Biju Patnaik University of Technology, Orissa
Rourkela

Syllabus
of
M.Tech

in

CIVIL ENGINEERING

(Specialization: Geotechnical Engineering)

From 2014 -2015 Academic Session

CIVIL ENGINEERING

Syllabus and Course Structure for M.Tech in Geotechnical Engineering

1st Semester				2nd Semester			
Theory (Compulsory)				**Theory (Compulsory)**			
Code	**Subject**	**Contact Hours (L-T-P)**	**Credit**	**Code**	**Subject**	**Contact Hours (L-T-P)**	**Credit**
GEPC 101	Advanced Geo-mechanics	4-0-0	4	GEPC 201	Advanced Foundation Engineering	4-0-0	04
GEPC 102	Subsurface Exploration and Soil Testing	4-0-0	4	GEPC 202	Ground Improvement Techniques	4-0-0	04
GEPC 103	Ground Water and Flow Through Porous Media	4-0-0	4				
Professional Elective-I (any One)				**Professional Elective-III (any One)**			
GEPE 101	Rock Mechanics	3-0-0	03	GEPE 201	Soil Dynamics and Geotechnical Earthquake Engineering	3-0-0	03
GEPE 102	Theory of Elasticity and Plasticity	3-0-0	03	GEPE 202	Optimization Methods and its Applications in Civil Engineering.	3-0-0	03
GEPE 103	Soil Stabilization by Admixtures	3-0-0	03	GEPE 203	Geo-environmental Engineering	3-0-0	03
Professional Elective-II (any One)				**Professional Elective-IV (any One)**			
GEPE 104	Pavement Design	3-0-0	03	GEPE 204	Stability analysis of Slopes, Embankments and Dams	3-0-0	03
GEPE 105	Soil Structure Interaction	3-0-0	03	GEPE 205	Reinforced Soil Structures	3-0-0	03
GEPE 106	Advance Construction Materials	3-0-0	03	GEPE 206	Infrastructure Engineering and Transportation Planning	3-0-0	03
Credits (Theory)			**18**				
				Professional Elective-IV (any One)			
				GEPE 207	Offshore Structures	3-0-0	03
				GEPE 208	Finite Elements in Geomechanics	3-0-0	03
				GEPE 209	Fundamentals of Soil Behaviour	3-0-0	03
				Credits (Theory)			**17**
Practical/Sessionals				**Practical/Sessionals**			
`GEPR 101	Geotechnical Engineering Laboratory	0-0-3	02	GEPR 201	Geotechnical Engineering Design practice.	0-0-6	04
GEPR 102	Computational Geo-techniques Laboratory	0-0-3	02	GECV 201	Comprehensive Viva	0-0-3	02
GEPT 101	Technical Seminar	0-0-3	02	GEPT 202	Technical Seminar	0-0-3	02
Credits(Practicals/Sessionals)			**06**	**Credits(Practicals/Sessionals)**			**08**

Total Semester Credits			**24**	**Total Semester Credits**			**25**
Total Cumulative Credits			**24**	**Total Cumulative Credits**			**49**
3rd Semester				**4th Semester**			
OE	**Open Electives (any ONE)**						
1	Disaster Management and Mitigation	3-0-0	03				
2	Non-conventional Energy	3-0-0	03				
3	Project Planning and Management	3-0-0	03				
Credits (Theory)			**03**	**Credits (Theory)**			**00**
Practical/Sessionals				**Practical/Sessionals**			
GEPT 301	Thesis Part – I	0-0-3	14	GEPT 401	Thesis Part - II	0-0-6	20
Credits (Practical/Sessional)			**14**	GEPT 402	Technical Seminar	0-0-3	02
Total Semester Credits			**17**	GECV 401	VIVA	0-0-3	02
				Credits (Practical/Sessional)			**24**
				Total Semester Credits			**24**
				Total Cumulative Credits			**90**

FIRST SEMESTER

1. Advanced Geomechanics (Cr = 04):

Soils, rocks and groundwater: geology and genesis of soils, principle of effective stress, indices and phase relationships, groundwater flow. Stress and strain analysis: Mohr circles, failure criteria, soil laboratory tests, shear strength and stiffness of sands: stress-strain, volume change and shearing in sands, critical state and stress paths, consolidation, shear strength and stiffness of clays: compression and consolidation, drained and un-drained shear strength, critical state and stress paths.

