

COEP Technological University Pune

(A Unitary Public University of Govt. of Maharashtra)

School of Civil Engineering and Planning

Curriculum Structure

F. Y. M. Tech.

(Regular)

Geotechnical Engineering

(Effective from: A.Y. 2023-24)

Program Educational Objectives (PEO)

- I.** Provide students with a sound foundation in the basic sciences, mathematical, scientific and engineering fundamentals necessary to formulate, solve and analyze the problems related to diversified field of Geotechnical and allied civil engineering fields.
- II.** Develop experimental setup for modelling of geotechnical Engineering problems along with the necessary instrumentation and synthesize the data obtained through field and laboratory tests to design geotechnical and foundation system.
- III.** Create awareness among the students for the use of state-of-the-art professional software.
- IV.** Exhibit Professionalism, ethical approach, communication skills, teamwork on multidisciplinary projects and adapt to modern trends by engaging in lifelong learning.

Program Outcomes (POs):

Graduate will be able to

PO1: Apply knowledge of mathematics, science and engineering to analyze geotechnical and foundation engineering problems.

PO2: Identify and formulate geotechnical and foundation engineering problems reviewing available literature.

PO3: Solve complex problems of analysis and design of various geotechnical and foundation system.

PO4: Apply appropriate research methodology, techniques and tools to design and conduct lab as well as field experiments.

PO5: Create, select and apply correct numerical technique to analyze complex geotechnical and foundation system with an understanding of the limitations.

PO6: Able to function as a member or a team leader for engineering as well as multidisciplinary projects.

PO7: Demonstrate application of engineering and management principles for efficient handling of projects.

PO8: Communicate effectively with the engineering community and society in both verbal and written form.

PO9: Engage in lifelong learning to continuously improve knowledge and competency.

PO10: Demonstrate professional ethics and work culture and to contribute in efficient technology transfer to the society.

PO11: Examine self-actions critically and applying corrections through learning from mistakes.

List of Abbreviations

Abbreviation	Title	No of courses	Credits	% of Credits
PSMC	Program Specific Mathematics Course	1	4	5.9%
PSBC	Program Specific Bridge Course	1	3	4.4%
PEC	Program Elective Course	3	9	13.2%
MLC	Mandatory Learning Course	2	0	0%
PCC	Program Core Course	6	22	32.4%
LC	Laboratory Course	2	2	2.9%
UOE	University Open Elective	1	3	4.4%
LLC/CCA	Liberal Learning Course	1	1	1.5%
SLC	Self-Learning Course	2	6	8.8%
SBC	Skill Based Course	2	18	26.5%

F.Y. M. Tech. in Geotechnical Engineering

Semester I

Sr. No.	Course Type	Course Code	Course Name	Teaching Scheme			Credits
				L	T	P	
1.	PSMC	CGE-23001	Computational Methods in Geotechnical Engineering	3	1	--	4
2.	PSBC	CGE-23002	Analysis and Design of Foundations	3	1	--	4
3.	PEC		Department Elective –I	3	--	--	3
		CGE(PE)-23001	1. Rock Mechanics				
		CGE(PE)-23002	2. Ground Improvement				
		CGE(PE)-23003	3. Reinforced Earth and Slopes				
		CGE(PE)-230044	4. Environmental Geotechnology				
		CGE(PE)-23005	5. Pavement Analysis and Design				
5.	PCC	CGE-23003	Soil Engineering	3	1	--	4
6.	PCC	CGE-23004	Earth and Rockfill Dam and Slope Stability	3	--	--	3
7.	LC	CGE-23005	Geotechnical Engineering Lab Practice-I	--	--	4	2
8.	LC	CGE-23006	Seminar	2	--	--	1
9.	LC	CGE-23007	Geotechnical Engineering Lab Practice-II	--	--	2	1
Total				17	3	6	22

Semester II

Sr. No.	Course Type	Course Code	Course Name	Teaching Scheme			Credits
				L	T	P	
1.	UOC	OEC	University Open Course (Solid waste management Technologies)	3	--	--	3
2.	PEC		Department Elective –II	3	--	--	3
		CGE(PE) - 23006	1. Centrifuge Modeling				
		CGE(PE) - 23007	2. Critical State Soil Mechanics				
		CGE(PE) - 23008	3. Geotechnical Exploration & Instrumentations				
		CGE(PE) - 23009	4. Applications of Geosynthetics in Geotechnical engineering				
		CGE(PE) - 23010	5. Offshore Geotechnical Engineering.				
		CGE(PE) - 23011	6. AI/ML Based Applications in Geotechnical Engineering				
3.	PEC		Department Elective –III	3	--	--	3
		CGE(PE) - 23012	1. Geotechnical Earthquake Engineering				
		CGE(PE) – 23013	2. Software Applications in Geotechnical Engineering.				
		CGE(PE) – 23014	3. Geotechnical Engineering for Underground Structures				
		CGE(PE) – 23015	4. Forensic Geotechnical Engineering				
		CGE(PE) – 23016	5. Geophysical Exploration Methods				
		CGE(PE) – 23017	6. Soft computing Techniques				
4.	CCA	LL	Liberal Learning Course	--	--	--	1
5.	MLC	ML-23001	Research Methodology and Intellectual Property Rights	2	--	--	--
6.	PCC	CGE-23008	Retaining Structures	3	--	--	3
7.	PCC	CGE-23009	Soil Dynamics and Machine foundations	3	--	--	3
8.	LC	CGE-23010	Mini Project	--	--	2	1
9.	PCC	CGE-23011	FEM in Geomechanics	3	--	--	3
10.	LC	CGE-23012	Geotechnical Engineering Lab Practice-III	--	--	4	2
Total				20	0	6	22

Semester-III

Sr. No.	Course Code	Course Name	Teaching Scheme			Credits
			L	T	P	
1.	VSEC	Dissertation Phase – I	--	--	18	9
2.	SLC	Massive Open Online Course -I	3	--	--	3

Semester-IV

Sr. No.	Course Code	Course Name	Teaching Scheme			Credits
			L	T	P	
1.	VSEC	Dissertation Phase – II	--	--	18	9
2.	SLC	Massive Open Online Course -II	3	--	--	3

Massive Open Online Course –I and II: New Courses (i.e. which has not been learnt earlier and not going to be learnt in next semester)

Exit option: PG Diploma in Civil-Geotechnical Engineering

After successful completion of the First Year of the program and eight weeks domainspecific industrial internship of one Credit.

CGE-23001 Computational Methods in Geotechnical Engineering

Teaching Scheme

Lectures: 3 Hrs/ week

Tutorials: 1 hr/week

Examination Scheme

T1 and T2 - 20 marks each

End Sem. Exam. - 60 marks

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

CO 1: Know and recall the core knowledge of the syllabus.

CO 2: Understand the concept. (To measure this outcome, questions may be of the type- explain, describe, illustrate, evaluate, give examples, compute etc.)

CO 3: Analyze the problem and apply the appropriate concept.

