5 vols. Pergamon Press, 1993.**
6. **K.Szechy, The Art of Tunnelling, Tesa, 1960. 8. L. Obert and W. I. Duvall, Rock Mechanics and the Design of Structures on Rock, Wiley, 1967.**

SYLLABUS FOR

M.E.CIVIL (GEOTECHNICAL ENGINEERING)

SEMESTER I

SUBJECT CODE 501204 (ELECTIVE I)

Site Investigations and Ground Improvement

Teaching scheme:

Lectures: 3 hrs/week

Examination Scheme:

Paper 100 marks

Credits: 3

Site Investigations: Planning of investigation programmes, Information required for planning different stages of investigations. Geophysical methods: electrical resistivity, and seismic refraction methods. Methods of site investigations: Direct methods, semi-direct methods and indirect methods, Drilling methods. Boring in soils and rocks, methods of stabilizing the bore holes, measurement of water table, field record. Field tests: In-situ shear test, in-situ permeability test, SPT, DCPT, SCPT, in-situ vane shear test, pressure meter test, plate load test. Codal provisions. Sampling techniques, Sampling disturbances, storage, labelling and transportation of samples, sampler design, influence on properties. Report writing. Safety measures.

Geotechnical Processes: Principles of compaction, Laboratory compaction, Engineering behaviour of compacted clays, field compaction techniques- static, vibratory, impact, Earth moving machinery, Compaction control. Shallow Stabilization with additives: Lime, fly ash, cement and other chemicals and bitumen. Deep Stabilization: sand column, stone column, sand drains, prefabricated drains, electro-osmosis, lime column. Soil-lime column. Grouting: permeation, compaction and jet. Vibro-floatation, dynamic compaction, thermal, freezing. Dewatering systems.

Reference Books:

1. **Site investigation by Clayton, Mathews and Simons.**
2. **Instrumentation in geotechnical engineering by K.R. Saxena and V.M. Sharma.**
3. **Hvorslev M.J. subsurface exploration and sampling of soils for Civil Engineering Purposes.**

SYLLABUS FOR

M.E.CIVIL (GEOTECHNICAL ENGINEERING)

SEMESTER I

SUBJECT CODE 501204 (ELECTIVE I)

Shallow and Deep Foundations

Teaching scheme:

Lectures: 3 hrs/week

Examination Scheme:

Paper 100 marks

Credits: 3

Types of foundations .Shallow Foundations: Design considerations - factors of safety (including limit state), allowable settlements, location and depth of foundations, codal provisions. Presumptive bearing capacity. Bearing capacity theories. Layered soils. Choice of shear strength parameters. Bearing capacity from N-values, static cone tests, plate load tests .Shallow foundations: Total and differential settlement. Stress distribution. Consolidation settlement in clays (with correction factors). Immediate settlement. Settlement in sands from N-values, elastic solutions. Static cone tests, plate load tests. Deep foundations: Types of piles. Construction methods. Axial capacity of single piles - dynamic formulae, soil mechanics approach. Skin friction and end bearing in sands and clays.

Deep foundations: Axial capacity of groups. Settlement of single piles and groups. Uplift capacity (including under-reamed piles). Negative skin friction. Pile load tests. Pile integrity tests. Codal provisions.

Caissons-types, construction techniques, difficulties in construction .Design of well foundation.

Foundations in difficult soils: expansive soils, chemically aggressive environment, soft soils, fill, regions of subsidence.

1. **Elastic Analysis of Soil Foundation Interaction, Developments in Geotechnical Engg.vol-17, Elsevier Scientific Publishing Co.**
2. **Vibration Analysis and Foundation Dynamics by N.S.V, Kameswara Rao, published by Wheeler publishing**
3. **Analysis and Design of Foundation for Vibration by P.J. Moore published by Oxford and IBH Publishing Company**
4. **Soil Dynamics and Machine Foundation by Swami Saran published by Galgotia Publication**

5. **Vibration of Soil and Foundation by F.E. Richart, J.R. Hall and R.D. Woods Published by Prentice-Hal Inc, New Jersy**
6. **IS: 5249-1969/1975 Method of test for Determination of In situ Dynamic Properties of soils**

