M.Tech CIVIL PROGRAMME
(Duration: TWO Years)
(Effective from year 2015-2016)
GEOTECHNICAL ENGINEERING

CORE COURSES: 18 Credits

Course	L:T:P	Course Title	Credits
GE-501	3:0:0	Soil Engineering I	03
GE-503	3:0:0	Earth Dam and Retaining Structures	03
GE-505	3:0:0	FEM in Geomechanics	03
GE502	3:0:0	Soil Engineering II	03
GE504	3:0:0	Analysis and Design of Foundations	03
GE506	3:0:0	Soil Dynamics	03

CORE ELECTIVES: Total 09 Credits

CE5308	3:0:0	Geotechnical Centrifuge Modeling	03
GE514	3:0:0	Ground Improvement	03
GE-513	3:0:0	Reinforced Earth and Geotextile	03
GE516	3:0:0	Rock Mechanics	03
GE-507	3:0:0	Geotechnical Aspects in Earthquake Engineering	03
GE		Machine Foundation	03

OPEN ELECTIVE COURSE: Total 03 Credits

CE5314	3:0:0	Soil Structure Interaction	03
CE5315	3:0:0	Environmental Geotechnology	03
CE5316	3:0:0	Pavement Analysis and Design	03

PSMC	**3-0-0 Computational methods in Engg.**	**03**

LIBERAL LEARING COURSE: Total 01 Credits

------	1:0:0	Constitution of India	01

MANDETORY LEARING COURSE : Total 00 credits

MLC1	**2:0:0**
MLC2	**2:0:0**
MLC3	**3:0:0**

LABORATORY COURSE : Total 08 Credits

GE-511 0:0:6 Aug. - Dec. Term (I) 04
GE 512 0:0:6 Jan.-April Term. (II) 04

PROJECT WORK: Total 32 Credits

Semester III: 14 Credits
GE601 0:0:14 **Dissertation I** 14

Semester IV : 18 Credits
GE602 0:0:18 **Dissertation II** 18

CREDIT SUMMERY

Semester	Course Type	Credits	Total Credits
I	**Open Elective Course (OEC)**	**03**	**19**
	Core Courses (CC)	**09**	
	Laboratory Course (LC)	**04**	
	Computational methods of Engg (PSMC)	**03**	
II	**Departmental Elective Courses (DEC)**	**06**	**20**
	Core Courses (CC)	**09**	
	Laboratory Course (LC)	**04**	
	LLC	**01**	
III	**Departmental Elective Course (DEC)**	**03**	**17**
	Project Work (PW)	**14**	
IV	**Project Work (PW)**	**18**	**18**
		TOTAL CREDITS	**74**

% Credit

Open Elective Courses - 4.05 %
Core Courses - 24.3 %
Departmental Elective Courses -12.15 %
Lab Courses -10.8 %
PSMC-4.05 %
Project Work- 43.2 %
LLC- 1.35 %

GEOTECHNICAL ENGINEERING

Computational Methods in Engineering

Teaching Scheme	Examination Scheme
Lectures : 3 hrs / week	Internal Test 1: 20 marks
	Internal Test 2: 20 marks
	End Sem. Exam: 60 marks

Objectives : The basic necessity for the foundation of Engineering & Technology being mathematics, the main aim is, to teach mathematical methodologies & models, develop mathematical skills & enhance thinking power of students. To give a very strong base of Mathematics to do quality research in Engineering is the main objective.

Unit I : Roots of Equations [6 Hrs]

Bracketing methods, open methods and case studies.

Unit II : Linear Algebraic Equations [8 Hrs]

Gauss Elimination, LU decomposition and matrix inversion, special matrices and Gauss-Seidel method, case studies.

Unit III : Numerical Differentiation and Integration [8 Hrs]

Newton-Cotes integration formulas, integration of equations, numerical differentiation, case studies.

Unit IV : Ordinary Differential Equations [9 Hrs]

Runge-Kutta methods, stiffness and multistep methods, boundary value and eigen value problems, case studies.