Roots of Equations: Bracketing methods, open methods and case studies. Linear Algebraic Equations: Gauss Elimination, LU decomposition and matrix inversion, special matrices and Gauss-Seidel method, case studies. Numerical Differentiation and Integration: Newton-Cotes integration formulas, integration of equations, numerical differentiation, case studies. Ordinary Differential Equations: Runge-Kutta methods, stiffness and multistep methods, boundary value and eigen value problems, case studies. Partial Differential Equations: Finite difference methods for elliptic and parabolic equations, case studies.

References

1. Advanced Engineering Mathematics by Erwin Kreyszig, John Wiley & Sons, Inc., 8th edition 2010.
2. Higher Engineering Mathematics by H K Dass, S Chand & Co. Ltd., 15th edition 2006.
3. Higher Engineering Mathematics by Dr B S Grewal, Khanna Publication, 40th edition 2007.
4. Introductory Methods in Numerical Analysis by S S Sastry, PHI, Latest Edition.
5. Applied Numerical Methods using MATLAB for Engineers and Scientists by Steven C. Chapra McGraw-Hill (Indian edition), 3rd edition 2012.

CGE-23002 Analysis and Design of Foundations

Teaching Scheme

Lectures: 3 Hrs/ week

Tutorials: 1 hr/week

Examination Scheme

T1 and T2 - 20 marks each

End Sem. Exam. - 60 marks

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

CO 1: Know various field test method and soil exploration methods.

CO 2: Know various foundation instrumentation

CO 3: Suggest various bearing capacity determination technique and settlement analysis and design shallow foundation.

CO 4: Design deep foundation.

CO 5: Design shallow and deep foundation for inclined load and moment and uplift load.

Geotechnical Exploration–Penetration Tests, plate load test, field vane shear, large box shear, pressure meter test, foundation instrumentation – settlement and displacement gauges. Shallow Foundation: Bearing capacity & settlement analysis, Design for shallow Foundation under vertical, horizontal and moment loading in sandy and in clayey soil, Raft in sand and clay, Pile Foundation – pile capacity and settlement analysis for individual and group piles in sandy and in clayey soil, pile load test, Foundation under Uplift Loads, negative skin friction, Foundations on rocky strata. Note – Actual foundation design problems will be covered during tutorial classes.

References

1. Foundation Engineering Hand book, Winterkorn& Fang
2. Analysis & Design of Pile Foundation, Polous& Davis
3. Foundation Design Manual, N.V. Nayak
4. Foundation Analysis and Design- Joseph E. Bowels, TATA Mc-Grawhill
5. Design Aids in Soil Mechanics and Foundation Engineering, Shenbaga R Kaniraj, TATA Mc-Grawhill
6. Design of Foundation Systems, Nainan P Kurian, Narosa publication house
7. Foundation Design & Construction, M. J. Tomlinson, ELBS publication
8. Foundation Engineering Hand book, Hsai-Yang-Fang, Chapman & hall, New York.
9. Foundaton Engineering-Nitin Som
10. Advanced Foundation Engineering-B. M. Das
11. Poulos, H. G. (2016). Tall building foundations: design methods and applications. Innovative Infrastructure Solutions, 1(1), 10.

CGE(PE) - 23001 Rock Mechanics

Teaching Scheme

Lectures: 3 Hrs/ week

Examination Scheme

T1 and T2 - 20 marks each

End Sem. Exam. - 60 marks

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

CO 1: Independently suggest the best suitable method of rock exploration based on site visit.

CO 2: Suggest and provide best possible solution for rock stability.

General, classification of genesis, lithological, Methods of exploration, direct penetration, geophysical, Theory, procedure, instruments, limitations and interpretation, In-situ test, necessity, types, Failure theories, deformability tests, shear strength tests, dilatometer, stress relief, flat jack –techniques., Physical and mechanical tests, types, permeability, electrical properties, thermal properties, durability, strength tests, elasticity constant tests, hardness., Rock testing: samples, specimens, compression, tension, shear test, shear strength properties, RMR, Creep phenomenon, simple and complex rheological models-purpose, idealization and applications. Shear strength of rock under high pressure, stability of rock slopes, anisotropic rock system, lateral pressure on retaining structures for high hill slopes, bearing capacity of rock masses, opening in rocks, lined and unlined tunnels.

References

1. Fundamentals of Rock Mechanics, Jaeger, J.C., Cook, N.G.W., Zimmerman, R.W., 4th Edition, Blackwell Publishing.
2. Experimental Rock Mechanics, Mogi Kiyoo, Taylor & Francis.
3. Engineering Rock Mechanics – An Introduction to Principles, Hudson, J.A. and Harrison, J.P., Pergamon.
4. Rock Mechanics and Design of Structures, Obert and Duvall, John Wiley & Sons.
5. Rock Mechanics in Engineering Practice, Stag and Zienkiewicz, John Wiley & Sons
6. Engineering in Rocks, T. Ramamurthy, PHI Learning Pvt. Ltd.

CGE(PE)-23002 Ground Improvement

Teaching Scheme

Lectures: 3 Hrs/ week

Examination Scheme

T1 and T2 - 20 marks each

End Sem. Exam. - 60 marks

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

CO 1: Independently design and suggest a suitable ground improvement technique for a given site where he should have prerequisite knowledge of soil properties, various laboratory and field tests and IS codes.

Principles of compaction, Laboratory compaction, Engineering behaviour of compacted clays, field compaction techniques- static, vibratory, impact, Earth moving machinery, Compaction control, Dynamic compaction, Shallow Stabilization with additives: Lime, flyash, cement and other chemicals and bitumen, in-situ soil mixing; Deep Stabilization- lime column, soil-lime column; Grouting: permeation, compaction and jet; sand column, stone column, Vibro-floatation, sand drains, prefabricated drains, electro-osmosis; thermal, freezing. Dewatering systems, Design of ground improvement system using stone columns, prefabricated drains and geosynthetics.

References

1. Ground Improvement by M. P. Mosely, CRC Press, Inc.
2. Winterkorn & Fang- Foundation Engineering Hand book
3. K.B. Woods, D.S. Berry and W.H. Goetz, Highway Engineering Handbook, 1960.
4. IS code for stone column and prefabricated drains
5. Foundation Engineering Manual-N.V. Nayak
6. Koerner, R. M.: Designing with Geosynthetics, Prentice Hall, NJ

CGE(PE)-23003 Reinforced Earth and Slopes

Teaching Scheme

Lectures: 3 Hrs/ week

Examination Scheme

T1 and T2 - 20 marks each
End Sem. Exam. - 60 marks

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

CO 1: Understand various types of geosynthetic materials, their properties and applications

CO 2: Understand about the laboratory testing required for the assessment of the properties of the geosynthetic materials.

CO 3: Design simple RE walls and RE slopes using BS and FHWA codes.

CO 4: Design simple RE slopes using BS code.

History and development of earth reinforcement, Bar mesh and welded wire mesh as reinforcement, Natural fibers, Reinforced soil structures: principles of soil reinforcement, Reinforced soil walls and slopes, design of RS walls and RS slopes using BS and FHWA codes, Design of Gabions, Properties of Geotextiles, Geomembranes, Geogrids, Geocomposite, Design strength of geotextiles and Geogrids, testing on Geotextiles, and Geogrids.