7. **Advanced soil mechanics- Braja M.Das, Tata Mc.- Grawhill**
8. **G. A. Leonards, Foundation Engineering, McGraw-Hill, 1962.**
9. **J.E. Bowles, Foundations Analysis and Design, 3rd Ed., McGraw-Hill, 1968.**
10. **R.B. Peck, W.E. Hanson and T.H. Thornburn, Foundation Engineering, 2nd Edition, John Wiley and Sons, 1974.**

SYLLABUS FOR

M.E.CIVIL (GEOTECHNICAL ENGINEERING)

SEMESTER I

SUBJECT CODE 501205 (ELECTIVE II)

Soil Stabilization

Teaching scheme:

Lectures: 3 hrs/week

Examination Scheme:

Paper 100 marks

Credits: 3

Objectives of soil stabilization. Classification of stabilizing agents and stabilization processes, nature and surface characteristics of soil particles, concepts of surface area and contact points.

Drainage and compaction, principles of mechanical stabilization, inorganic stabilizing agents and their characteristics - lime, cement, lime-fly ash, hydroxides, carbonates etc., inorganic stabilizers, reaction mechanism in relation to strength improvement, characteristics under various conditions of soil properties, time, temperature and stress.

Deleterious effects of organic substance and sulphates on inorganic stabilization, organic stabilizers, binding and water-proofing agents-bituminous materials, lignin, large organic cations, aniline furferols, resins, rosins and derivatives and other organic wastes, bituminous stabilization, electrical and thermal stabilization.

1. **Manfred R. Hausmann: Engineering Principles of Ground Modifications, McGraw Hill International.**
2. **Physical & geotechnical properties of soils – Joseph E.Bowels, Tata Mc.- Grawhill**
3. **Advanced soil mechanics- Braja M.Das, Tata Mc.- Grawhill**
4. **Proceedings of the Conference on Soil Stabilization, Massachusetts Institute of Technology, June 18-30, 1959.**
5. **K.B. Woods, D.S. Berry and W.H. Goetz, Highway Engineering Handbook, 1960.**

SYLLABUS FOR

M.E.CIVIL (GEOTECHNICAL ENGINEERING)

SEMESTER I

SUBJECT CODE 501205 (ELECTIVE II)

Soil Structure Interaction

Teaching scheme:

Lectures: 3 hrs/week

Examination Scheme:

Paper 100 marks

Credits: 3

General soil-structure interaction problems. Contact pressures and soil-structure interaction for shallow foundations. Concept of sub grade modulus, effects/parameters influencing sub grade modulus. Analysis of foundations of finite rigidity, Beams on elastic foundation concept, introduction to the solution of beam problems.

Curved failure surfaces, their utility and analytical/graphical predictions from Mohr-Coulomb envelope and circle of stresses. Earth pressure computations by friction circle method. Earth pressure distribution on walls with limited/restrained deformations, Dubravo's analysis. Earth pressures on sheet piles, braced excavations. Design of supporting system for excavations. Arching in soils. Elastic and plastic analysis of stress distribution on yielding bases. Analysis of conduits. Design charts for practical use.

Modern concept of analysis of piles and pile groups. Axially, laterally loaded piles and groups. Interaction analysis. Reese and Matlock's solution. Elastic continuum and elasto-plastic analysis of piles and pile groups. Hrennikoff's analysis. Ultimate lateral resistance of piles by various approaches. Non-linear load-deflection response. Uplift capacity of piles and anchors.

Reference:

1. **Bowels J.E.," Analytical and Computer Methods in Foundation", McGraw Hill Book Co. New York. (1974)**
2. **.Desai C.S. and Christian J.T."Numerical Methods in Geotechnical Engineering" McGraw Hill Book Co. New York.**
3. **Soil Structure Interaction, the real behaviour of structures, Institution of Structural Engineers.**
4. **.Elastic Analysis of Soil Foundation Interaction, Developments in Geotechnical Engg.vol-17, Elsevier Scientific Publishing Co.**

UNIVERSITY OF PUNE
SYLLABUS FOR

M.E.CIVIL (GEOTECHNICAL ENGINEERING)

SEMESTER I

SUBJECT CODE 501205 (ELECTIVE II)

Geoenvironmental Engineering

Teaching scheme:

Lectures: 3 hrs/week

Examination Scheme:

Paper 100 marks

Credits: 3

Sources and effects of subsurface contamination; Physical, Chemical and biological characteristics of solid wastes; Soil-waste interaction; Contaminant transport; Laboratory and field evaluation of permeability; Factors affecting permeability; Waste disposal on land.