References:

1. Wood, D.M., Soil Behaviour and Critical State Soil Mechanics, Cambridge University Press, 1991.
2. Bolton, M.D., A Guide to Soil Mechanics, Cambridge University Press, 1991.
3. Salgado, R., The Engineering of Foundations, McGraw Hill, 2008.
4. Atkinson, 'Critical State Soil Mechanics'

5. Das, B.M., Principles of Geotechnical Engg, PWS Publishing Comp, Boston, 1998
6. McCarthy D.F., Essentials of Soil Mechanics & Foundations, Prentice-Hall, 2002.

2. Subsurface Exploration and Soil Testing (Cr = 04)

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, analysis of results and interpretation, importance of in-situ testing. Performing various in-situ tests. Precautions and interpretation, site evaluation and reporting, block vibration test.

References:

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

3. Ground Water and Flow Through Porous Media (Cr = 04)

Soil Water: Modes of occurrence of water in soils. Adsorbed water, capillary water, Capillary potential, capillary tension and soil suction. Effective and Neutral pressures in soil; Flow through porous Media: Darcy's law and measurement of permeability in laboratory and field. Steady State flow solutions of LaPlace's equation, Plane problems, 3-dimensional problems, Partial cut-offs, uplift pressure, consolidation theory: one and three dimensional consolidation, Secondary consolidation. Ground water Hydraulics: Water table in regular materials, Geophysical exploration for locating water table. Confined water, Equilibrium conditions, Non-equilibrium conditions, Water withdrawal from streams, Method of ground water imaging.

References:

1. D.K.Todd, Groundwater Hydrology, John wiley and Sons

2. H. M. Raghunath, Ground Water, Willy Eastern Ltd.
3. C. Fitts, Ground Water Science, Elsevier Publications, U. S. A.
4. P. P. Raj, Geotechnical Engineering, Tata McGraw-Hill
5. A. Jumikis, Soil Mechanics, East West Press Pvt Ltd.

Professional Electives – I (any ONE)

4. Rock Mechanics (Cr = 03)

Rock: Formation of rocks, Physical properties, Classification of rocks and rock masses, Static Elastic constants of rock; Rock Testing: Laboratory and Field tests; Discontinuities in Rock Masses: Discontinuity orientation,Effect of discontinuities on strength of rock; Strength Behaviour: Compression, Tension and Shear, Stress-Strain relationships, Rheological behavior; Strength/ Failure

Criterion: Coulomb, Mohr, Griffith theory of brittle strength and other strength criteria. Stresses in rock near underground openings; Application of rock mechanics in Civil Engineering: Rock tunneling, Rock slope stability, bolting, blasting, grouting and rock foundation design.

References

1. W. Farmer, Engineering Behavior of Rocks, Chapman and Hall Ltd.

2. R. E. Goodman, Introduction to Rock Mechanics

3. P.R. Sheorey, Empirical Rock Failure Criteria, Balkema, Rotterdam, 1997

4. V.S. Vutukuri and R D Lama, Hand Book on Mechanical Properties

5.Theory of Elasticity & Plasticity (Cr = 03)

Linear elasticity; stress, strain, constitutive relations, strain displacement relations, three dimensional stress and strain analysis, compatibility, stress and displacement functions.

Two dimensional problems in Cartesian and polar coordinates, description of an elasticity problem as a boundary value problem, bending of beams-cantilever and simply supported beam.

Torsion of rectangular bars including hollow sections, torsion of a circular and a rectangular section

Elements of plasticity, failure & yield criterion, Equations of plasticity, plastic stress-strain relations, flow rule, velocity field, slip lines and plastic flow, incremental plasticity.

References

(1) S.P.Timoshenko & J.N.Goodier,"Theory of Elasticity", McGraw Hill-1970.