References

1. Swami Saran "Reinforced Soil & its Engineering Applications".
2. R. A. Jewel: Soil Reinforcement with Geotextiles, Construction Industry Research & Information Association (CIRIA) Thomas Telford.
3. Engineering with Geosynthetics: ed. G. Venkatappa Rao, GVS Suryanarayana Raju, Tata McGraw Hill Publishing Co. Ltd.
4. ASTM and Indian Standards on Geotextiles.
5. Koerner, R. M.: Designing with Geosynthetics, Prentice Hall, NJ.
6. Jones, C.J.E.P. Reinforcement and soil structures, Butter worth Publications.
7. BS 8006:1995, "Code of practice for strengthened/reinforced soils and other fills".
8. FHWA-NH1-00-043, "Mechanically stabilized earth walls and reinforced soil slopes design and construction guidelines".

CGE(PE)-23004 Environmental Geotechnology

Teaching Scheme

Lectures: 3 Hrs/ week

Examination Scheme

T1 and T2 - 20 marks each

End Sem. Exam. - 60 marks

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

CO 1: Understand the need for the solid waste management.

CO 2: Understand about the waste management and planning issues.

CO 3: Understand how engineered landfills helps in management of solid waste.

CO 4: Understand about the requirements of various components of engineered landfills and will be able to analyze the liner stability problems.

Introduction: Scope, role of Geotechnical engineering. in environmental protection , geomorphologic principles relating to laterites and pedagogical changes, Climate and soil, Type of Wastes, Surface and sub surface contamination, Pollutant transport in porous media, Design and construction of landfills for municipal and hazardous wastes, Liners : Basic concepts, design and construction , liner stability , compatibility, performance, Modification / Improvement in soil structure , Reuse: Geotechnical reuse of waste material , waste management and planning issues, Regulations, special applications and case studies.

References

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.
6. Geoenvironmental Engineering- Principles & Applications by Lakshmi N. Reddi & Hillary I. Inyang.
7. Geoenvironmental Engineering by Hari D. Sharma & Krishna R. Reddy.
8. Guidelines of CPCB (Central Pollution Control Board)-Landfills.

CGE(PE)-23005 Pavement Analysis and Design

Teaching Scheme

Lectures: 3 Hrs/ week

Examination Scheme

T1 and T2 - 20 marks each
End Sem. Exam. - 60 marks

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

CO 1: Evaluate stresses and strains for various loading and environmental conditions for flexible and rigid pavements.

CO 2: Design flexible and rigid pavements.

CO 3: Analyze and evaluate pavement distresses and select best suited rehabilitation techniques.

CO 4: Design reinforced flexible pavement.

Theories of pavement design, Factors affecting pavement design, Methods of flexible pavement design- applications of CBR, Burmister, Asphalt Institute, AASHTO and IRC methods, Load and temperature stresses in rigid pavements- Westergaard's, Bradburry's and Picket's concepts, Design of rigid pavements by PCA, AASHTO and IRC methods, Design of joints in rigid pavements, Evaluation of pavement distress, Design aspects of flexible and rigid overlays, Rehabilitations Techniques – Reflective Cracking, Reinforced Overlays, Ultra-Thin White Topping, IRC 37.

References

1. Yoder and Witzack, Principles of Pavement Design, John Willey and Sons, October 1975
2. Yang H. Huang, Pavement Analysis and Design, PH, 2nd Edition, 2004, RILIM Conference Proceedings
3. IRC-37
4. IRC-58
5. FHWA for Pavement Design.

CGE-23003 Soil Engineering

Teaching Scheme

Lectures: 3 Hrs/ week

Tutorials: 1 hr/week

Examination Scheme

T1 and T2 - 20 marks each

End Sem. Exam. - 60 marks

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

CO 1: Judge physical, chemical and engineering properties of soils based information processes history, minerals and soil structure.

CO 2: Collect undisturbed soil samples and plan lab tests for engineering characteristics of soil.

CO 3: Conduct consolidation test and analyze the data.

CO 4: Select and use state of the art instruments and data acquisition system.

Introduction to Soils, Formation of soils, complexity of soils nature, typical engineering behavior of soils of India, Soil structure: Types of bonds, important clay minerals, DDL theory, The soil drainage, soil temperature, & control, The soil reaction, soil acidity and alkalinity, the buffering of soils, physical properties of soil in relation to tillage and erosion, soil water potential, X-ray and Differential Thermal Analysis; structure of coarse grained soil, behavior of granular and cohesive soils with respect to their water content ; Consolidation: Steady State flow, 2D and 3D seepage, transient flow; Compressibility and rate of consolidation, one, two, and three dimensional consolidation theories; Sand drains ; Elastic methods of stress distribution in soils, Shear strength behavior of sand and clay, shear strength parameters to be used under different field loading and drainage conditions, Rheology.

References

1. Physical & geotechnical properties of soils – Joseph E. Bowels, Tata Mc.- Grawhill.
2. Advanced soil mechanics- Braja M. Das, Tata Mc.- Grawhill.
3. Principles of Soil Mechanics, R F Scott, Addison & Wesley.
4. Mitchell, James K, Fundamentals of Soil Behaviour, John Wiley and Sons.
5. Soil physics by Baver.
6. Soil Physics by Ghidyal & Tripathi, New Age International Publishers.
7. Clay Mineralogy by Harr.

CGE-23004 Earth & Rockfill Dam and Slope Stability**Teaching Scheme****Lectures:** 3 Hrs/ week**Examination Scheme****T1 and T2** - 20 marks each**End Sem. Exam.** - 60 marks**Course Outcomes:** At the end of the course, the students will be able to:**CO 1:** Identify type of earthen dam**CO 2:** Identify different types of soil for construction of earthen dam.**CO 3:** Understand the stability analysis.**CO 4:** Design earthen dam.**CO 5:** Identify various forces acting on the retaining wall and design retaining wall and cofferdam

Embankment dams –causes of failures and criteria for safe design, seepage through dams, Casagrande's solution, Kozeny's parabola, entrance and exit correction, electrical resistivity to assess seepage, flow nets and applications, Control of seepage through dams and foundations, filters, drains, rock-toe and relief wells. Stability analysis – steady seepage and sudden draw down condition, seismic stability, Pore pressure role in stability analysis, Earth Pressure Theories, Failure modes of gravity and flexible retaining walls, design of gravity and rigid cantilever retaining wall, Design of flexible retaining wall – cantilever and anchored, Cofferdam. Methods of slope stability.

References

1. Christian Kutzner, "Earth & Rock fill dams – Principles of design and construction", Published Oxford and IBH.
2. USIBR, "Design of small dams" Oxford and IBH Publishing Company.
3. USIBR, "Earth Manual", CBS Publishers and distributors.
4. E. N. Bromhead, "The stability of slopes", Blackie Academic and Professional
5. C.R.I. Clayton, J. Milititsky, Ufrgs and R.I. Woods, "Earth pressure and Earth Retaining structures", Blackie Academic and Professional
6. Sherad, "Earth and Rock fill dams".
7. Bharat Singh, "Earth and Rock fill dams".
8. Winterkorn and Fang, "Foundation Engineering Hand Book".