Types of landfills: Silting criteria; waste containment principles; Types of barrier materials; Planning and design aspects relating to waste disposal. Landfills, in ash ponds and tailing ponds, and in rocks.

Environmental monitoring around landfills; Detection, control and remediation of subsurface contamination; Engineering properties and geotechnical reuse of waste, demolition waste dumps; Regulations; Case studies.

Reference:

1. **Daniel, D.E. Geotechnical practice for waste disposal, Chapman and Hall, London.**
2. **Kays, W.B. Construction of Linings for reservoirs, Tanks and Pollution control facilities.**
3. **Sincero and sincero. Environmental Engineering: A Design Approach, Prentice Hall of India (P) Ltd. New Delhi.**
4. **Hsai-Yang Fang, Introduction to Environmental Geotechnology, CRC Press.**
5. **Geoenvironment 2000: Characterization, Contain in Environmental Geotechnics, ASCE, Geotechnical special Publication no. 46, vol. I and II NY, 1995.**

UNIVERSITY OF PUNE
SYLLABUS FOR

M.E.CIVIL (GEOTECHNICAL ENGINEERING)

SEMESTER I

SUBJECT CODE 501205 (ELECTIVE II)

Earth Pressure and Retaining Structures

Teaching scheme:

Lectures: 3 hrs/week

Examination Scheme:

Paper 100 marks

Credits: 3

Earth Pressure: Types - at rest, active, passive; Rankine's theory; Backfill features - soil type, surface inclination, loads on surface, soil layers, water level; Coulomb's theory; Effects due to wall friction and wall inclination; Graphical methods; Earthquake effects.

Rigid Retaining Structures: Types; Empirical methods; Stability analysis.

Flexible Retaining Structures: Types; Material; Cantilever sheet piles; Anchored bulkheads - free earth method, fixed earth method, moment reduction factors, anchorage.

Braced Excavation: Types; Construction methods; Pressure distribution in sands and clays; Stability - bottom heave, seepage, ground deformation.

Reinforced Soil Walls: Elements; Construction methods; External stability; internal stability.

Laterally Loaded Piles: Short and long piles; Free head and fixed head piles; Lateral load capacity of single piles; Lateral deflection; Elastic analysis; Group effect; Lateral load test; Codal provisions.

Underground Structures in Soils: Pipes; Conduits; Trench less technology; Tunnelling techniques - cut-and-cover method, shield tunnelling.

References:

1. **Earth pressure and Earth Retaining structures by C.R.I. Clayton, J. Milititsky, Ufrgs and R.I. Woods Published by Blackie Academic and Professional**
2. **Karl Terzaghi, Theoretical Soil Mechanics, Chapman and Hall, 1954.**
3. **R.F. Scott, Principles of soil Mechanics, Addison Wesley, World Student Edition, 1963.**

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SYLLABUS FOR

M.E.CIVIL (GEOTECHNICAL ENGINEERING)

SEMESTER I

SUBJECT CODE 501206

LAB PRACTICE I

Teaching scheme: **Examination Scheme:**

Practical: 6 hrs/week **TW-50 marks**

Credits: 3

I. LABORATORY TESTS (Any seven)

1. Determination of water content-dry density relation using light and heavy Compaction on unstabilized and stabilized soil with admixture such as fly ash/lime etc and comparison of results.

2. Determination of unconfined compressive strength of unstabilized and stabilized soil with admixture such as fly ash/lime etc and Comparison of results.

3. Determination of shear strength parameter of soil from consolidated Undrained triaxial compression test with measurement of pore water pressure

4. Determination of density index of cohesion less soils.

5. Determination of consolidation properties of soil.

6. Determination of centrifuge moisture equivalent.

7. Determination of free swell index and swelling pressure of soil.

8. Plummet balance/Hydrometer analysis.

9. Determination of linear shrinkage.

II. Assignment (Any two)

1. **Use of a suitable computer software for analysis and design of substructure, stability of slopes, retaining structure or any other geotechnical related problem.**
2. **Design of reinforced earth wall**
3. **Determination of earth pressure using software or manually using graphical method**
4. **Design of embankment reinforced with geosynthitcs and its stability analysis.**

III. A report on the basis of field visit to reinforced earth retaining structures, well foundation,pavement,embankment etc. all under construction. Report should contain the technical details such as design, construction techniques being adopted, and type of construction machinery being used.

