Curriculum and Syllabus for M. Tech in Geotechnical Engineering

L-Lecture; T-Tutorial; P-Practical

1st Semester							
Course Code	Paper Code	Subject Name	Contact Hours / Week				Credit Points
			L	T	P	Total	
A: THEORY:							
PC	GTE 101	Advanced Mechanics of Soil and Rock	3	1	0	4	4
PC	GTE 102	Advanced Foundation Engineering-I	3	1	0	4	4
PE-1	GTE 103	A. Soil Structure Interaction B. Ground Improvement Techniques C. Transportation Geo Techniques	3	1	0	4	4
PE-2	GTE 104	A. Underground construction and Tunnelling B. Slope Stability and Earthen Dam C. Instrumentation in Geotechnical Engineering	3	1	0	4	4
IPR	GTE 105	Research Methodology and IPR	2	0	0	2	2
AUDIT1	GTE 106	English for Research Paper Writing	1	0	0	1	0
B: LABORATORY:							
Core Lab-I	GTE 191	Geotechnical Laboratory -I	0	0	2	2	2
Core Lab-II	GTE 192	Computer Application in Geotechnical Engineering - LAB	0	0	2	2	2
Total of Theory & Practical							22

2nd Semester							
Course Code	Subject Code	Subject Name	Contact Hours / Week				Credit Points
			L	T	P	Total	
A: THEORY:							
PC	GTE201	Advanced Foundation Engineering- II	3	1	0	4	4
PC	GTE202	Subsoil Investigation	3	1	0	4	4
PE-3	GTE203	A. Advanced Ground	3	1	0	4	4

		Improvement Techniques B. Retaining Structures and Coffer Dam C. Offshore Structures					
PE-4	GTE204	A. Soil Dynamics and Machine Foundation. B. Advanced Ground Water Hydrology. C. Geosynthetics Engineering	3	1	0	4	4
AUDIT2	GTE 205	Disaster Management	1	0	0	1	0
B: LABORATORY:							
Core Lab-III	GTE291	Geotechnical Lab- II	0	0	2	2	2
Core Lab-IV	GTE292	Field geotechnical Investigation & preparation of report	0	0	2	2	2
C: SESSIONAL							
PROJECT & SEMINAR	GTE281	Mini Project with Seminar	0	0	0	2	2
Total of Theory, Practical & Sessional							22

3rd Semester							
Course Code	Subject Code	Subject Name	Contact Hours / Week				Credit Points
			L	T	P	Total	
A: THEORY:							
PE	GTE301	A. Geotechnical Earthquake Engineering B. Remote Sensing and its application in Geo Technical Engineering C. Reinforced Earth	3	1	0	4	4
OE	GTE302	A. Industrial Safety B. Operations Research C. Cost Management of Engineering Projects D. Waste to Energy	3	1	0	4	4
C: SESSIONAL							
Thesis/ Dissertation	GTE381	Dissertation- Stage I	0	0	24	24	12
Total of Theory, Practical & Sessional							20

4th Semester							
Course Code	Subject Code	Subject Name	Contact Hours / Week				Credit Points
			L	T	P	Total	
C: SESSIONAL							
Thesis/ Dissertation	GTE481	Dissertation- Stage II - Final (Continued from Semester-3)	0	0	32	32	16
Thesis/ Dissertation	GTE482	Comprehensive Exam (Viva-Voce)	0	0	0	0	6
Total of Theory, Practical & Sessional							22

TOTAL CREDIT = 86

1st Semester							
Course Code	Paper Code	Subject Name	Contact Hours / Week				Credit Points
			L	T	P	Total	
A: THEORY:							
PC	GTE 101	Advanced Mechanics of Soil and Rock	3	1	0	4	4
PC	GTE 102	Advanced Foundation Engineering-I	3	1	0	4	4
PE-1	GTE 103	A. Soil Structure Interaction B. Ground Improvement Techniques C. Transportation Geo Techniques	3	1	0	4	4
PE-2	GTE 104	A. Underground construction and Tunnelling B. Slope Stability and Earthen Dam C. Instrumentation in Geotechnical Engineering	3	1	0	4	4
IPR	GTE 105	Research Methodology and IPR	2	0	0	2	2
AUDIT1	GTE 106	English for Research Paper Writing	1	0	0	1	0
B: LABORATORY:							
Core Lab-I	GTE 191	Geotechnical Laboratory -I	0	0	2	2	2
Core Lab-II	GTE 192	Computer Application in Geotechnical Engineering - LAB	0	0	2	2	2
Total of Theory & Practical							22

Syllabus-1st Semester

ADVANCED MECHANICS OF SOIL AND ROCK

(CODE: GTE 101)
L: 3 T: 1 P: 0
TOTAL CONTACT HOURS: 52
CREDIT:4

Course Outcomes: On completing the course students will be able to:

CO1- Select suitable soils for various geotechnical applications based on the factors governing the Engineering behaviour of soils.