CGE-23005 Geotechnical Laboratory Practice-I

Teaching Scheme

Practical: 4 Hrs/ week

Examination Scheme

Teamwork - 50 marks

Oral - 50 marks

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

CO 1: Perform and interpret the laboratory experiments such as Hydrometer Test, Consolidation Test, Swelling Pressure Test, Triaxial Test with Measurement of Pore Pressure

CO 2: Use a suitable computer software for analysis and design of geotechnical problems

1) Laboratory tests (**Any three**)

Hydrometer Analysis, Consolidation Test, Swelling Pressure Test, Triaxial Test with Measurement of Pore Pressure, Types of samplers.

2) Assignments (**Any Two**) on use of a suitable computer software for analysis and design of substructure, stability of slopes, Seepage Analysis, retaining structure.

References

1. SP 36 (Part I) 1987 Compendium of Indian Standards on Soil Engineering: Part I Laboratory testing of soils for civil engineering purposes.

CGE-23006 Seminar**Teaching Scheme****Lecture:** 2 Hrs/ week**Examination Scheme****End Sem. Exam** - 100 marks**Course Outcomes:** At the end of the course, the students will be able to:**CO 1:** Identify a topic for study and carry out literature survey**CO 2:** Write a technical report related to selected topic**CO 3:** Present outcome of the study with the help of ppt.

Seminar is to be performed and reported by the end of the first semester.

CGE-23007 Geotechnical Laboratory Practice-II

Teaching Scheme

Practical: 2 Hrs/ week

Examination Scheme

Teamwork - 50 marks

Oral - 50 marks

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

CO 1: Perform and interpret the laboratory experiments such as Hydrometer Test, Consolidation Test, Swelling Pressure Test, Triaxial Test with Measurement of Pore Pressure

CO 2: Use a suitable computer software for analysis and design of geotechnical problems

Laboratory tests (Any three)

Hydrometer Analysis, Consolidation Test, Swelling Pressure Test, Triaxial Test with Measurement of Pore Pressure, Types of samplers.

2) Assignments **(Any Two)** on use of a suitable computer software for analysis and design of substructure, stability of slopes, Seepage Analysis, retaining structure.

References

OEC Solid Waste Management and Technologies

Teaching Scheme

Lectures: 3 Hrs/ week

Examination Scheme

T1 and T2 - 20 marks each

End Sem. Exam. - 60 marks

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

CO 1: Understand municipal solid waste management systems with respect to its physical properties, and associated critical considerations in view of emerging technologies

CO 2: Know sources, types and composition of solid waste with methods of handling, sampling and storage of solid waste.

CO 3: Select the appropriate method for solid waste collection, transportation, redistribution and disposal.

CO 4: Describe methods of disposal of hazardous solid waste.

Solid Waste analysis and characterization, Hazardous waste Characterization
Environmental legislation for solid and hazardous waste disposal and transport Risk
Assessment, Waste minimization and resource recovery, Waste stabilization
techniques, Chemical, physical and biological treatment Landfill design for Sanitary and
Hazardous Wastes, Incineration.

References

1. Tchobanoglous, G., Theisen, H., Vigil, S. A., & Alaniz, V. M. (1993). Integrated solid waste management: engineering principles and management issues (Vol. 4). McGraw-Hill New York.
 2. Henstock, M. E. (1983). Disposal and recovery of municipal solid waste.
 3. Ahsan, N. (1999). Solid waste management plan for Indian megacities. Indian Journal of Environmental Protection, 19, 90–95.
- Davis, M. L., & Masten, S. J. (2004). Principles of environmental engineering and science. McGraw-Hill New York

CGE(PE)-23006 Centrifuge Modeling

Teaching Scheme

Lectures: 3 Hrs/ week

Examination Scheme

T1 and T2 - 20 marks each
End Sem. Exam. - 60 marks

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

CO 1: Understand various types of modeling techniques such as physical and numerical, for solving the problems of geotechnical engineering.

CO 2: Understand the concept of centrifuge modeling.

CO 3: Understand the application of dimensional analysis in centrifuge modeling such as similarity laws and scale effects.

CO 4: Understand the utility of the centrifuge modeling techniques for solving geotechnical problems related to static, dynamic, seepage and consolidation cases.

Modeling, Physical and numerical modeling, Types of physical modeling: 1-g and N-g modeling, Concept of centrifuge modeling, Application of dimensional analysis in centrifuge modeling, similarity laws, scale effect, application of centrifuge modeling for static and dynamic geotechnical problems, seepage and consolidation problems, case studies

References

1. R. N. Taylor, "Geotechnical centrifuge technology" Blackie Academic and Professional-an imprint of Chapman and Hall, UK (1995)
2. Wood, D. M. (2014). Geotechnical modelling. CRC press.

CGE(PE)-23007 Critical State Soil Mechanics**Teaching Scheme****Lectures:** 3 Hrs/ week**Examination Scheme****T1 and T2 - 20 marks each****End Sem. Exam. - 60 marks****Course Outcomes:** At the end of the course, the students will be able to:**CO1:** Plot stress paths under various drainage conditions.**CO2:** Evaluate critical state soil parameters under various drainage conditions.**CO3:** Analyze and evaluate elastic and plastic properties of soils.**CO4:** Develop constitutive relationships for soils.**CO5:** Select and implement soil stabilization techniques based on field conditions.

Critical state soil mechanics: Critical State Line, Hvorslev Surface, Yield Surfaces: Modified Cam-clay and Original Cam-clay; Elastic and plastic analysis of soil:- Constitutive relationships of soil; failure theories. Limit analysis-Upper bound theorems, lower bound theorems, limit equilibrium methods.

References

1. Advanced soil mechanics- Braja M. Das, Tata Mc. - Grawhill.
2. Principles of Soil Mechanics, R F Scott, Addison & Wesley.
3. Fundamentals of Soil Behaviour, Mitchell, James K, John Wiley and Sons.
4. Elasticity and Geomechanics, R.O. Davis and A.P.S. Selvadurai, Cambridge University Press, New York.
5. Soil Behaviour and Critical State Soil Mechanics, D.M. Wood, University of Glasgow.
6. The Mechanics of Soil – J.H. Atkinson.
7. Critical State Soil Mechanics-A. Scdofield, P. Wroth.
8. Limit Analysis- W. F. Chen.
9. Applied Analysis in Geotechnics-Fethi Azizi.

CGE(PE)-23008 Geotechnical Exploration & Instrumentations**Teaching Scheme****Lectures:** 3 Hrs/ week**Examination Scheme****T1 and T2** - 20 marks each**End Sem. Exam.** - 60 marks**Course Outcomes:** At the end of the course, the students will be able to:**CO 1:** Know about the various subsoil exploration methods and its suitability for the specific site.**CO 2:** Evaluate subsoil properties for various civil engineering projects.**CO 3:** Know the principles and working of various instrumentations required for finding different geotechnical parameters.