Unit V : Partial Differential Equations [9 Hrs]

Finite difference methods for elliptic and parabolic equations, case studies.

Text Book :

- Numerical Methods for Engineers by Steven C. Chapra, Raymond P. Canale, McGraw-Hill (special Indian edition), 5th edition 2010.

Reference Books :

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

Outcomes : Students will be able to

1. know and recall the core knowledge of the syllabus. (To measure this outcome, questions may be of the type- define, identify, state, match, list, name etc.)
2. understand the concept. (To measure this outcome, questions may be of the type- explain, describe, illustrate, evaluate, give examples, compute etc.)
3. analyze the problem and apply the appropriate concept. (To measure this outcome, questions will be based on applications of core concepts)
4. apply core concepts to new situations. (To measure this outcome, some questions will be based on self-study topics and also comprehension of unseen passages.)

5. give reasoning. (To measure this outcome, questions may be of the type-true/false with justification, theoretical fill in the blanks, theoretical problems, prove implications or corollaries of theorems, etc.)
6. organize and present thoughts. (To measure this outcome, questions mayasked to write summaries and short notes on a given topic.)

GE-501 Soil Engineering I

Teaching Scheme
Lectures: 3Hrs/week

Examination Scheme
100marks: Continuous evaluation-
Assignments/quiz-40 Marks,
End-sem Exam-60 Marks

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 coarsegrained 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.

Reference Books:

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

Course outcomes:

A. Students will able to judge physical, chemical and engineering properties of soils based on formation processes history, minerals and soil structure.
B. Students will able to collect undisturbed soil samples and plan lab tests for engineering characteristics of soil.

C. Students will able to conduct consolidation test and analyze the data.
D. Student will able to select and use state of the art instruments and data acquisition system.

GE-503 Earth Dam and Retaining Structures

Teaching Scheme	Examination Scheme
Lectures: 3Hrs/week	100marks: Continuous evaluation-Assignments/quiz-40 Marks, End-sem Exam-60 Marks

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 rolein stability analysis,methods of stability analysis, Instrumentation - pore pressure measurement, earth pressure cell, settlement gauges.

Types of Retaining structure and their Geotechnical Design

Reference books:

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

Course outcomes:

A. Students will be able to identify type of earthen dam.
B. Students will be able to identify different types of soil for construction of earthen dam.
C. Students will be capable of understanding stability analysis.
D. Students will be able to design earthen dam.
E. Students will be able to identify various forces acting on the retaining wall and design retaining wall and cofferdam

GE-505 Finite Element Methods in Geomechanics

Teaching Scheme
Lectures: 3Hrs/week

Examination Scheme
100marks: Continuous evaluation-
Assignments/quiz-40 Marks,
End-sem Exam-60 Marks

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

Reference:

1. Finite Element Analysis in geotechnical engineering – Theory, David M. Potts and Lidija Zdravkovic.
2. Finite Element Analysis in geotechnical engineering – Applications, David M. Potts and Lidija Zdravkovic.
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

Course Outcomes:

A. Students will be familiar with the use of FEM for solving geotechnical problems.
B. Students will be capable of adopting a suitable constitutive model.
C. Students will able to apply this technique for the solution of stress-strain, seepage problems which are widely encountered in geotechnical engineering.
D. Students will able to identify the proper technique for solution of the problem in field and then obtain the solution to the same.

GE-507 Geotechnical Earthquake Engineering

Teaching Scheme
Lectures: 3Hrs/week

Examination Scheme
100marks: Continuous evaluation-
Assignments/quiz-40 Marks,
End-sem Exam-60 Marks

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 retainingwalls during earthquakes, Dynamic behavior of gravity dams/pile foundations, Review of damages during past earthquakes and remedial measures.

Reference:

1. Wiegel R.L., " Earthquake Engineering", Prentice Hall, 2nd Ed, 1989.
2. Jai Krishna and A.R. Cahndrasekaran, "Elements of Earthquake Engineering".
3. Arya, Shamsher Prakash, Srivastava L.S., Brijesh Chandra, "Earthquake Engineering
4. Kamleshkumar- "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.
7. FHWA code guidelines for geotechnical structures.