CO2- Calculate the shear strength and compressibility parameters to design different structures for different conditions of loading, drainage and failure criteria.

CO3- Estimate the stresses in soil medium of any type due to foundation load, settlement of foundation and to evaluate bound and true collapse loads of soil structures.

Course Contents

One- and three-dimensional consolidation theories and applications, Immediate settlement, Methods of determination, Estimation of Pre-consolidation pressure, Secondary consolidation.

Shear strength parameters of cohesion less and saturated cohesive soils, Principles of Effective stress condition,

Effect of rate of stress on shear parameters, Stress- Strain relationship, Skempton's Pore pressure coefficients, Hvorslev's true shear parameters, Effect of over consolidation on shear parameters.

Stability analysis of slope -effective vs. total stress analysis, Stability Analysis of Slope: Effective and total stress approach, shape of slip surface, methods of slices, graphic methods, location of critical slip circle, wedge analysis method, stability during critical conditions.

Earth pressure – Rankine, Columb and Graphical Methods, Retaining walls structures, Gravity cantilever and counter fort retaining walls: Stability checks and design:

Sheet Pile Structures: Cantilever sheet piling, Anchored sheet piling: Free and fixed earth support methods of Analysis, Braced excavations.

Soil Anchors: Inclusions and Installation Techniques, Design of Soil Anchors, Application Criteria: Advantages and Limitations: Geological survey and exploration, Classification and characterisation of rock mass, in-situ determination of engineering properties of rock mass, in-situ stresses.

Text / Reference Books:

1. B M Das, *Advanced Soil Mechanics*, Taylor and Francis
2. R F Scott, *Principles of Soil Mechanics*, Addison & Wesley.
3. R.O. Davis and A.P.S. Selvadurai, *Elasticity and Geomechanics*, Cambridge University Press, New York.
4. Mitchell, James K, *Fundamentals of Soil Behaviour*, John Wiley and Sons
5. D.M. Wood, *Soil Behaviour and Critical State Soil Mechanics,* University of Glasgow

CO – PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	2	3	3	3	2	3
CO2	3	2	3	2	3	3
CO3	2	3	2	2	2	2

ADVANCED FOUNDATION ENGINEERING-I
(CODE: GTE 102)
L: 3 T: 1 P: 0
TOTAL CONTACT HOURS: 52
CREDIT:4

Course Outcomes:

CO1. To make students understand Allowable total and differential settlement of structures.

CO2. To provide brief explanation on Plate load test and penetration tests

CO3. To explain in detail of shallow foundations

Course Contents

Shallow Foundation: Terzaghi's bearing capacity equation, General bearing capacity equation, different bearing capacity theories, I.S. Code method, Effect of foundation shape, eccentricity and inclination of load, Influence of soil compressibility and water table, Footing pressure for settlement on sand, Soil pressure at a depth, Boussinesq's & Westergaard methods,

Raft Foundation: Settlement and Bearing Capacity analysis, Analysis of flexible and rigid raft as per IS 2950.

Computation of settlements (Immediate & Consolidation); Permissible settlements, Allowable total and differential settlement of structures.

Proportioning of footing, Inclined & Eccentric loads. Settlement of footings on stratified deposits. Influence of adjacent footings.

Bearing Capacity from SPT and SCPT and Plate load Test data, proportioning of footing based on settlement criteria.

Foundations on Problematic soils: Problems and Remedies.