(2) M.Kachanov, "Theory of Plasticity", MIR Publication.

(3) C.R.Calladine, "Plasticity for Engineers", Ellis Horwood, Chichester,U.K.,1985

6. Soil Stabilisation by Admixtures (Cr = 03)

Principles of soil stabilization, role of admixtures, purpose based classification of soils. Methods of stabilization – lime, cement, bitumen and special chemicals, mechanisms, uses and limitations. Use of fly ash and other waste materials. Methods and applications of grouting. Application to embankments, excavations, foundations and sensitive soils.

References:

1. Ingles, O.G., and Metcalf, J.B., Soil Stabilization, Principles and Practice, Butterworths, 1972.
2. Bowen, R., Grouting in Engineering Practice, Allied Science Publishers Ltd., 1975.

Professional Electives – II (any ONE)

7. Pavement Design (Cr = 03)

BASIC CONCEPTS

Pavements types – Historical developments - Approaches to pavement design – vehicle and traffic considerations –behaviour of road materials under repeated loading – Stresses and deflections in layered systems.

FLEXIBLE PAVEMENT

Factors affecting flexible pavements – material characterization for analytical pavement design – CBR and stabilometer tests – Resilient modulus – Fatigue subsystem – failure criteria for bituminous pavements – IRC design guidelines.

RIGID PAVEMENT

Factors affecting rigid pavements - Design procedures for rigid pavement – IRC guidelines – Airfield pavements. Highway pavements – CRC pavements.

PAVEMENT EVALUATION AND REHABILITATION

Pavement evaluation and rehabilitation, condition and evaluation surveys causes and types of distress – in flexible and rigid pavements – PSI models – Serviceability index of rural roads – Overlay design, pavements maintenance management and construction.

STABILIZATION OF SOILS FOR ROAD CONSTRUCTIONS

The need for a stabilized soil – Design criteria and choice of stabilizers – Testing and field control – Stabilisation in India for rural roads – Use of Geosynthetics in road construction - Case studies.

References:

1. Wright, P.H., Highway Engineers, John Wiley & Sons, Inc., New York, 1996.
2. Khanna S.K and Justo C.E.G, Highway Engineering, Eighth Edition, New Chand and Brothers, Roorkee, 2001.
3. Yoder R.J and Witchak M.W., Principles of Pavement Design, John Wiley, 2000.
4. Croney, D., Design and Performance of Road Pavements, HMO Stationary Office, 1979.

5. Design and Specification of Rural Roads (Manual), Ministry of rural roads, Government of India, New Delhi, 2001.
6. Guidelines for the Design of Flexible Pavements, IRC:37 - 2001, The Indian roads Congress, New Delhi.
7. Guideline for the Design of Rigid Pavements for Highways, IRC:58-1998, The Indian Roads Congress, New Delhi.
8. O' Flaherty, C.A., Highway Engineering (Vol. 2), Edward Arnold Cp., 1978.
9. Bell. P.S., Developments in Highway Engineering, Applied Sciences publishers, 1978.

8. Soil Structure Interaction (Cr = 03)

Soil-Foundation Interaction: Introduction to soil-foundation interaction problems, Soil behaviour, Foundation behaviour, Interface behaviour, Scope of soil foundation interaction analysis, soil response models, Winkler, Elastic continuum, Two parameter elastic models, Elastic plastic behaviour, Time dependent behavior ; Beam on Elastic Foundation- Soil Models: Infinite beam, Two parameters, Isotropic elastic half space, Analysis of beams of finite length, Classification of finite beams in relation to their stiffness. Plate on Elastic Medium: Thin and thick plates, Analysis of finite plates, Numerical analysis of finite plates, simple solutions ; Elastic Analysis of Pile: Elastic analysis of single pile, Theoretical solutions for settlement and load distributions, Analysis of pile group, Interaction analysis, Load distribution in groups with rigid cap ; Laterally Loaded Pile: Load deflection prediction for laterally loaded piles, Subgrade reaction and elastic analysis, Interaction analysis, Pileraft system, Solutions through influence charts.