Introduction: Data required for soil investigation, Methods of Exploration - Planning the Exploration Program, Sampling and Programme: Soil Boring, Soil Samplers and Sampling, Underwater Sampling Groundwater Table (GWT) Location, Number and Depth of Borings. Drilling and/or Exploration of Closed Landfills or Hazardous Waste Sites, Preparation of Soil Report, Penetration Tests: Standard Penetration Test - SPT Correlations, Design N Values – Cone Penetration Tests, Field Vane Shear Testing, Borehole Shear Test, Flat Dilatometer Test, Pressure meter Test, Rocks: Rock Sampling, RQD, Strength and modulus from classifications, Classification based on strength & modulus and strength and fracture strain, Geoengineering classification, Instrumentation - pore pressure measurement, earth pressure cell, settlement gauges. Inclometers, Stress measurements, Seismic measurements.

References

1. Bowles, J. E. - Foundation Analysis & Design 7th Edition McGraw-Hill Companies, Inc. (1996)
2. Das, B. M. - Principles of Foundation Engineering 9th Edition Nelson Engineering (2004)
3. Donald P Coduto – Foundation Design Principles and Practices, 3rd edition, Pearson, Indian edition, 2012.
4. Goodman – Introduction to Rock mechanics, Willey International (1980).
5. Geotechnical Investigation Methods: A Field Guide for Geotechnical Engineers. EHUNT, Taylor & Francis, .2006.
6. Handbook of Geotechnical Investigation and Design Tables, Routledge, (2007).

CGE(PE)-23009 Applications of Geosynthetics in Geotechnical Engineering**Teaching Scheme****Lectures:** 3 Hrs/ week**Examination Scheme****T1 and T2** - 20 marks each**End Sem. Exam.** - 60 marks**Course Outcomes:** At the end of the course, the students will be able to:**CO 1:** Student will be able to understand basic concepts of using geosynthetics for ground improvement and containment purpose.

Geosynthetics: types and functions, properties of geo-synthetics, materials and manufacturing processes, testing and evaluation, application of geotextiles and geogrids in roads, walls, and embankments. Application of geotextiles, geonets and geocomposites as drains and filters. Multiple functions: railways and overlay design. Geosynthetics in environmental control: covers and liners for landfills, material aspects and stability considerations, applications of geo-synthetics in bearing capacity improvement, slope stability, retaining walls, embankments on soft soil, and pavements, filtration, drainage and seepage control with geo-synthetics, geo-synthetics in landfills, soil nailing and other applications of geosynthetics.

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.

CGE(PE)-23010 Offshore Geotechnical Engineering

Teaching Scheme

Lectures: 3 Hrs/ week

Examination Scheme

T1 and T2 - 20 marks each

End Sem. Exam. - 60 marks

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

CO 1: Understand differences between the soil and loading conditions of on-shore and offshore structures.

CO 2: Know various types of offshore foundation systems.

CO 3: Evaluate the performance of offshore structures.

The nature of Submarine Soils: origin, classification and distribution of marine sediments; Offshore Geotechnical Investigations: Foundations for Offshore foundations types and design, seabed anchors, Offshore Pile Foundations, Seafloor Stability, slope stability under gravity forces and wave forces, Effects of soil instability on piles

References

1. Marine Geotechnics – H.G. Poulos (1988), Prentice Hall Inc.
2. Construction of marine and offshore structures – Ben C Gerwick, jr., CRC Press, Taylor and Francis Group. (2012).
3. Seabed Reconnaissance and Offshore Soil Mechanics (for the installation of petroleum structures) – Pierre LE Tirant (1979), Gulf Publishing Company, Houston, Texas.
4. API (2000) – Recommended Practice for Planning, Designing and Constructing Fixed Offshore Platforms – API, RP2A.
5. Pile design and construction practice – M J Tomlinson, View point Publications, Palladian Publications Limited. (1987).

CGE(PE)-23011 AI/ML Based Applications in Geotechnical Engineering**Teaching Scheme****Lectures:** 3 Hrs/ week**Examination Scheme****T1 and T2 - 20 marks each****End Sem. Exam. - 60 marks****Course Outcomes:** At the end of the course, the students will be able to:**CO 1:** Comprehend the basic principles of artificial intelligence (AI) and machine learning (ML) algorithms.**CO 2:** Understanding Data collection & management tools & techniques for AI/ML application to Civil Engineering.**CO 3:** Derive the need and benefits of using AI/ML algorithms for developing applications in Civil Engineering using big-data analysis.**CO 4:** Solve the real-life problems in Civil Engineering using real-time data collection and big-data analysis involving AI/ML tools.

Introduction to Machine Learning, Machine Learning Basics: Data Collection, Data Management, Big data, taxonomy of machine learning algorithms, Supervised Learning: Classification – Bayesian Classifier, K-nearest Neighbours, Regression- Linear Regression, Multivariate Regression, Logistic regression. Support Vector Machine (SVM) Algorithm. Unsupervised Learning: Clustering- K-means clustering algorithm and Hierarchical clustering algorithm. Reinforcement Learning: Q-Learning algorithm. Data Collection Apparatuses. Type of data sources, Types of data, Types of sensors, Edge-devices, Introduction to microcontrollers, data communication protocols, Cloud storage and cloud computing, Local server setup, Cloud server setup, Introduction to Python, Introduction to Django server, Database setup. Intelligent Transportation systems, smart mobility, shared mobility, Mobility as a Service (MaaS), Real-time data monitoring, soil settlement monitoring, Soil liquefaction, Forecasting foundation related parameters, Bearing Capacity

References

1. Machine Learning using Python, by Manaranjan Pradhan, U Dinesh Kumar, Wiley.
2. A Primer on Machine Learning Applications in Civil Engineering, by Deka P C, Taylor & Francis.
3. Structural Health Monitoring: A Machine Learning Perspective, by Charles R. Farrar, Keith Worden, Wiley.
4. Building Blocks for IoT Analytics, By John Soldatos, Athens Information Technology, Greece, River Publishers.
5. Django - The Easy Way (2nd Edition), By Samuli Natri.
6. The Django Book (Release 2.0), By Adrian Holovaty, Jacob Kaplan-Moss, et al., 2013.
7. Benjamin J. R., Cornell C. A., Probability Statistics and Decision for Civil Engineers, McGraw-Hill, 1970.
8. Simon P. Washington, Matthew G. Karlaftis, Fred, Mannering L., Statistical and econometric methods for transportation data analysis, CRC Press, Second Edition, 2010.