Text / Reference Books:

1. B. M Das, Principles of Foundation Engineering, Thomson Brooks/Cole
2. J. E. Bowles, Foundation Analysis and Design, McGraw-Hill Book Company
3. N.P. Kurien, Design of Foundation Systems: Principles & Practices, Narosa, New Delhi 1992
4. H. F. Winterkorn and H Y Fang, Foundation Engineering Handbook, Galgotia Booksource

CO – PO Mapping:

COs	PO1	PO2	PO3	PO4	PO5	PO6
CO1	2	2	3	1	3	2
CO2	2	3	2	2	1	2
CO3	1	1	2	2	1	1

SOIL STRUCTURE INTERACTION
(CODE: GTE 103A)
L: 3 T: 1 P: 0
TOTAL CONTACT HOURS: 52
CREDIT:4

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

CO1-Identify situations where soil-structure interaction is likely to occur and assess its impact on the behaviour of a structure
CO2-Analyze finite and infinite length beams and plates on isotropic elastic medium
CO3-Analyze Axially and Laterally Loaded Piles and Pile Groups
CO4-Understand analysis and design of Beam on Elastic Foundation.
CO5-Evaluate sub grade reaction and elastic analysis.

Course Contents

General soil-structure interaction problems: Contact pressures and soil-structure interaction for shallow foundations, concept of sub grade modulus, effects/parameters influencing subgrade modulus. Soil behaviour, Foundation behaviour, Interface behaviour, Scope of soil foundation interaction analysis, soil response models, Winkler, Elastic continuum, Two parameter elastic models
Beam on Elastic Foundation: Soil Models: Infinite beam, Two parameters, Isotropic elastic half space, Analysis of beams of finite length, Classification of finite beams in relation to their stiffness.
Plate on Elastic Medium: Thin and thick plates, Analysis of finite plates, Numerical analysis of finite plates, simple solutions.
Elastic Analysis of Pile: Elastic analysis of single pile, Theoretical solutions for settlement and load distributions, Analysis of pile group, Interaction analysis, Load distribution in groups with rigid cap.
Laterally Loaded Pile: Load deflection prediction for laterally loaded piles, Sub-grade reaction and elastic analysis, Interaction analysis.

Text / Reference Books:

1) Selva durai, A. P. S, Elastic Analysis of Soil-Foundation Interaction , Elsevier,1979.
2) Poulos, H. G., and Davis, E. H.,Pile Foundation Analysis and Design, John Wiley,1980.
3) Scott, R. F., Foundation Analysis, Prentice Hall, 1981.
4) Structure Soil Interaction - State of Art Report, Institution of Structural Engineers, 1978.
5) ACI 336. (1988), Suggested Analysis and Design Procedures for combined footings and Mats, American Concrete Institute, 1988.

CO – PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	2	2	3	3	3	2
CO2	2	3	2	3	2	2
CO3	2	2	3	2	3	3
CO4	1	1	2	2	3	3
CO5	3	1	2	3	2	3

GROUND IMPROVEMENT TECHNIQUES
(CODE: GTE 103B)
L: 3 T: 1 P: 0
TOTAL CONTACT HOURS: 48
CREDIT:4

Course Outcomes:

CO1 : Understand the different ground improvement techniques.
CO2 : Understand the methods of stabilisation
CO3 : Understand the methods and properties of reinforced soil
CO4 : Understand the basic concepts of geosynthetics
CO5 : Understand the basic concept of consolidation of soil
CO6 : Understand the concept of shear strength in soil

Course Contents

Module 1: Introduction to Ground Improvement: Need of ground improvement, different methods of ground improvement.

Module 2: Mechanical Modification: General principles of compaction, quality control in field, dynamic compaction, impact loading, compaction by blasting, vibro-compaction, preloading methods, types of drains – design of vertical drains, construction techniques, stone column – design principles, construction techniques, settlement of stone column foundation.

Module 3: Chemical Modification: Lime stabilization, cement stabilization, fly-ash - lime stabilization, bitumen stabilization, modification by admixtures, stabilization using industrial wastes, grouting, types of grout, desirable characteristics, grouting pressure, grouting methods.

Module 4: Thermal Modification: Ground freezing and thawing.

Module 5: Soil Reinforcement: Reinforced earth, reinforcement-soil interaction, type of reinforcements, geosynthetics and their application, ground anchors, soil nailing.