References:

1. Foundation Design by Teng W.C (1969), Prentice Hall, NJ.
2. Tomlinson M.J. (1986), Foundation Design and Construction, 5th edition, John Wiley, Newyork
3. Bowles J.E., Foundation Analysis and Design, 5th edition, Mc-GrawHill, Newyork
4. Tomlinson M. J., Pile Design and Construction Practice, 1977 Viewpoint publications,London
5. Desai, C. S., and Abel, J.F., Introduction to the Finite Element Method: A Numerical Method for Engineering Analysis, Van Nostrand Reinhold Co., New York,

1972. Tenth Reprint. Translated into Japanese and Chinese (Peking). Asian (Indian) Edition, Taiwanese Edition.
6. N.P. Kurien, Design of Foundation Systems : Principles & Practices, Narosa, New Delhi 1992,

7. E.S. Melerski, Design Analysis of Beams, Circular Plates and Cylindrical Tanks on Elastic Foundation, Taylor and Francis, 2006.

8. L.C. Reese, Single piles and pile groups under lateral loading, Taylor & Francis, 2000

9. G. Jones, Analysis of Beams on Elastic foundation, Thomas Telford, 1997.

9. **Advance Construction Materials (Cr = 03)**

Fresh concrete and its rheology. Mechanical, deformational behavior and microstructure of hardened concrete. Creep and shrinkage. Testing of concrete. mix design and properties of concrete; High strength concrete; High density and lightweight concretes; admixtures.

Industrial waste materials in concrete, their influence on physical and mechanical properties and durability of concrete, Concreting under extreme weather conditions, High strength concrete. Changes in concrete with time, Corrosion of concrete in various environments. Corrosion of reinforcing steel. Ferro-cement, material and properties.

Foams and light weight materials, fibrereinforced concrete. Types of fibres, workability, mechanical and physical properties of fibre reinforced concrete. Polymers in Civil Engineering, Polymers, fibres and composites,
Fibre reinforced plastic in sandwich panels, modeling. Architectural use and aesthetics of composties. Adhesives and sealants. Structural elastomeric bearings and resilient seating. Moisture barriers, Polymer foams and polymers in Building, Polymer concrete composites.

References

1. Neville A.M., 'Properties of concrete', 3rd ed., 1985, ELBS Lea F.M.,
2. 'Chemistry of cement and concrete', 3rd ed., 1970, Edward Arnold Proceedings of recent seminars etc. and journals

PRACTICALS/SESSIONALS

1.GEOTECHNICAL ENGINEERING LABORATORY (Cr = 02)

Modified Proctor Compaction Test; Permeability of fine grained soils; Direct Shear Test; Triaxial Shear Test (CU, CD, UU); C.B.R (Unsoaked & Soaked); Consolidation Test; Mechanical properties of geosynthetics / geogrid, Tensile strength of fibres.

2.COMPUTATIONAL LABORATORY (Cr = 02)

Computer programming in C++, Development of computer programs to solve problems related to Civil Engineering using matrix method.

3.TECHNICAL SEMINAR (Cr = 02)

20 min presentation by each student in presence of both B. Tech and M. Tech students and the teachers of the Deptt under the supervision of an external observer on the theories and practices they have learnt during course work. After presentation, there should be minimum 10 minutes question answer session.

SECOND SEMESTER

10. Advanced Foundation Engineering (Cr = 04)

INTRODUCTION

Developments - Need of Foundation Engineering - Responsibility of Foundation Engineer - Classification - General requirements - Additional consideration - selection of type of foundation - hostile environment - structural integrity - economy.

BEARING CAPACITY ESTIMATIONS

Bearing capacity of shallow foundations - Homogeneous - Layered soils - Soft and Hard Rocks - Evaluation of bearing capacity from insitu tests - partial safety factor approach codal - Recommendations.

SETTLEMENT EVALUATION

Settlement analysis-immediate-consolidation settlement-stress path method of settlement evaluation-layered soil and rocks-construction period correction-evaluation from insitu tests - code recommendations.