CGE(PE)-23012 Geotechnical Earthquake Engineering**Teaching Scheme****Lectures:** 3 Hrs/ week**Examination Scheme****T1 and T2** - 20 marks each**End Sem. Exam.** - 60 marks**Course Outcomes:** At the end of the course, the students will be able to:**CO 1:** Capable of understanding the strong ground motion characteristics and will be able to collect and analyze the pertaining data.**CO 2:** Obtain the response in terms of the requisite spectra by idealization of the system into elastic, inelastic, discrete or continuous system.**CO 3:** Identify the sites prone to liquefaction using various approaches.**CO 4:** Capable of understanding the behavior of geotechnical structures gravity dam and retaining wall subjected to earthquake

Earthquake occurrence in India, Seismic zoning map of India, strong motion measurements in earthquake engineering, Characterization of ground motion, Earthquake spectra for elastic and inelastic systems, Vibration of single, multiple DOF and continuous system, Liquefaction of sands due to earthquake., Behavior of retaining walls during earthquakes, Dynamic behavior of gravity dams/pile foundations, Review of damages during past earthquakes and remedial measures.

References

1. Wiegel R.L., "Earthquake Engineering", Prentice Hall, 2nd Ed, 1989.
2. Jai Krishna and A.R. Chandrasekaran, "Elements of Earthquake Engineering".
3. Arya, Shamsheer Prakash, Srivastava L.S., Brijesh Chandra, "Earthquake Engineering"
4. Kamlesh Kumar- "Basic Geotechnical Earthquake Engineering" New Edge Publication
5. Steven Kramer- "Geotechnical Earthquake Engineering", ISBN Publication, Low price edition.
6. Relevant Codes-IS 1893, IRC 6.
FHWA code guidelines for geotechnical structures.

CGE(PE)-23013 Software Applications in Geotechnical Engineering	
Teaching Scheme	Examination Scheme
Lectures: 3 Hrs/ week	T1 and T2 - 20 marks each
	End Sem. Exam. - 60 marks

Course Outcomes: At the end of the course, the students will be able to:
CO 1: Understand and adopt suitable constitutive model.
CO 2: Familiar with the use of different software for solving geotechnical problems.

Introduction to modeling, Constitutive models (elasticity, ideal plasticity, Mohr-Coulomb model, plasticity with hardening). FEM Analysis of simple Geotechnical Problems using PLAXIS Software. Theory and modeling of shallow foundations, deep foundations, retaining walls, reinforcement structures, embankments and cuttings, and underground structures. Different geotechnical engineering softwares viz. GEO5, GEOSLOPE, MIDAS etc.

References

1. Neural Networks, Fuzzy Logic and Genetic Algorithm - Synthesis and Applications- Rajasekaran S., Vijayalakshmi and Pai G.A, PHI Learning Private Limited.
2. Manuals of GEO5, PLAXIS, GEOSLOPE, MIDAS, Midas SOILWORKS.

CGE(PE)-23014 Geotechnical Engineering for Underground Structure**Teaching Scheme****Lectures:** 3 Hrs/ week**Examination Scheme****T1 and T2** - 20 marks each
End Sem. Exam. - 60 marks**Course Outcomes:** At the end of the course, the students will be able to:**CO 1:** Acquire knowledge in the design and construction of underground line structures in soil and rocks.

Underground structures - types, specific requirements for investigation, construction methods. Geotechnical survey and classification of rock mass for construction of underground structures, Geotechnical monitoring during excavations, technology of the construction of underground line structures in soil and rocks, principles of the maintenance, repair and reconstruction of underground structures.

References

1. Sinha, R. S. (2012). Underground structures: design and instrumentation. Elsevier.

CGE(PE)-23015 Forensic Geotechnical Engineering

Teaching Scheme

Lectures: 3 Hrs/ week

Examination Scheme

T1 and T2 - 20 marks each

End Sem. Exam. - 60 marks

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

CO 1: Deal with investigations of soil-interaction related failures of engineered facilities or structures.

CO 2: Analyze failures connected with geotechnical and geological origin to improve professional practice, codes of analysis and design as well as practice.

Introduction, Types of Damages, Preliminary Information, Accepting Assignment, Planning the Investigations, Site Investigations, Settlement of sub structures, Expansive soils, types of expansive soil movements, Foundation design for expansive soils, lateral movements of soils, Ground water moisture related problems of substructures, Repairs and crack diagnosis.

References

1. Forensic Geotechnical Engineering Developments in Geotechnical Engineering- V.V.S. Rao and G.L. Shivakumar Babu (eds) Springer India
2. Geomechanics of failures- A.M. Puzrin et al, Springer Science + Business Media B.V.2010.

CGE(PE)-23016 Geophysical Exploration Methods**Teaching Scheme****Lectures:** 3 Hrs/ week**Examination Scheme****T1 and T2** - 20 marks each
End Sem. Exam. - 60 marks**Course Outcomes:** At the end of the course, the students will be able to:**CO 1:** Measure the physical properties of the subsurface through these techniques

Applications of geophysical methods in Civil Engineering. Electrical resistivity method, Seismic reflection method, Geophysical logging and resistivity logging, Cross hole test, down hole test & up hole test, spectral analysis of surface waves, seismic cone penetration test.

References

1. Kearey, P., Brooks, M., & Hill, I. (2013). An introduction to geophysical exploration. John Wiley & Sons.

CGE(PE)-23017 Soft Computing Techniques

Teaching Scheme

Lectures: 3 Hrs/ week

Examination Scheme

T1 and T2 - 20 marks each

End Sem. Exam. - 60 marks

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

CO1: Appraise characteristics of real-world problem and select appropriate soft computing technique.

CO2: Solve the optimization problems using the genetic algorithm.

CO3: Identify vagueness in data and formulate appropriate fuzzy model.

CO4: Calibrate ANN model by adopting appropriate activation function, learning rule and training algorithm

GENETIC ALGORITHMS: Goals of optimization - Comparison with traditional methods - Schemata – Terminology in GA – Strings, Structure, Parameter string - Data Structures – Operators - Coding fitness function – Algorithm - Applications. FUZZY LOGIC: Concepts of uncertainty and imprecision – Sets - Concepts, properties and operations on Classical sets & Fuzzy Sets - Classical & Fuzzy Relations - Membership Functions – Fuzzy Logic – Fuzzification - Fuzzy Rule based Systems – Fuzzy propositions - Applications. ARTIFICIAL NEURAL NETWORKS: Basics of ANN; Models of a Neuron – Topology: Multi-Layer Feed Forward Network (MLFFN), Radial Basis Function Network (RBFN), Recurring Neural Network (RNN) – Learning Processes: Supervised and unsupervised learning. Error-correction learning, Hebbian learning; Single layer perceptrons - Multilayer perceptrons - Least mean square algorithm, Back propagation algorithm Applications. HYBRID SYSTEMS: Fuzzy neural systems – Genetic Fuzzy Systems – Genetic Neural Systems.

References

1. Timothy J. Ross, Fuzzy Logic with Engineering Applications, McGraw-Hill
2. Simon Haykin, Neural Networks, Prentice Hall
3. J.M. Zurada, Introduction to artificial neural systems., Jaico Publishers
4. H.J. Zimmermann, Fuzzy set theory and its applications., III Edition, Kluwer Academic Publishers, London.
5. Suran Goonatilake, Sukhdev Khebbal (Eds), Intelligent hybrid systems., John Wiley & Sons, New York, 1995.

LL Liberal Learning

Teaching Scheme

Lectures: 1 Hrs/week

Examination Scheme

T1 and T2 – 20 marks each
End Sem. Exam. – 60 marks

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

CO 1: Develop capacity to understand multidisciplinary sciences in a friendly manner.