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SEMESTER I

SUBJECT CODE 501207

Seminar I

Teaching scheme:

Practical: 4 hrs/week

Examination Scheme:

TW-50 marks

Credits: 2

Contents of seminar- I report to be submitted could be any of the following.

1. **Literature review on any topic associated with the syllabus by referring to standard journal, papers published in various conferences and by using the internet, etc presented in a standard format**
2. **Documented case studies associated with Geotechnical engineering.**

Note:-Seminar I should not be meagre submission of report. Student should be asked to deliver lecture on the topic of the seminar for undergraduate students or a group of students/faculty members.

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M.E.CIVIL (GEOTECHNICAL ENGINEERING)

SEMESTER II

SUBJECT CODE 501208

Finite Element Methods in Geotechnical Engineering

Introduction. Steps in FEM. Stress deformation analysis: One-,Two-dimensional formulations; Three-dimensional formulations; Boundary conditions; Solution algorithms; Descretization; use of FEM2D Program and Commercial packages. Analysis of foundations, dams, underground structures and earth retaining structures. Analysis of flow (seepage) through dams and foundations. Linear and non-linear analysis. Insitu stresses. Sequence construction and excavation. Joint/interface elements. Infinite elements. Dynamic analysis. Evaluation of material parameters for linear and non-linear analysis, recent developments.

Reference:

1. **Zienkiewicz O.C. and Taylor R.L., Finite Element Methods, McGrawhill,1991**
2. **Desai C.S. and Abel J.F. "Introduction to FEM, A numerical method for Engineering analysis ", East West Edition, 1972.**

UNIVERSITY OF PUNE
SYLLABUS FOR

M.E.CIVIL (GEOTECHNICAL ENGINEERING)

SEMESTER II

SUBJECT CODE 501209

Reinforce Earth and Geosynthetics/Geosynthetics

Basic introduction to the elements of Ground Engineering characteristics of reinforcing materials, definition of reinforced and advantage of RE, soil reinforcement interaction, behaviour of Reinforced earth walls, basis of wall design, the Coulomb force method, the Rankine force methods, internal and external stability condition, field application of RE, randomly reinforced earth and analysis of reinforced soils, testing of soil reinforcements.

Definitions, functions, properties, and application of Geotextiles, design of Geotextile applications, definitions, functions, properties and applications of geomembranes, design of geomembranes applications, Geotextiles associated with geomembranes, testing on geotextiles, environmental efforts, ageing and weathering.

Texts/References

1. **Karl Terzaghi, Theoretical Soil Mechanics, Chapman and Hall, 1954.**
2. **R.F. Scott, Principles of soil Mechanics, Addison Wesley, World Student Edition, 1963.**
3. **Manfred R. Hausmann: Engineering Principles of Ground Modifications, McGraw Hill International.**
4. **Engineering with Geosynthetics: ed. G. Venkatappa Rao, GVS Suryanarayana Raju, Tata McGraw Hill Publishing Co. Ltd.**
5. **ASTM and Indian Standards on Geotextiles.**
6. **Koerner, R. M.: Designing with Geosynthetics, Prentice Hall, NJ.**
7. **Jones, C.J.E.P. Reinforcement and soil structures, Butter worth Publications.**

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SYLLABUS FOR

M.E.CIVIL (GEOTECHNICAL ENGINEERING)

SEMESTER II

SUBJECT CODE 501210

Foundation Design and detailing.

Analysis and interpretation of soil exploration data, estimation of soil parameters for foundation design, selection of type of foundation, load calculations, depth of foundation, proportioning of shallow foundations for safe pressure and allowable settlement, structural design : individual footings, strip footing, combined footing, rigid and flexible mat, buoyancy raft, basement raft and detailing in each case, deep foundation : design of single pile and pile groups, pile cap design and detailing, design of well foundation, check for stability, base pressure, side pressure and lateral deflection, design of retaining wall including detailing, stability calculations, design of cantilever and anchored sheet pile walls and ring foundations.