Course outcomes:

A. Students will be capable of understanding the strong ground motion characteristics and will be able to collect and analyze the pertaining data.
B. Students will able to obtain the response in terms of the requisite spectra by idealization of the system into elastic, inelastic, discrete or continuous system.
C. Students will able to identify the sites prone to liquefaction using various approaches.
D. Students will be capable of understanding the behavior of geotechnical structures gravity dam and retaining wall subjected to earthquake.
E. Students will be capable to provide the suitable measures to minimize the ill effects likely to be caused by earthquake.

CE-5305 Soil Engineering II

Teaching Scheme
Lectures: 3Hrs/week

Examination Scheme
100marks: Continuous evaluation-
Assignments/quiz-40 Marks,
End-sem Exam-60 Marks

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.

Reference Books:

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

Course outcomes:

A. Students will able to plot stress paths under various drainage conditions.
B. Students will able to evaluate critical state soil parameters under various drainage conditions.
C. Students will able to analyze and evaluate elastic and plastic properties of soils.
D. Students will able to develop constitutive relationships for soils.
E. Students will able to select and implement soil stabilization techniques based on field conditions.

GE-504 Analysis and Design of Foundations

Teaching Scheme
Lectures: 3Hrs/week

Examination Scheme
100marks: Continuous evaluation-
Assignments/quiz-40 Marks,
End-sem Exam-60 Marks

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.

Reference Books:

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 Engineerimg, Shenbage 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

Course outcomes:

A. Students will be able to know various field test method and soil exploration methods.
B. Students will able to know various foundation instrumentation.
C. Students will be able to suggest various bearing capacity determination technique and settlement analysis and design shallow foundation.
D. Students will be able to design deep foundation
E. Students will be able to design shallow and deep foundation for inclined load and moment and uplift load.

CE-506 Soil Dynamics

Teaching Scheme
Lectures: 3Hrs/week

Examination Scheme
100marks: Continuous evaluation-
Assignments/quiz-40 Marks,
End-sem Exam-60 Marks

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,Design of shallow foundation, Machine Foundation- Principle of Machine foundation, methods of decreasing vibration in existing foundations.
Note: - In this course all relevant IS codes will be discussed

Reference:

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 Jersy
5. IS: 5249-1969/1975 Method of test for Determination of In situ Dynamic Properties of soils
6. Design of Machine Foundation-Vaidyanathan

Course outcomes:

A. Students will be familiar with identification and solution of a particular dynamic system.
B. Students will be capable of analyzing dynamic behavior of soil through wave propagation theory and also be able to determine the dynamic soil properties.
C. Students will able to analyze and carry out the design of machine foundation and will be able to provide appropriate vibration isolation technique if necessary.
D. Students will able to obtain dynamic response of geotechnical structures such as retaining walls and shallow foundations.

CE-5308 Geotechnical Centrifuge Modeling

Teaching Scheme
Lectures: 3Hrs/week

Examination Scheme
100marks: Continuous evaluation-
Assignments/quiz-40 Marks,
End-sem Exam-60 Marks

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

Reference:

R. N. Taylor, "Geotechnical centrifuge technology" Blackie Academic and Professional- an imprint of Chapman and Hall, UK (1995)

Course outcomes:

A. Students will be able to understand various types of modeling techniques such as physical and numerical, for solving the problems of geotechnical engineering.
B. Students will be able to understand the concept of centrifuge modeling.
C. Students will be able to understand the application of dimensional analysis in centrifuge modeling such as similarity laws and scale effects.
D. Students will be able to understand the utility of the centrifuge modeling techniques for solving geotechnical problems related to static, dynamic, seepage and consolidation cases.

GE-514 Ground Improvement

Teaching Scheme
Lectures: 3Hrs/week

Examination Scheme
100marks: Continuous evaluation-
Assignments/quiz-40 Marks,
End-sem Exam-60 Marks

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.