CO 2: Create openness to diversity.

CO 3: Acquire ability to lead and examine life and value the need for life learning.

Student will be able to choose and enhance practical learning and application in the subject of his/her choice. One credit course spread over the semester to enhance practical learning and application.

- Agriculture
- Business
- Clay Art & Pottery
- Corporate Culture
- Defense
- French
- Geography
- Holistic Health
- Modern Film Making
- Music (Instrumental)
- Photography
- Political Science
- Music (Vocal)
- Wood and Metal Art
- Japanese
- Painting

MLC-23001 Research Methodology and Intellectual Property Rights	
Teaching Scheme Lectures: 2 Hrs/ week	Examination Scheme Continuous evaluation Assignments/Presentation/Quiz/Test

Course Outcomes: At the end of the course, the students will be able to:
CO 1: Understand research problem formulation and approaches of investigation of solutions for research problems
CO 2: Learn ethical practices to be followed in research and apply research methodology in case studies and acquire skills required for presentation of research outcomes
CO 3: Discover how IPR is regarded as a source of national wealth and mark of an economic leadership in context of global market scenario
CO 4: Summarize that it is an incentive for further research work and investment in R & D, leading to creation of new and better products and generation of economic and social benefits

Unit 1	
	Meaning of research problem, Sources of research problem, Criteria Characteristics of a good research problem, Errors in selecting a research problem, Scope and objectives of research problem. Approaches of investigation of solutions for research problem, data collection, analysis, interpretation, necessary instrumentations.
Unit 2	
	Effective literature studies approaches, analysis Use Design of Experiments /Taguchi Method to plan a set of experiments or simulations or build prototype Analyze your results and draw conclusions or Build Prototype, Test and Redesign
Unit 3	
	Plagiarism, Research ethics, Effective technical writing, how to write report, Paper. Developing a Research Proposal, Format of research proposal, a presentation and assessment by a review committee
Unit 4	
	Introduction to the concepts Property and Intellectual Property, Nature and Importance of Intellectual Property Rights, Objectives and Importance of understanding Intellectual Property Rights
Unit 5	
	Understanding the types of Intellectual Property Rights: -Patents-Indian Patent Office and its Administration, Administration of Patent System – Patenting under Indian Patent Act, Patent Rights and its Scope, Licensing and transfer of technology, Patent information and database. Provisional and Non Provisional Patent Application and Specification, Plant Patenting, Idea Patenting, Integrated Circuits, Industrial Designs, Trademarks (Registered and unregistered trademarks), Copyrights, Traditional Knowledge, Geographical Indications, Trade Secrets, Case Studies

Unit 6	
	New Developments in IPR, Process of Patenting and Development: technological research, innovation, patenting, development, International Scenario: WIPO, TRIPs, Patenting under PCT

References

1. Aswani Kumar Bansal: Law of Trademarks in India
2. B L Wadehra: Law Relating to Patents, Trademarks, Copyright, Designs and Geographical Indications.
3. G.V.G Krishnamurthy: The Law of Trademarks, Copyright, Patents and Design.
4. Satyawrat Ponkse: The Management of Intellectual Property.
5. S K Roy Chaudhary & H K Saharay : The Law of Trademarks, Copyright, Patents
6. Intellectual Property Rights under WTO by T. Ramappa, S. Chand.
7. Manual of Patent Office Practice and Procedure
8. WIPO: WIPO Guide To Using Patent Information
9. Resisting Intellectual Property by Halbert, Taylor & Francis
10. Industrial Design by Mayall, Mc Graw Hill
11. Product Design by Niebel, Mc Graw Hill
12. Introduction to Design by Asimov, Prentice Hall
13. Intellectual Property in New Technological Age by Robert P. Merges, Peter S. Menell, Mark A. Lemley

CGE-23008 Retaining Structures

Teaching Scheme

Lectures: 3 Hrs/ week

Examination Scheme

T1 and T2 - 20 marks each

End Sem. Exam. - 60 marks

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

CO 1: Design conventional/Reinforced earth retaining walls, sheet pile walls, bracing system for open excavations.

Earth Pressure Theories: Rankine's and Coulomb's Earth pressure theories for cohesive and cohesionless soils, stresses due to compaction and surcharge loads. Conventional Retaining Wall: Types of retaining walls, Stability (sliding, overturning, bearing capacity & overall) of gravity and cantilever walls, Proportioning of retaining walls, Backfill material and drainage. Flexible Walls: Sheet pile walls, Construction methods- Cantilever and Anchored (Free and Fixed support methods) sheet pile walls in coarse- and fine-grained soils, moment reduction method. Reinforced Soil Walls/Mechanically Stabilized Earth: - Failure mechanisms-bond and rupture failures, Analysis methods, Limit equilibrium method- Internal and external stability, Static analyses. Braced Cuts and Soil Nailing: Lateral earth pressure in braced cuts, Design of various components, Stability of braced cuts, base heave and stability, yielding and settlement of ground surrounding excavation, Diaphragm walls – slurry support; Soil Nailing.

References

1. Das, B. M. - Principles of Foundation Engineering 5th Edition Nelson Engineering (2004)
2. Bowles, J. E. - Foundation Analysis & Design 5th Edition McGraw-Hill Companies, Inc. (1996)
3. Rowe, R. K. - Geotechnical & Geoenvironmental Engineering Hand Book – Springer (2001)
4. Hans Friedrich Winterkorn, Hsai-Yang Fang - Foundation Engineering Handbook, Van Nostrand Reinhold, 1975.
5. Donald P Coduto – Foundation Design Principles and Practices, 2nd edition, Pearson, Indian edition, 2012.

CGE-23009 Soil Dynamics and Machine foundations

Teaching Scheme

Lectures: 3 Hrs/ week

Examination Scheme

T1 and T2 - 20 marks each

End Sem. Exam. - 60 marks

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

CO 1: Familiar with identification and solution of a particular dynamic system.

CO 2: Capable of analyzing dynamic behavior of soil through wave propagation theory and also be able to determine the dynamic soil properties.

CO 3: Analyze and carry out the design of machine foundation and will be able to provide appropriate vibration isolation technique if necessary.

CO 4: Obtain dynamic response of geotechnical structures such as retaining walls and shallow foundations.

Theory of vibration, Dynamics Systems, single degree and two degree of freedom system, Wave propagation theory and its application to dynamic problems, Measurement of dynamic soil properties- cyclic plate load, tri-axial tests and seismic refraction, Dynamic earth pressure measurement, displacement of retaining walls, Machine Foundation- Principle & Design of Machine foundation, methods of decreasing vibration in existing foundations.