1. **Foundation Analysis and Design- Joseph E. Bowels, TATA Mc-Grawhill**
2. **Design Aids in Soil Mechanics and Foundation Engineerimg-Shenbage R Kaniraj, TATA Mc-Grawhill**
3. **Design of Foundation Systems- Nainan P Kurian, Narosa publication house**
4. **Foundation Design & Construction- M.J.Tamlinson, ELBS publication**
5. **Hsai-Yana-Fana- Foundation Engineering Hand book, Chapmon & hall, Newyark**
6. **G. A. Leonards, Foundation Engineering, McGraw-Hill, 1962.**
7. **J.E. Bowles, Foundations Analysis and Design, 3rd Ed., McGraw-Hill, 1968.**
8. **R.B. Peck, W.E. Hanson and T.H. Thornburn, Foundation Engineering, 2nd Edition, John Wiley and Sons, 1974.**

LIST OF ELECTIVES

8211-- ELECTIVES--III

1. **Slope Stability and Earth Dams**
2. **Geosynthetics:**
3. **Geotechnical Earthquake Engineering**
4. **Foundations of Offshore Structures**

8212-- Elective IV (Open)

1. **Geotechnical Engineering Survey**
2. **Slopes and Foundations**
3. **Geotechnical Processes in Rock Engineering**
4. **Numerical Methods**

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SYLLABUS FOR

M.E.CIVIL (GEOTECHNICAL ENGINEERING)

SEMESTER II

SUBJECT CODE 501211 (ELECTIVE III)

Slope Stability and Earth Dams

Teaching scheme: **Examination Scheme:**

Lectures: 3 hrs/week **Paper 100 marks**

Credits: 3

Slope Stability: Short term and long term stabilities; Limit equilibrium methods; Infinite slopes; Finite height slopes - Swedish method, Bishop's simplified method, other methods; Stability charts;

Conditions of analysis - steady state, end of construction, sudden draw down conditions; Factor of safety; Codal provisions; Earthquake effects.

Seepage Analysis: Types of flow; Laplace equation; Flow net in isotropic, anisotropic and layered media; Entrance-exit conditions; Theoretical solutions; Determination of phreatic line.

Earth Dams: Introduction; Factors influencing design; Design of components; Construction; Instrumentation - piezometer, settlement gauge, inclinometer; Road and rail embankments.

Reinforced Slopes: Steep slopes; Embankments on soft soils; Reinforcement design.

Landslides: Remedial measures for unstable slopes - soil nailing, gabions, drainage.

Refrences:-

- **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.**
- **Earth & Rock fill dams – Principles of design and construction by Christian Kutzner Published Oxford and IBH**
- **Design of small dams – united states department of the Interior Bureau of Reclamation Published by Oxford and IBH Publishing Company**
- **Earth Manual – CBS Publishers and distributors**
- **The stability of slopes by E.N.Bromhead published by Blackie Academic and Professional**
- **Earth pressure and Earth Retaining structures by C.R.I. Clayton, J. Milititsky, Ufrgs and R.I. Woods Published by Blackie Academic and Professional**
- **Earth and Rock fill dams by Sherad**

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M.E.CIVIL (GEOTECHNICAL ENGINEERING)

SEMESTER II

SUBJECT CODE 501211 (ELECTIVE III)

Geosynthetics

Teaching scheme:

Lectures: 3 hrs/week

Examination Scheme:

Paper 100 marks

Credits: 3

Geosynthetics and Reinforced Soil Structures:

Types and functions; Materials and manufacturing processes; Testing and evaluations; Principles of soil reinforcement; Design and construction of geosynthetic reinforced soil retaining structures - walls and slopes; Codal provisions; Bearing capacity improvement; embankments on soft soils; Indian experiences.

Geosynthetics in Pavements:

Geosynthetics in roads and railways; separations, drainage and filtering in road pavements and railway tracks; overlay design and construction; AASHTO and other relevant guidelines; trench drains.

Geosynthetics in Environmental Control:

Liners for ponds and canals; covers and liners for landfills - material aspects and stability considerations; Landslides - occurrences and methods of mitigation; Erosion - causes and techniques for control.