INTERACTIVE ANALYSIS AND DESIGN OF FOUNDATIONS

Analysis of foundation - isolated - strip - combined footings and mat foundations. Conventional - elastic approach - Soil Structure Interaction Principles - Application - Numerical techniques - finite element method - Application of softwares - Structural Design of shallow foundations - working stress method - limit state method - Codal Recommendations.

FOUNDATION FOR SPECIAL CONDITIONS

Structural Design of shallow foundations - working stress method Introduction to special foundations - Foundation design in relation to ground movements - Foundation on recent refuse fills - Design of Foundation for seismic forces - Codal Recommendations.

REFERENCES:

1. Donald P. Coduto, Foundation Design Principles and Practices - Prentice Hall, Inc., Englewood Cliffs, New Jersey, 2001.
2. Winterkorn, H.F. and Fang, Y.F., Foundation Engineering Handbook, Van Nostrand Reinhold, 1994.
3. Bowles, J.E., Foundation Analysis and Design, Fifth Edition, McGraw Hill, New York, 1995.
4. Robert Wade Brown, Practical Foundation Engineering Handbook, McGraw Hill, New York, 1996.
5. Tomlinson, M.J. Foundation Engineering, ELBS, Long man Group, UK Ltd., England, 1995.

6. Swami Saran, Soil Dynamics and Machine Foundation, Galgottia Publications Pvt. Ltd., New Delhi-110002, 1999.
7. Vargheese, P.C. Limit State Design of Reinforced concrete, Prentice-Hall of India, 1994.

11. Ground Improvement Techniques (Cr = 04)

Principles of ground improvement. Mechanical modification, properties of compacted soil, compaction control tests. Hydraulic modification, dewatering systems, filtration, drainage and seepage control with geosynthetics, preloading and vertical drains, Electri-kinetic dewatering, chemical modification. Modification by admixtures, stabilization using industrial wastes, grouting, modification by inclusion and confinement, soil reinforcement, flexible geosysthetic sheet reinforcement, anchorage. Reinforcement techniques, bearing capacity improvement, slope stability, retaining walls and pavements.

References

1. Hausmann, M.R., Engineering Principles of Ground Modification, McGraw Hill, 1990.
2. Jones, C.J.E.P., Reinforcement and Soil Structures, Butterworth Publications, 1996.
3. Koerner, R.M., Designing with Geosynthetics, Prentice Hall Inc. 1998.

Professional Elective – III (any ONE)

12. Soil Dynamics and Geotechnical Earthquake Engineering (Cr = 03)

Soil Dynamics: Introduction: Soil mechanics and soil dynamics, problems of dynamic loading on soil structure. Theory of vibrations: Introduction, definitions, properties of simple harmonic motion, free vibrations of spring-mass system, Equations for free and forced vibrations with and without viscous damping. Dynamic Soil Properties: Introduction, measurement of dynamic soil properties (laboratory and field tests - Stress and strain controlled cyclic tri-

axial tests, seismic reflection and refraction test, seismic up-hole/down hole test, dilatometer and pressure meter tests, seismic cone penetration test, suspension logging test), stress-strain behaviour of cyclically loaded soils, strength of cyclically loaded soils.

Geotechnical Earthquake Engineering: Introduction, background, seismic hazards; ground shaking, structural hazards, liquefaction, landslides, lifeline hazards, tsunami hazards, mitigation of seismic hazards, significant historical earthquakes. Seismology and earthquakes: Internal structure of the earth, continental drift and plate tectonics, faults, elastic rebound theory, other sources of seismic activity location of earthquakes, size of earthquakes (intensity, magnitude and energy).

Seismic Liquefaction: Introduction, Flow liquefaction and cyclic mobility, liquefaction susceptibility (historical, geologic, and compositional). Initiation of liquefaction due to excess pore water pressure, effects of liquefaction (alteration of ground motion, development of sand boils, settlement and instability).

Bearing Capacity Analysis: Introduction, punching shear failure approach for cohesive and cohesion-less soils, Terzaghi's method for both cohesion-less and cohesive soils.

Ground Improvement Techniques for Remediation of seismic hazards: introduction, densification techniques (Vibro-technique, dynamic compaction, blasting, grouting and mixing and drainage techniques).