Note: - In this course all relevant IS codes will be discussed

References

1. Vibration Analysis and Foundation Dynamics by N.S.V, Kameswara Rao, published by Wheeler publishing
2. Analysis and Design of Foundation for Vibration by P.J. Moore published by Oxford and IBH Publishing Company
3. Soil Dynamics and Machine Foundation by Swami Saran published by Galgotia Publication
4. Vibration of Soil and Foundation by F.E. Richart, J.R. Hall and R.D. Woods Published by Prentice-Hal Inc, New Jersey
5. IS: 5249-1969/1975 Method of test for Determination of In situ Dynamic Properties of soils
6. Design of Machine Foundation-Vaidyanathan

CGE-23010 Mini Project

Teaching Scheme

Lectures: 2 Hrs/ week

Examination Scheme

Mid Sem. Exam - 40 marks

End Sem. Exam. - 60 marks

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

CO 1: Identify a topic for study and carry out literature survey

CO 2: Write a technical report related to selected topic

CO 3: Present outcome of the study with the help of presentation

Course content

A mini project on Geotechnical Engineering is to be carried by group of students on the basis of field surveys and observations. The mini project site can be in cities/towns or rural areas.

Final project report is to be submitted & presented for examination after one mini project brief seminar.

Selection of Topic:

- Select a topic relevant to the stream of study with content suitable for M. Tech. level. For selection topics refer to internationally reputed journals and find the research gap/methodology that can be replicated as mini project. The primary reference should be published during the last two or three years.
- Some of the journals/publications suitable for reference are: ASCE/Springer/Science Direct journals in the areas of Transportation Engineering and any other related domain
- Get the topic approved by the mini project guide well in advance.

Preparation of Presentation and Report:

- In slides, list out key points only. You may include figures, charts, equations, tables etc., but not running paragraphs. The font size used should be at least 20.
- Figures should be very clear and possibly drawn by you using suitable software tools.
- A report on the project should be prepared which should contain the following.
 - Title of the mini project.
 - Name and other details of presenter and the guide.
 - Abstract of the topic.
 - Contents such as Introduction, Theory to elaborate the concept, Implementation if carried out by the presenter, Comparison with other relevant techniques, Conclusion, etc.
 - List of references strictly in ASCE format.

Oral Presentation:

- Student needs to orally present the topic for 15-20 minutes with good voice projection and with modest pace.

Answering Queries:

Student needs to answer queries raised by the audience and evaluators.

CGE-23011 FEM in Geomechanics

Teaching Scheme

Lectures: 3 Hrs/ week

Examination Scheme

T1 and T2 - 20 marks each

End Sem. Exam. - 60 marks

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

CO 1: Use of FEM for solving geotechnical problems.

CO 2: Adopt a suitable constitutive model.

CO 3: Apply this technique for the solution of stress-strain, seepage problems which are widely encountered in geotechnical engineering.

CO 4: Identify the proper technique for solution of the problem in field and then obtain the solution to the same.

Basic equation from solid mechanics, FEM procedure, Types of elements, Shape function, Element properties, Natural Coordinates, Isoperimetric element and Constitutive models for soils, Introduction to techniques for non-linear analysis, Application of FEM to problems such as seepage/consolidation/earth dams.

References

1. Finite Element Analysis in geotechnical engineering – Theory, David M. Potts and LidijaZdravkovic.
2. Finite Element Analysis in geotechnical engineering – Applications, David M. Potts and LidijaZdravkovic.
3. Finite Element in geotechnical engineering, Naylor, Pande and Simpson.
4. Introduction to FEM, A numerical method for Engineering analysis, Desai C.S. and Abel J.F., East West Edition, 1972.
5. Programming FEM with applications to Geomechanics, Smith I.M, John Wiley and son, 1982.
6. Basic principles of the finite element methods-K.M.Entwistle.
7. Finite Element Methods, Zienkiewicz O.C. and Taylor R.L., McGrawhill,1991.

CGE-23012 Geotechnical Laboratory Practice-III

Teaching Scheme

Practical: 4 Hrs/week

Examination Scheme

Teamwork: 50 Marks

Oral: 50 Marks

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

CO 1: Obtain the CBR value of the soils

CO 2: Obtain the shear strength parameters of the coarse-grained soil using large box direct shear test and drained shear strength parameters of the soil using triaxial test

CO 3: Carry out and interpret any three of the field tests such as Seismic refraction test, Electrical resistivity test, Standard penetration test (SPT) / Dynamic cone penetration test as per IS 4968 Part-I(DCPT), Static cone penetration test (SCPT) as per IS 4963 Part III, Plate bearing test, Pressure meter test

CO 4: Understand real life geotechnical problems with the help of site visits

- 1) The following Laboratory experiments shall be carried out
 - California Bearing Ratio test including swelling pressure
 - Large- Box Shear test
 - Triaxial Consolidated- Drained test
- 2) Any three of the following field tests may be carried out
 - Seismic refraction test
 - Electrical resistivity test
 - Standard penetration test (SPT) / Dynamic cone penetration test as per IS 4968 Part-I (DCPT)
 - Static cone penetration test (SCPT) as per IS 4963 Part III.
 - Plate bearing test
 - Pressure meter test
- 3) Report on the basis of the field visit,
- 4) Use of suitable computer software for analysis and design of substructure, stability of slopes, retaining structure or any other Geotechnical related problem.

References

1. SP 36 (Part-II): 1987 Compendium of Indian Standard on Soil Engineering: Part-I & II (Laboratory & Field) testing of soils Civil Engineering purposes.

Semester III

Dissertation I

Teaching Scheme:

Practical: 14Hrs/week

Examination Scheme:

Mid Sem. Presentation - 40 Marks

End Sem. Presentation - 60 Marks

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

CO 1: Learn to identify scope for conducting research.

CO 2: Learn application of research techniques acquired by them.

CO 3: Verify their planning proficiency acquired during the course of programme.

CO 4: Develop competency to work in professional fields

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

Dissertation-I will have mid semester presentation and end semester presentation.

Mid semester presentation should be done along with the report and will include any one of the following.

- i) Literature review on any topic associated with the syllabus done by referring to standard journals; papers published in various conferences, and by using the internet, web pages etc; presented in a standard format.
- ii) Extracts from various documented case studies associated with a particular area of construction and management; compiled and presented in a standard format.
- iii) Information of new lab/field testing/exploration methods, analytical tools viz. FEM, DEM, ANN, Commercial software.
- iv) Information of various professional practices adopted in the construction sector for foundation, ground improvement through field interaction.

End semester presentation should be done along with the report on identification of topic for the work and the methodology adopted. This will be continuation of the same topic as presented during mid-semester presentation.

Semester IV

Dissertation II

Teaching Scheme	Examination Scheme
Practical: 18Hrs/week	Mid-Sem presentation - 30 Marks Pre-submission - 30 Marks External Exam - 40 Marks

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

CO 1: Learn to initiative actions on their own and work independently.

CO 2: Learn application of knowledge acquired by them.

CO 3: Verify their planning proficiency acquired during the course of programme.

CO 4: Develop competency to work in professional fields.

Dissertation –II will be related to work on the topic identified in Dissertation – I. Dissertation-II will have mid semester presentation and pre-submission presentation at the end of the semester.

**CONTINUOUS ASSESSMENT OF DISSERTATION – I AND DISSERTATION – II
WILL BE MONITORED BY THE DEPARTMENTAL COMMITTEE.**