References:

1. **Manfred R. Hausmann: Engineering Principles of Ground Modifications, McGraw Hill International.**
2. **Engineering with Geosynthetics: ed. G. Venkatappa Rao, GVS Suryanarayana Raju, Tata McGraw Hill Publishing Co. Ltd.**
3. **ASTM and Indian Standards on Geotextiles.**
4. **Koerner, R. M.: Designing with Geosynthetics, Prentice Hall, NJ.**
5. **Jones, C.J.E.P. Reinforcement and soil structures, Butter worth Publications.**
6. **International Conference on Soil Reinforcement, RE and other techniques, Paris, March, 1979.**
7. **Second International Conference on Geotextiles, Las Vegas, August, 1982.**
8. **International Conferences in-situ soil and rock reinforcement, Paris, October, 1984.**

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M.E.CIVIL (GEOTECHNICAL ENGINEERING)

SEMESTER II

SUBJECT CODE 501211 (ELECTIVE III)

Geotechnical Earthquake Engineering

Teaching scheme:

Lectures: 3 hrs/week

Examination Scheme:

Paper 100 marks

Credits: 3

Introduction, Seismic Risks and seismic hazards, cause and strength of earthquake, social and economic consequences, theory of dynamics and seismic response, the nature and attenuation of ground motion. Determination of site characteristics, local geology and soil condition, site investigation and soil test. Determination of design earthquake, response spectra and accelerograms as design earthquake, criteria for earthquake resistant design. Site response to earthquake, liquefaction of saturated cohesion less soils, seismic response of soil structure system, shallow foundation, pile foundation, foundation in liquefiable ground. A seismic design of earth retaining structures.

Reference:

1. **Wiegel R.L., "Earthquake Engineering", Prentice Hall, 2nd Ed, 1989.**
2. **Jai Krishna and A.R. Chandrasekhar, "Elements of Earthquake Engineering".**
3. **Arya, Shamsher Prakash, Srivastava L.S., Brijesh Chandra, "Earthquake Engineering**
4. **Vibration Analysis and Foundation Dynamics by N.S.V, Kameswara Rao, published by Wheeler publishing**
5. **Analysis and Design of Foundation for Vibration by P.J. Moore published by Oxford and IBH Publishing Company**
6. **Soil Dynamics and Machine Foundation by Swami Saran published by Galgotia Publication**
7. **Vibration of Soil and Foundation by F.E. Richart, J.R. Hall and R.D. Woods Published by Prentice-Hal Inc, New Jersy**
8. **IS: 5249-1969/1975 Method of test for Determination of In situ Dynamic Properties of soils**

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M.E.CIVIL (GEOTECHNICAL ENGINEERING)

SEMESTER II

SUBJECT CODE 501211 (ELECTIVE III)

Foundations of Offshore Structures

Teaching scheme:

Lectures: 3 hrs/week

Examination Scheme:

Paper 100 marks

Credits: 3

Nature and magnitude of load on foundations of offshore structures, criteria of foundation design in offshore environment, features of foundations of gravity structures, bearing capacity and settlement under dynamic loads, immediate and long term behaviour, liquefaction under cyclic loads, problems relating to jack-up platforms, dynamic stress in pile driving, pile behaviour under cyclic lateral loads, development of p-y curves, analysis of single piles and pile groups, finite element and other numerical methods of interactive analysis using linear and nonlinear foundation response, geotechnical aspects of anchors and submarine pipelines.

Texts/References

- **Proceedings of the Conference on Behaviour of Offshore Structures, 1976.**
- **Proceedings of the Conference on Finite Element Methods in Geotechnical Engineering (Ed.), C. S. Desai.**
- **Proceedings of Offshore Technology Conference, Houston, Texas.**

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M.E.CIVIL (GEOTECHNICAL ENGINEERING)

SEMESTER II

SUBJECT CODE 501212 (ELECTIVE IV)

Geotechnical Engineering Survey

Teaching scheme: **Examination Scheme:**

Lectures: 3 hrs/week **Paper 100 marks**

Credits: 3

Importance of geotechnical engineering surveys and maps in the planning and execution of major civil engineering projects, such as construction of earth dams, highways and railways, rural, urban and industrial development etc., concept of land use planning, drainage, soil horizons, colour, texture, structure, consistency, reaction etc., landscape and geomorphology, different types of base maps.