Reference books:

1. Ground Imrovement 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. Soil Stabilization-H.M.So
6. Foundation Engineering Manual-N.V.Nayak
7. Koerner, R. M.: Designing with Geosynthetics, Prentice Hall, NJ

Course Outcomes:

A. Students will be able to 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.

GE-513 Reinforced Earth Geotextiles

Teaching Scheme
Lectures: 3Hrs/week

Examination Scheme
100marks: Continuous evaluation-
Assignments/quiz-40 Marks,
End-sem Exam-60 Marks

History and development of earth reinforcement, Bar mesh and welded wire mesh as reinforcement, Natural fibers, Geosynthetics: Types and functions, materials, manufacturing methods, Reinforced soil walls and slopes, design of RS walls and RS slopes using BS and FHWA codes, Gabions

Properties, and application of Geotextiles, Geomembranes, Geogrids, Geosynthetic clay liners, Geocomposite, Design strength of geotextiles and Geogrids, testing on Geotextiles, and Geogrids.

Reference:

1. Swami Saran " Reinforced Soil & it's 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"

Course Outcomes:

A. Students will be able to understand various types of geosynthetic materials,there properties and applications
B. Students will be able to understand about the laboratory testing required for the assessment of the properties of the geosynthetic materials
C. Students will be able to design simple RE walls and RE slopes using BS and FHWA codes
D. Students will be able to design simple RE slopes using BS code

GE-516 Rock Mechanics

Teaching Scheme
Lectures: 3Hrs/week

Examination Scheme
100marks: Continuous evaluation-
Assignments/quiz-40 Marks,
End-sem Exam-60 Marks

General, classification of genesis, litho logical, 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.

Reference:

1. Fundamentals of Rock Mechanics, Jaeger, J.C., Cook, N.G.W., Zimmerman, R.W., 4th Edition, Blacmwell 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 Willey & Sons.
5. Rock Mechanics in Engineering Practice, Stag and Zienkiewez, John Willey & Sons
6. Engineering in Rocks, T. Ramamurthy, PHI Learning Pvt. Ltd.

Course outcomes :

A. Students will be able to independently suggest the best suitable method of rock exploration based on site visit.
B. Students will be able to suggest and provide best possible solution for rock stability.

CE-5314 Soil Structure Interaction

Teaching Scheme
Lectures: 3Hrs/week

Examination Scheme
100marks: Continuous evaluation-
Assignments/quiz-40 Marks,
End-sem Exam-60 Marks

Critical study of conventional methods of foundation design: nature and complexities of soil structure interaction: application of advanced techniques of analysis such as FEM and finite difference method, Relaxation and interaction for the evaluation of soil structure interaction for different types of structure under various conditions of loading and subsoil characteristics. Preparation of comprehensive design oriented computer programs for specific problems, Interaction problems based on theory of sub grade reaction such as beams, footings, rafts etc. + Analysis of different types of frame structure founded on stratified natural deposits with linear and non-linear stress-strain characteristics., Determination of pile capacities and negative skin friction, group of action of piles considering stress-strain characteristics of real soils., Anchor piles and determination of pullout resistance, well foundation

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 behavior of structures, Institution of Structural Engineers.
4. Elastic Analysis of Soil Foundation Interaction, Developments in Geotechnical Engg.vol-17, Elsevier Scientific Publishing Co.
5. Selvadurai A.P.S. "Elastic Analysis of Soil-Foundation Interaction", Elsevier Scientific Publishing Company.
6. Swami Saran " Analysis & Design of substructures", Oxford & IBH Publishing Co. Pvt. Ltd.
7. Kurian Nainan P. " Design of Foundation System- Principles & Practices", Narosa Publishing House.

Course outcomes:

A. Students will able to understand concept of nature and complexities of soil structure interaction.
B. Students will able to evaluate soil structure interaction for different types of structure under various conditions of loading and subsoil characteristics.
C. Students will able to prepare comprehensive design oriented computer programs for interaction problems based on theory of subgrade reaction such as beams, footings, rafts etc.