Text / Reference Books:

1. R. M. Korner, *Design with Geosynthetics*, Prentice Hall, New Jersy, 3rd Edn. 2002
2. P. Purushothama Raj, *Ground Improvement Techniques*, Tata McGrawHill, New Delhi, 1995.
3. Dr. B.C.Chattopadhyay and J.Maity, *Ground Control and Improvement Techniques*, PEEDOT, Howrah, 2011.
4. G. V. Rao and G. V. S. Rao, *Text Book On Engineering with Geotextiles*, Tata McGraw Hill
5. T. S. Ingold and K. S. Miller, *Geotextile Hand Book*, Thomas Telfrod, London
6. N. V. Nayak, *Foundation Design Manual*, Dhanpat Rai and Sons, Delhi.
7. M.P.Moasley, *Ground Improvement Techniques*

CO – PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	3	1	2	3	2
CO2	3	3	1	2	3	2
CO3	3	3	2	2	3	3
CO4	3	3	1	3	1	2
CO5	3	3	1	1	2	1
CO6	3	2	3	1	2	2

TRANSPORTATION GEOTECHNIQUES
(CODE: GTE 103C)
L: 3 T: 1 P: 0
TOTAL CONTACT HOURS: 52

Course Outcomes: On completion of the course student will be able to
CO1 – Understand the philosophy of Geo-techniques of Road
CO2 – Analyze the design basis of Rigid and flexible pavement
CO 3 – Design the Pavement as per requirement and soil condition

Course Contents

Unit I: Philosophy of design of flexible and rigid pavements,
Unit II: analysis of pavements using different analytical methods,
Unit III: selection of pavement design input parameters – traffic loading and volume,
Unit IV: material characterization, drainage, failure criteria, reliability,
Unit V: design of flexible and rigid pavements using different methods,
Unit VI: comparison of different pavement design approaches, design of overlays and drainage system.

Text / Reference Books:

Yang and H. Huang, Pavement Analysis and Design, Pearson Prentice Hall, 2004.
Yoder and Witzech, Pavement Design, McGraw-Hill, 1982.
Sharma and Sharma, Principles and Practice of Highway Engg., Asia Publishing House, 1980.
Teng, Functional Designing of Pavements, McGraw- Hill, 1980.

CO – PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	2	3	2	2	2	2
CO2	3	-	3	-	2	3
CO3	2	3	-	3	-	2
CO4	1	1	2	1	3	1

UNDERGROUND CONSTRUCTION AND TUNELLING
(CODE: GTE 104A)
L: 3 T: 1 P: 0
TOTAL CONTACT HOURS: 48
CREDIT:4

Course Outcomes: On completion of the course student will be able to:
CO1 – Understand techniques and philosophy of underground structures
CO2 – Understand techniques and philosophy of tunnelling.
CO3 – Design underground structure and Tunnels
CO4 – Analyze the properties and effectiveness of Rocks

Course Contents

Braced excavation, types, earth pressure, effect of wall rigidity and sequence of construction, Design of wall and wall supports; tunnels and shafts, pressure distribution, design of tunnel lining, methods of tunnelling, ground loss.
Underground openings, structural geology in rock tunnelling, Rock slopes, Rock foundations; Bearing Capacity of Rocks; Drilling and blasting of rocks; Grouting; Instrumentation and measurements in tunnelling.

Text / Reference Books:

Sl No.	Name	Author
1	Testing of Concrete in Structure	Bungey (Surrey University Press)
2	Non Destructive Testing	Malhotra & Carino (CRC Press)
3	Corrosion of Steel in Concrete	Broomfield John P. (Taylor & Francis)

CO – PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	2	2	3	2	3	2
CO2	2	2	2	2	2	2
CO3	3	2	3	2	2	2
CO4	2	3	2	3	3	3
CO5	2	2	3	3	3	3

SLOPE STABILITY AND EARTHEN DAM
(CODE: GTE 104B)
L: 3 T: 1 P: 0
TOTAL CONTACT HOURS: 48
CREDIT:4

Course Outcomes: On completion students will be able to:

CO1- Recognize potential failure modes or deformation types for soil slopes and embankments
CO2- Determine the stability of a slope using slope stability software
CO3- Distinguish the common causes/triggering mechanisms for landslides/slope instabilities
CO4- Design proper slope and stable earthen structure as per requirement

Course Contents

Effective stress analysis; Stability of earth and rock fill dams; Steady state seepage and rapid draw down cases. Design of earth dams; Pore pressure during construction stage; Methods of seepage control in earth dams. Seismic analysis of embankment. Analysis of

reinforced slope.

Text / Reference Books:

1. L. W Abramson, T. S Lee, S Sharma and G M Boyce, Slope Stability and Stabilization Methods, Willey Interscience publications
2. B M Das, Principles of Geotechnical Engineering, Thomson Brooks/Cole
3. T W. Lambe and R V Whitman, Soil Mechanics, John Wiley & sons
4. V N S Murthy, Principles of Soil Mechanics and Foundation Engineering, UBS Publishers Private Ltd.