Organization of field work and collection of soils and the parent materials, identification and nomenclature of soil horizons and series, preparation of geotechnical engineering maps for specific uses, soil survey reports.

The entire course of instruction and field work will be covered intensively over a period of about three weeks, normally during winter vacation.

Texts/References

- **Soil Survey Manual, Bureau of Plant Industry, Soil Agricultural Engineering, 1951.**
- **Earth Manual, U.S. Bureau of Reclamation, Denver, Colorado, 1965.**
- **Site investigation by Clayton, Mathews and Simons.**
- **Instrumentation in geotechnical engineering by K.R. Saxena and V.M. Sharma.**
- **Hvorslev M.J. subsurface exploration and sampling of soils for Civil Engineering Purposes.**

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M.E.CIVIL (GEOTECHNICAL ENGINEERING)

SEMESTER II

SUBJECT CODE 501212 (ELECTIVE IV)

Slopes and Foundations

Teaching scheme:

Lectures: 3 hrs/week

Examination Scheme:

Paper 100 marks

Credits: 3

Introduction, Short-term and long-term stability. Influence of ground water, Seismic effects. Types of rock slope failures. Infinite slopes, Circular and non-circular slip surface analysis, Stability charts.

Plane failure analysis. Wedge failure analysis analytical, stereographic methods. Buckling and toppling failures, Rock falls, Landslides. Foundations: Bearing capacity, settlement and stress distribution in intact and layered rocks. Foundations of dams. Deep foundations. Tension foundations, Codal provisions. Foundation improvement. Use of appropriate software packages.

- **G. A. Leonards, Foundation Engineering, McGraw-Hill, 1962.**
- **J.E. Bowles, Foundations Analysis and Design, 3rd Ed., McGraw-Hill, 1968.**
- **R.B. Peck, W.E. Hanson and T.H. Thornburn, Foundation Engineering, 2nd Edition, John Wiley and Sons, 1974.**
- **Foundation Analysis and Design- Joseph E. Bowels, TATA Mc-Grawhill**
- **Design Aids in Soil Mechanics and Foundation Engineerimg-Shenbage R Kaniraj, TATA Mc-Grawhill**
- **Design of Foundation Systems- Nainan P Kurian, Narosa publication house**
- **Foundation Design & Construction- M.J.Tamlinson, ELBS publication**
- **Hsai-Yana-Fana- Foundation Engineering Hand book, Chapmon & hall, Newyark**

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M.E.CIVIL (GEOTECHNICAL ENGINEERING)

SEMESTER II

SUBJECT CODE 501212 (ELECTIVE IV)

Geotechnical Techniques in Rock Engineering

Teaching scheme:

Lectures: 3 hrs/week

Examination Scheme:

Paper 100 marks

Credits: 3

Ground improvement techniques, assessment. Compaction of disintegrated and weathered rocks. Grouting, type of grouts, suspensions, solutions and resins, Rheological models. Viscous and viscoplastic flows. Spherical and radial flows. Grout ability.

Grouting techniques, materials, equipment, specifications, evaluation and quality control. Case histories, Shotcrete, method and materials, factors. Fibre reinforced shotcrete. Ground anchors, principles of reinforcement, rock bolts, mechanism, mechanical, friction, grouted tensioned and untensioned bolts. Design of bolts. Installation. Equipment. Testing. Cable anchors. Dewatering techniques, classification, assessment of insitu permeability, filter criteria and design of wells, Codal provisions.

- **J.C. Jagger and N.G.W. Cook, Fundamentals of Rock Mechanics, Methuen and Co., London, 1971.**
- **Obert, Leonard and W.I. Duvall, Rock Mechanics and Design Structures of Rock, 1967.**
- **J.A. Hudson et. al. (Ed), Comprehensive Rock Mechanics, in 5 vols., Pergamon Press, 1993.**
- **Brown E.T. "Analysis and computational methods.**
- **Hoek E. and Brown E. T. "Underground excavation in rock".**
- **Megan T.M. and Barllette J.V. "Tunnel Planning and design".**
- **Szechy K.- Art of Tunneling.**
- **Zienkiewicz, OCH and Taylor R.L.- Finite element method .Vol –2.**