D. Students will able to analyze different types of frame structure founded on stratified natural deposits with linear and non-linear stress strain characteristics.
E. Students will able to evaluate group of action of piles considering stress-strain characteristics of real soils.

CE 5315 Environmental Geotechnology

Teaching Scheme
Lectures: 3Hrs/week

Examination Scheme
100marks: Continuous evaluation-
Assignments/quiz-40 Marks,
End-sem Exam-60 Marks

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.

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.
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

Course outcomes:

A. Students will be able to understand the need for the solid waste management
B. Students will be able to understand about the waste management and planning issues

C. Students will be able to understand how engineered landfills helps in management of solid waste
D. Students will be able to understand about the requirements of various components of engineered landfills and will be able to analyze the liner stability problems.

CE 5316 Pavement Analysis and Design

Teaching Scheme
Lectures: 3Hrs/week

Examination Scheme
100marks: Continuous evaluation-
Assignments/quiz-40 Marks,
End-sem Exam-60 Marks

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

Reference:

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
3. RILIM Conference Proceedings
4.IRC-37
5.FHWA for Pavement Design

Course outcomes:

A. Students will able to evaluate stresses and strains for various loading and environmental conditions for flexible and rigid pavements.
B. Students will able to design flexible and rigid pavements.
C. Students will able to analyze and evaluate pavement distresses and select best suited rehabilitation techniques.
D. Students will able to design reinforced flexible pavement

GE-511 Laboratory Practice- I

Teaching Scheme
Practical: 4 Hrs/week

Examination Scheme
Term-work: 50 Marks
Oral: 50 Marks

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)**
Seepage Analysis, Stability of Slopes, Filter Design, Clay Mineralogy, Soil Physics, Centrifuge Modeling

3) Report on the basis of field visit

4) Use of a suitable computer software for analysis and design of substructure , stability of slopes , retaining structure

Reference :

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

Course outcomes :

A. Students will be able to obtain the grain size distribution curve of the fine grained soils with the help of hydrometer test
B. Students will be able to obtain the consolidation parameters of the clayey soil and swelling pressure of the soil.
C. Students will be able to obtain undrained shear strength parameters of the soil using triaxial test
D. Students will be able to carry out additional geotechnical analysis such asseepage analysis, slopes stability problems etc. with and without help of softwares.

GE-512 Laboratory Practice-II

Teaching Scheme
Practical: 4 Hrs/week

Examination Scheme
Term-work: 50 Marks
Oral: 50 Marks

a) The following Laboratory experiments shall be carried out
- California Bearing Ratio test including swelling pressure
- Large- Box Shear test
- Triaxial Consolidated- Drained test

b) 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

c) Report on the basis of the field visit,

d) Use of suitable computer software for analysis and design of substructure, stability of slopes, retaining structure or any other Geotechnical related problem

Reference

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

Course outcomes:

A. Students will be able to obtain the CBR value of the soils
B. Students will be able to 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
C. Students will be able to 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
D. Student will be able to understand real life geotechnical problems with the help of site visits

GE 601 Dissertation I

Teaching Scheme
Practical: 14 Hrs/week

Examination Scheme
100marks: Continuous evaluation-
Mid-sem presentation-40 Marks,
End-sem Presentation-60 Marks

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.

Course outcomes:

A. Students will learn to indentify scope for conducting research.
B. Students will learn application of research techniques acquired by them.
C. Students will verify their planning proficiency acquired during the course of programme.
D. Students will develop competency to work in professional fields

GE 602 Dissertation II

Teaching Scheme
Practical: 18 Hrs/week

Examination Scheme
100marks: Continuous evaluation-
Mid-sem presentation-30 Marks,
Pre-submission-30 Marks
External Exam-40marks

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.

Course outcomes:

A. Students will learn to initiative actions on their own and work independently.
B. Students will learn application of knowledge acquired by them.
C. Students will verify their planning proficiency acquired during the course of programme.
D. Students will develop competency to work in professional fields.

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