References:

1. Geotechnical Earthquake Engineering by Steven L. Kramer, Low Price Edition, Pearson Education, www.pearsoned.co.in

2. Soil Dynamics by Shamsher Prakash, McGraw-Hill Book Company

3. Soil Behaviour in Earthquake Geo-technics by Kenji Ishihara, Clarendon Press, Oxford

4. Theory of Vibrations with Applications by W. T. Thomson and M. D. Dahleh, Low Price Edition, Pearson Education, www.pearsoned.co.in

13. Optimization Methods and its Applications in Civil Engineering (Cr = 03)

Introduction: Need for engineering optimal design, Optimum design formulation: Design variable, objective function and constraints; Unconstrained optimization methods Single variable optimization methods: Region elimination method – Golden section search, Interval halving method; Gradient based method – Newton-Raphson, bisection and secant method. Multi variable optimization methods: Direct search method: Hooke-Jeeve pattern search, simplex reflection search, Powell's conjugate direction search. Gradient Based methods: Cauchy's steeped descent, Newton's method, Levenberg-Marquardt's method, Fletcher- Reeve method; Constrained optimization methods Kuhn

Tucker condition, Penalty function method, Augmented Lagrangian method, sequential unconstrained minimization, cutting plane method; Introduction to Evolutionary algorithms: Need for evolutionary algorithms, Type of evolutionary methods, Introduction to Genetic algorithm (GA), Difference and similarities between GA and traditional methods. Basic operations of GA: reproduction, crossover, mutation and elitism. Binary coded and Real coded GA; Application of Optimization techniques: Water resource planning management, Structural Optimization, Transportation planning and Management, Slope stability and optimal dimensioning of foundations. multi-objective optimization models.

References

1. J.S. Arora, Introduction to Optimum Design, Elsevier, 2nd Edition, 2004.

2. K. Deb, Optimization for Engineering. Design: Algorithms & Examples, Prentice Hall India, 2006

3. S.S. Rao, Engineering Optimization: Theory & Practice, New Age International (P) Ltd, 3rd Edition, 1996, Reprint : June, 2008

4. K. Deb, Multi-Objective Optimization Using Evolutionary Algorithms, John Wiley, 2003

14. Geo-environmental Engineering (Cr = 03)

Source, production and classification of wastes. Soil pollution processes, physical-chemical and biological interactions in soil, effects on geotechnical properties and case studies, waste disposal facilities such as landfills and impoundments, slurry walls, etc. Barrier systems – basic concepts, design and construction, stability, compatibility and performance. Transport in subsurface, reuse of waste materials. Contaminated site remediation.

1. Daniel, D.E., Geotechnical Practice for Waste Disposal, Chapman and Hall, London, 1993.
2. Reddi, L.N., and Inyang, H.F., Geoenvironmental Engineering–Principles and Applications, Marcel Dekker, Inc., 2000.
3. Sharma, H.D., and Lewis, S.P., Waste Containment Systems, Waste Stabilization and Landfills: Design and Evaluation, John Wiley and Sons Inc. NY, 1994.

PROFESSIONAL ELECTIVE- IV (any ONE)

15. Stability analysis of Slopes, Embankments and Dams (Cr = 03)

Landslide phenomenon: Types and causes of slope failures, Practical applications ; Stability analysis of infinite slopes with or without water pressures ; Stability analysis of finite and Infinite slopes: concept of factor of safety, pore pressure coefficients, Mass analysis, Wedge methods, friction circle method ; Method of slices, Bishop's method, Janbu's method ; Effect of seepage, submerged and sudden draw down conditions ; Design of slopes in cutting, Embankments and Earth dams ; Site Investigation: Reconnaissance, Preliminary and detailed investigation, Investigation for foundations ; Advances in stability analysis of slopes.