CO – PO Mapping:

COs	PO1	PO2	PO3	PO4	PO5	PO6
CO1	*1*	*3*	*2*	*3*	*1*	*3*
CO2	*1*	*2*	*2*	*2*	*3*	*2*
CO3	*2*	*2*	*3*	*2*	*2*	*2*
CO4	*2*	*1*	*1*	*2*	*2*	*1*

INSTRUMENTATION IN GEOTECHNICAL ENGINEERING
(CODE: GTE 104C)
L: 3 T: 1 P: 0
TOTAL CONTACT HOURS: 48
CREDIT:4

Course Outcomes: Students shall be able to:
CO1: understand instrumentation used in Geo Technical Engineering
CO2 – Apply knowledge of using instrumentation technique.
CO3 – Control various parameters by using the technique of Instrumentation
CO4 – Design proper system to meet the requirement

Course Contents

Types of field measurements; Principles of instrumentation; Settlement gauges, Piezometers, earth pressure cells and inclinometers; Planning of instrumentation; Vibration measurements.

Case histories; Building settlement; in-situ stresses in soils; Underground construction and tunnelling in soft ground; Dams and embankments; Failure investigations in Geo technical Engineering.

Text / Reference Books:

1. Geotechnical Instrumentation for Monitoring Field Performance; John Dunnicliff, Gordon E. Green; Wiley
2. A Guide to Field Instrumentation in Geotechnics: Principles, Installation and Reading; Richard Bassett; CRC Press
3. Geotechnical Instrumentation and Monitoring in Open Pit and Underground Mining; T.

Szwedzicki; CRC Press

CO – PO Mapping:

COs	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	2	-	2	3	-
CO2	2	3	2	3	-	2
CO3	-	2	3	3	2	2
CO4	3	-	2	-	2	3

RESEARCH METHODOLOGY AND IPR
(CODE: GTE 105)
L: 2 T: 0 P: 0
TOTAL CONTACT HOURS: 24
CREDIT:2

Course Outcomes: Students will be able to:

1. Understand research problem formulation.
2. Analyze research related information, Follow research ethics
3. Understand that today's world is controlled by Computer, Information Technology, but tomorrow world will be ruled by ideas, concept, and creativity.
4. Gather knowledge when IPR would take such important place in growth of individuals & nation, it is needless to emphasis the need of information about Intellectual Property Right to be promoted among students in general & engineering in particular.
5. Apply IPR protection provides an incentive to inventors for further research work and investment in R & D, which leads to creation of new and better products, and in turn brings about, economic growth and social benefits.

Course Contents

Module 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

Module 2: Effective literature studies approaches, analysis
Plagiarism, Research ethics

Module 3: Effective technical writing, how to write report, Paper Developing a Research Proposal, Format of research proposal, a presentation and assessment by a review committee

Module 4: Nature of Intellectual Property: Patents, Designs, Trade and Copyright. Process of Patenting and Development: technological research, innovation, patenting, development. International Scenario: International cooperation on Intellectual Property. Procedure for grants of patents, Patenting under PCT.

Module 5: Patent Rights: Scope of Patent Rights. Licensing and transfer of technology. Patent information and databases. Geographical Indications.

Module 6: New Developments in IPR: Administration of Patent System. New developments in IPR; IPR of Biological Systems, Computer Software etc. Traditional knowledge Case Studies, IPR and IITs.

Text / Reference Books:

Sl No.	Name	Author
1	Research methodology: an introduction for science & engineering students	Stuart Melville and Wayne Goddard
2	Research Methodology: An Introduction	Wayne Goddard and Stuart Melville
3	Research Methodology: A Step by Step Guide for beginners	Ranjit Kumar, 2nd edition
4	Resisting Intellectual Property	Halbert, Taylor & Francis Ltd ,2007.
5	Intellectual Property in New Technological Age	Robert P. Merges, Peter S. Menell, Mark A. Lemley
6	Intellectual Property Rights Under WTO	T. Ramappa, S Chand

CO – PO Mapping:

COs	PO1	PO2	PO3	PO4	PO5	PO6
CO1	2	2	3	2	3	2
CO2	1	3	2	3	3	3
CO3	2	2	3	3	3	3
CO4	3	2	2	2	2	2
CO5	2	3	3	3	3	3

ENGLISH FOR RESEARCH PAPER WRITING
(CODE: GTE 106)
L: 1 T: 0 P: 0
TOTAL CONTACT HOURS: 12
CREDIT: 0

Course Outcomes:

Students will be able to:

1. Understand that how to improve your writing skills and level of readability
2. Learn about what to write in each section
3. Understand the skills needed when writing a Title
Ensure the good quality of paper at very first-time submission
4. Gain knowledge about technical writing for research purposes

Course Contents

Module 1: Planning and Preparation, Word Order, Breaking up long sentences, Structuring Paragraphs and Sentences, Being Concise and Removing Redundancy, Avoiding Ambiguity and Vagueness

Module 2: Clarifying Who Did What, Highlighting Your Findings, Hedging and Criticising, Paraphrasing and Plagiarism, Sections of a Paper, Abstracts. Introduction

Module 3: Review of the Literature, Methods, Results, Discussion, Conclusions, The Final Check.

Module 4: key skills are needed when writing a Title, key skills are needed when writing an Abstract, key skills are needed when writing an Introduction, skills needed when writing a Review of the Literature,

Module 5: skills are needed when writing the Methods, skills needed when writing the Results, skills are needed when writing the Discussion, skills are needed when writing the Conclusions

Module 6: useful phrases, how to ensure paper is as good as it could possibly be the first- time Submission

Text / Reference Books:

Sl No.	Name	Author
1	Writing for Science, Yale University Press	Goldbort R (2006)
2	How to Write and Publish a Scientific Paper, Cambridge University Press	Day R (2006)
3	Handbook of Writing for the Mathematical Sciences, SIAM. Highman's book	Highman N (1998),
4	English for Writing Research Papers, Springer New York Dordrecht Heidelberg London, 2011	Adrian Wallwork

CO – PO Mapping:

COs	PO1	PO2	PO3	PO4	PO5	PO6
CO1	2	1	3	2	3	2
CO2	2	2	2	2	3	2
CO3	1	2	2	3	2	3
CO4	1	3	3	3	2	3

GEOTECHNICAL LAB- I
(CODE: GTE191)
L: 0 T: 0 P: 3
TOTAL CONTACT HOURS: 36
CREDIT:2

Course Outcomes: Students will be able to:

CO1- Evaluate various soil characteristics
CO2 - Measure shear strength of soil
CO3 – Apply knowledge of soil exploration
CO4 – Gather expertise in soil investigation work

Course Contents

1. Determination of In-situ density by core cutter method.
2. Determination of In-situ density by sand replacement method
3. Determination of undrained shear strength of soil by vane shear test
4. Determination of shear parameter of soil by Triaxial test
5. Determination of compressibility characteristics of soil by Oedometer test.
6. Determination of CBR of a soil specimen as per IS code recommendation

CO – PO Mapping:

COs	PO1	PO2	PO3	PO4	PO5	PO6
CO1	2	3	-	3	3	-
CO2	3	-	3	-	2	3
CO3	2	2	2	-	-	2
CO4	-2	1	1	3	3	3

COMPUTER APPLICATION IN GEOTECHNICAL ENGINEERING- LAB
(CODE: GTE192)
L: 0 T: 0 P: 3
TOTAL CONTACT HOURS: 36
CREDIT:2

Course Outcomes: Students will be able to:

CO1 Process and present the data appropriately using MS EXCEL or any other open source software.

CO2 Write programs using Python/ MATLAB and apply them for geotechnical engineering problems.

CO3 Use software R/ Minitab/ equivalent open source software for statistical analyses.

CO4 Work with finite element software (PLAXIS) and finite difference software (FLAC) and other software packages.

CO5 Analyse foundations, earth retaining structures, tunnels under different loading conditions using FEM packages.

CO6 Carry out slope stability analysis using FEM packages.

Course Contents

1. Data processing and graphical presentation using MS EXCEL or any other open source software.
2. Programming using Python/ MATLAB and their applications in geotechnical engineering.
3. Data analysis using statistical packages (Minitab, R or open source software) and their applications in geotechnical engineering.
4. Analysis and design of foundations, earth retaining structures, embankments and tunneling using standard geotechnical software packages (PLAXIS/ FLAC).
5. Slope stability analysis using GEOSLOPE or equivalent FEM software packages.

Liquefaction studies and ground response analysis.