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M.E.CIVIL (GEOTECHNICAL ENGINEERING)

SEMESTER I :

SUBJECT CODE 501201

Numerical Methods

Teaching scheme:

Lectures: 3 hrs/week

Examination Scheme:

Paper 100 marks

Credits: 3

Fundamentals of numerical methods, Error analysis, Differentiation, integration, interpolation & extrapolation, Solution of non-linear algebraic and transcendental equation, Solution of systems of linear & non-linear algebraic equations, Eigen value problems, Solution of partial differential equation, initial and boundary value problems, Computer oriented algorithms, Numerical solution of problems related to shallow and deep foundation, Flow through porous media., Settlement computations under different loading conditions & consolidation

Reference

5. **Numerical methods for Scientific and Engineering Computation by M.K. Jain, S.R.K Iyengar & R.K. Jain and published by Wiley Eastern Ltd.**
6. **Numerical methods for Engineering Computation byD.V. Griffiths and I.M.Smith published by Blackwell Scientific Publication.**
7. **Numerical methods in FORTRAN by John M.Mc & M.G.Salvadori Published by Prentice Hall of India**
8. **Numerical analysis Geotechnical Engg. By C.S.Desai**

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M.E.CIVIL (GEOTECHNICAL ENGINEERING)

SEMESTER II

SUBJECT CODE 501213

Lab Practice II

Teaching scheme: **Examination Scheme:**

Practical: 6 hrs/week **TW-50 marks**

Credits: 3

I.The following experiments shall be carried out

1. **California bearing ratio test (unsoaked and soaked)**
2. **Soil swelling pressure test**
3. **Consolidation test to determine c_v and c_c**
4. **Electrical resistivity test to find electrical resistivity of soils**
5. **Exploration of soil strata by seismic refraction method**
6. **Standard penetration test (SPT) / Dynamic cone penetration test as per IS 4968 Part-I (DCPT)**
7. **Static cone penetration test as per IS 4963 Part III using either hand operated or Engine driven**
8. **Plate bearing test**
9. **To find load bearing test of under-reamed pile**
10. **Mini pressure meter with 3 cell probe, driving rod, drop hammer, monitoring equipment etc. complete to determine E modulus and limit pressure PL may be used.**

II. Report on the basis of the field visit, Use of a suitable computer software for analysis and design of substructure, stability of slopes, retaining structure or any other Geotechnical related problem

Reference

SP 36 (Part-I): 1987 Compendium of Indian Standard on soil Engineering: Part-I Laboratory testing of soils Civil Engineering purposes

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M.E.CIVIL (GEOTECHNICAL ENGINEERING)

SEMESTER II

SUBJECT CODE 501214

Seminar II

Teaching scheme:

Practical: 4 hrs/week

Examination Scheme:

TW-50 marks

Credits: 2

Seminar II report and the examination shall be based on literature survey and the work for the dissertation in the semester III

Note:-Seminar I should not be meagre submission of report. Student should be asked to deliver lecture on the topic of the seminar for undergraduate students or a group of students/faculty members.

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M.E.CIVIL (GEOTECHNICAL ENGINEERING)

SEMESTER III

SUBJECT CODE 501215

Seminar III

Teaching scheme:

Practical: 4 hrs/week

Examination Scheme:

TW-50 marks

Credits: 2

Seminar III report and the examination shall be based on literature survey and the work for the dissertation in the semester III

Note:-Seminar I should not be meagre submission of report. Student should be asked to deliver lecture on the topic of the seminar for undergraduate students or a group of students/faculty members.

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M.E.CIVIL (GEOTECHNICAL ENGINEERING)

SEMESTER III & IV

SUBJECT CODE 501216 & 501217

Project Stage I and II in Semester III &IV

SEMESTER III (501216)

Teaching scheme: **Examination Scheme:**

Practical: 18 hrs/week **TW-50 marks**

Credits: 6

SEMESTER IV (501217)

Teaching scheme: **Examination Scheme:**

Practical: 18 hrs/week **Project - 150 marks**

Oral - 50 marks

Credits: 12

The Project Work will start in semester III and should preferably be live problem in industry or a micro issue having a bearing on performance of the construction industry and should involve scientific research, design, collection and analysis of data, determining solution and must preferably bring out the individual contribution.