References

1. L. W Abramson, T. S Lee, S Sharma and G M Boyce, Slope Stability and Stabilization Methods,Willey Interscience publications

2. B M Das, Principles of Geotechnical Engineering, Thomson Brooks/Cole

3. T W. Lambe and R V Whitman, Soil Mechanics, John Wiley & sons

4. V N S Murthy, Principles of Soil Mechanics and Foundation Engineering, UBS Publishers Private Ltd.

16. Reinforced Soil Structures (Cr = 03)

PRINCIPLES AND MECHANISMS OF SOIL REINFORCEMENT

Historical Background, Principles, Concepts and Mechanisms of reinforced earth.

REINFORCING MATERIALS AND THEIR PROPERTIES

Materials used in reinforced soil structures, fill materials, reinforcing materials metal strips, Geotextile, Geogrids, Geomembranes, Geocomposites and Geojutes, Geofoam, Natural fibers - facing elements – Properties and methods of Testing.

DESIGN OF SOIL REINFORCEMENT

Reinforcing the soil-Geotextiles and Geogrids – Embankments and slopes – reinforced walls – bearing capacity – Road way reinforcement – slop stabilization.

DESIGN FOR SEPARATION, FILTRATION AND DRAINAGE

Geotextiles - requirement for design of separation – Filtration – General behaviour - filtration behind retaining walll, under drains, erosion control and silt fence – drainage design – Liners for liquid containment – Geomembrance and Geosynthetic clay liners.

DURABILITY OF REINFORCEMENT MATERIALS

Measurement of corrosion factors, resistivity - redox potential, water content, pH, electrochemical corrosion, bacterial corrosion – influence of environmental factors on the performance of Geosynthetic materials.

REFERENCES:

1. **Jewell, R.A., Soil Reinforcement with Geotextile, CIRIA, London, 1996.**
2. Jones, C.J.F.P., Earth Reinforcement and Soil Structures, Earthworks, London, 1982.
3. Koerner, R.M., Designing with Geosynthetics, Third Edition, Prentice Hall, 1997.
4. **Muller, W.W. HDPE Geomembrances in Geotechnics, Springer, New York 2007.**
5. John, N.W.M., Geotextiles, John Blackie and Sons Ltd., London, 1987.
6. Gray, D.H., and Sotir, R.B., Biotechnical and Soil Engineering Slope Stabilization: A practical Guide for Erosion control, John Wiley & Son Inc., New York, 1996.
7. Ramanatha Ayyar , T.S., Ramachandran Nair, C.G. and Balakrishna Nair, N., Comprehensive Reference Book on Coir Geotextile, Centre for Development for Coir Technology, 2002.
8. Sivakumar Babu, G.L., An Introduction to Soil Reinforcement and Geosynthetics, University Press (India), Pvt. Ltd., Hyderabad, 2006.

17. Infrastructure Engineering & Transportation Planning (Cr = 03)

Module 1:

Quick response travel evaluation procedure, TSM actions: Traffic management techniques for improving vehicular flow, preferential treatment for high occupancy modes, demand management technique for reduced traffic demand, staggered hours, vehicle restrictions. Small area management: individual sites, residential neighbourhoods,

Module 2:

Introduction to transportation systems. Transportation innovations, social and economic impacts of transportation. Decision makers and their options, demand

modelling and prediction. Stated and Revealed Preference approaches; Modelling transportation technologies.

Module 3:

Analysis of network flows. Transportation networks. Network Theory. planning for pedestrians, parking planning. Travel demand management and telematics in travel planning, Design and drawing of grade intersections, Rotaries, interchanges (cloverleaf, trumpet), multilevel intersections; Onstreet parking facilities; Off-street parking facilities (parking lots and garages);

Module 4:

Layout for buses and trucks; Bridges and Fly-overs; Guard rails; Culverts; Retaining Sides; Mix wells; Foot bridges; River Spans; Tunnels and Underpasses;

PROFESSIONAL ELECTIVES – V (any ONE)

18. Offshore Structures (Cr = 03)

Design of offshore platforms: Introduction, fixed and floating platforms. case studies and general features-elements of hydrodynamics and wave theory-fluid structure interaction, Steel, concrete and hybrid platforms.

Design criteria. Environmental loading, Wind, wave and current loads after installation. Stability during towing. Foundations: Site investigations. Piled foundation. Foundations for gravity structures.