CO – PO Mapping:

COs	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	2	1	3	3	3
CO2	3	3	2	3	3	1
CO3	3	2	2	3	3	2
CO4	3	2	2	3	3	3
CO5	3	3	2	3	3	-
CO6	3	3	3	3	3	1

2nd Semester							
Course Code	Subject Code	Subject Name	Contact Hours / Week				Credit Points
			L	T	P	Total	
A: THEORY:							
PC	GTE201	Advanced Foundation Engineering- II	3	1	0	4	4
PC	GTE202	Subsoil Investigation	3	1	0	4	4
PE-3	GTE203	A. Advanced Ground Improvement Techniques B. Retaining Structures and Coffer Dam C. Offshore Structures	3	1	0	4	4
PE-4	GTE204	A. Soil Dynamics and Machine Foundation. B. Advanced Ground Water Hydrology. C. Geosynthetics Engineering	3	1	0	4	4
AUDIT2	GTE205	Disaster Management	1	0	0	1	0
B: LABORATORY:							
Core Lab-III	GTE291	Geotechnical Lab- II	0	0	2	2	2
Core Lab-IV	GTE292	Field geotechnical Investigation & preparation of report	0	0	2	2	2
C: SESSIONAL							
PROJECT & SEMINAR	GTE281	Mini Project with Seminar	0	0	0	2	2
Total of Theory, Practical & Sessional							22

Syllabus-2nd Semester

ADVANCED FOUNDATION ENGINEERING- II
(CODE: GTE 201)
L: 3 T: 1 P: 0
CREDIT: 4

Course Outcomes:

CO1. To make students understand Allowable total and differential settlement of structures.

CO2. To provide brief explanation on Pile load test

CO3. To explain in detail of deep foundations

Course Contents

Deep Foundation: Modes of failure. Bearing capacity and settlement of pile foundation. Types of piles. Allowable load, Pile Load test. Dynamic and static formulae. Bearing Capacity factors. Pile group bearing capacity and settlement. Interference, Behavior of piles under lateral loading. Winkler's assumption. Pile resistance and deflection under lateral loads, elastic method, Broms method.

Well Foundation: Design and construction. Bearing capacity, settlement and lateral resistance. Tilts and shifts.

Drilled Shaft: Construction procedures, Design Considerations, Load Carrying Capacity and settlement analysis

Text / Reference Books:

1. B. M Das, *Principles of Foundation Engineering*, Thomson Brooks/Cole
2. J. E. Bowles, *Foundation Analysis and Design*, McGraw-Hill Book Company
3. H.G. Poulos, and E.H.Davis, Pile Foundation Analysis and Design, John Wiley and Sons, New York.
4. N.P. Kurien, *Design of Foundation Systems : Principles & Practices*, Narosa, New Delhi 1992
5. H. F. Winterkorn and H Y Fang, *Foundation Engineering Hand Book*, Galgotia Booksource

CO – PO Mapping:

COs	PO1	PO2	PO3	PO4	PO5	PO6
CO1	2	3	2	2	3	1
CO2	1	2	1	2	1	1
CO3	1	2	1	1	1	2

SUBSOIL INVESTIGATION
(CODE: GTE 202)
L: 3 T: 1 P: 0
CREDIT: 4

Course Outcomes:

CO1_To make students understand concepts of methods of boring, types of samples & sampling, field tests

CO2_ To provide brief explanation on pile load test

CO3_To explain in detail Advanced topics on in-situ soil testing

Course Contents

Module 1: Site Investigation: Planning of exploration, exploration for preliminary design, exploration for detailed design, geophysical explorations (sounding, probing, boring methods), excavation methods for explorations, ground water investigations, rock boring, miscellaneous exploratory techniques.

Module 2: Sampling and In-Situ Field Tests: Types of samples, samplers, preservation, shipment and storage of samples, bore log, pore pressure measurements, core recovery, rock strength, rock quality designation, in-situ field testing and laboratory investigation of soils and rock (including advanced equipment), instrumentation, data acquisition and measurement techniques, SPT, SCPT, DCPT, pressuremeter, dilatometer, permeability, plate load test, lateral pressure test.

Module 3: Data Interpretation: Data interpretation for determination of engineering properties of soils and their application to geotechnical design, preparation of site investigation reports.