Behaviour under dynamic loading. Static and dynamic analysis of platforms and components.

Dynamic response in deterministic and indeterministic environment, codes of practice, analysis of fixed platform and semisubmersible related topics.

19. Finite Elements in Geo-mechanics (Cr = 03)

Basic concepts - Discretization of continuum, typical elements, the element characteristic matrix, element assembly and solution for unknowns - Applications.

Variational principles, variational formulation of boundary value problems, variational methods approximation such as Ritz and weighted residual (Galerkin)

methods, Applications.

Displacements based elements, finite elements for axial symmetry. One-dimensional problems of stress, deformation and flow, assembly, convergence requirements, Finite elements analysis of two-dimensional problems. The linear and quadratic triangle, Natural coordinates.

Isoparametric formulation – Isoparametric bar element – plane bilinear isoparametric element – refined elements – Numerical integration techniques.

Use of FEM to Problems in soils and rocks, Introduction to non-linearity. Description and application to consolidation, seepage and soil – structure interaction problems.

REFERENCES

1. Cook, R.D., Malkus, D.S., and Plesha, M.E., Concepts and Applications of Finite Element Analysis, John Wiley, 1989.
2. Reddy, J.N., An Introduction to the Finite Element Method, McGraw Hill, 1984.
3. Chadrupatla, R.T., and Belegundu. A.D, Introduction to Finite Elements in Engineering, Third Edition, Prentice- Hall, 2006.
4. Rockey, K.C., Erans, H.R., Griffiths, D.W., and Nethercot, D.A., The Finite Element method, Grostry Lockwood Staples, London, 1975.
5. Rajasekaran, S., Finite Element Analysis in Engg Design, Wheller Publishing, Allahabad, 1993.
6. Smith, I.M., Programming the Finite Element Method with Application to Geomechanics, John Wiley and sons, New Delhi, 2000.
7. Gupta, O.P. Finite and Boundary Element Methods in Engineering, Oxford & IBH Publishing Co., Pvt. Ltd., New Delhi, 2000.
8. Rao, S.S. The finite element method in Engg, Butterworth - Heinemann., 1998.
9. Potts, D.M. and Zdramcovic, L., Finite Element analysis in Geotechnical Engineering - Application, Thomas Telford, 2001.
10. Shen, J. and Kushwaha. R.L., Soil-Machine Interaction - A finite element perspective, Moral Dikker, Inc. 1998.

20. Fundamentals of Soil Behaviour (Cr = 03)

Origin of soils, identification of clay minerals, soil structure, soil classification, soil-water interactions in the environment, effective stress concepts, role of mineralogy in hydraulic conductivity, consolidation and shear strength of fine-grained soils, problematic soils.

1. Mitchell, J.K., Fundamentals of Soil Behaviour, John Wiley, 1993.
2. Yong, R.N., and Warkentin, B.P., Soil Properties and Behaviour, Elsevier, 1975.
3. Fang, H.Y., and Daniels, J.L., Introductory Geotechnical Engineering – An Environmental Perspective, Taylor and Francis, 2006.

PRACTICALS/SESSIONALS

IInd Semester SESSIONAL

1. Geotechnical Engineering Design practice. (Cr = 04)

Standard Penetration test; Field vane shear test; Cone penetration tests; Plate load test (both field and laboratory); Pile load tests; Nondestructive testing of piles; Pressure meter test; Dilatometer Test, Static and Cyclic Triaxial Test, Geophysical Exploration; Field Visit.

2. Comprehensive Viva (Cr = 02)

3. Technical Seminar (Cr = 02)

3rd Semester

OPEN ELECTIVES (any ONE)

21. Disaster Management and Mitigation (Cr = 03)

22. Non-conventional Energy (Cr = 03)

23. Project Planning and Management (Cr = 03)

PRACTICALS/SESSIONALS

1. Thesis Part – I (0 - 0 - 3) Cr = 14

FOURTH SEMESTER

1. Thesis Part – II (0-0-6) Cr = 16
2. Technical Seminar (0-0-3) Cr = 02
3. VIVA (0-0-3) Cr = 02