Text / Reference Books:

1. Hausmann, M.R., Engineering Principles of Ground Modification, McGraw-Hill International Editions, 1990.
2. Yonekura, R., Terashi, M. and Shibazaki, M. (Eds.), Grouting and Deep Mixing, A.A. Balkema, 1966.
3. Moseley, M.P., Ground Improvement, Blackie Academic & Professional, 1993.
4. Xanthakos, P.P., Abramson, L.W. and Bruce, D.A., Ground Control and Improvement, John Wiley & Sons, 1994.
5. Koerner, R. M., Designing with Geosynthetics, Prentice Hall Inc. 1998.
6. Shukla, S.K., Yin, Jian-Hua, "Fundamentals of Geosynthetic Engineering", Taylor & Francis.

CO – PO Mapping:

COs	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	2	3	2	2	2
CO2	2	1	2	2	3	2
CO3	2	2	1	2	1	1

ADVANCED GROUND IMPROVEMENT TECHNIQUES
(CODE: GTE 203A)
L: 3 T: 1 P: 0
CREDIT: 4

Course Outcomes:

CO1: To understand the concept on different ground improvement technique depending on different soil types and properties.

CO2: Apply the knowledge determine the mechanics of quality control in field ground compaction

CO3: To analyse the design principal and load carrying capacity of vertical elementary structure and their characterisation

CO4: To identify different stabilization methods and mechanism at different circumstances

Course Contents

Introduction: Need of Ground Improvement: Different methods of Ground improvement, General Principal of Compaction: Mechanics, field procedure, quality control in field.

Ground Improvement in Granular Soil: In place densification by (i) Vibrofloatation (ii) Compaction pile (iii) Vibro Compaction Piles (iv) Dynamic Compaction (v) Blasting Ground Improvement in Cohesive Soil: Compressibility, vertical and radial consolidation, preloading methods.

Types of Drains, Design of vertical Drains, construction techniques. Stone Column: Function Design principles, load carrying capacity, construction techniques, settlement of stone column foundation.

Ground Improvement by Grouting and Soil Reinforcement: Grouting in soil, types of grout, desirable characteristics, grouting pressure, grouting methods. Soil Reinforcement: Mechanism, Types of reinforcing elements, reinforcement-soil interaction, Reinforcement of soil beneath the roads, foundation. Geosynthetics and their application.

Soil Stabilization: Lime stabilization-Base exchange mechanism, Pozzolanic reaction, lime soil interaction, line columns, Design of Foundation on lime columns. Cement stabilization: Mechanism, amount, age and curing. Fly-ash - Lime Stabilization, Soil Bitumen Stabilization.

Text / Reference Books:

1. R. M. Korner, Design with Geosynthetics, Prentice Hall, New Jersy, 3rd Edn. 2002
2. P. Purushothama Raj, Ground Improvement Techniques, Tata McGrawHill, New Delhi, 1995.
3. Dr. B.C.Chattopadhyay and J.Maity, Ground Control and Improvement Techniques, PEEDOT, Howrah, 2011.
4. V. Rao and G. V. S. Rao, Text Book On Engineering with Geotextiles, Tata McGraw Hill
5. T. S. Ingold and K. S. Miller, Geotextile Hand Book, Thomas Telfrod, London
6. N. V. Nayak, Foundation Design Manual, Dhanpat Rai and Sons, Delhi.
7. M.P.Moasley, Ground Improvement Techniques,

CO – PO Mapping:

COs	PO1	PO2	PO3	PO4	PO5	PO6
CO1	2	3	2	1	2	3
CO2	3	-	3	3	2	1
CO3	1	2	1	2	1	2
CO4	-	1	3	-	-	3

RETAINING STRUCTURES AND COFFER DAM
(CODE: GTE 203B)
L: 3 T: 1 P: 0
CREDIT: 4

Course Outcomes:

CO1: To understand lateral earth pressure theories and pressure theories and design of retaining walls.
CO2: To design anchored bulkheads by different methods.
CO3: To understand pressure envelops and design of various components in braced cuts and cofferdams.
CO4: To understand stability of earth dams and its protection and construction.

Course Contents

Earth pressure theories, conditions of applicability, arching effect; Retaining walls, different types and their stability, design considerations, drainage provisions; Cantilever sheet pile wall; Anchored bulk head, Free and fixed earth support methods, types of sheet piles and construction aspects; cellular coffer dams, design procedures, interlock, piling rise and overturning; Braced excavation, types, earth pressure, effect of wall rigidity and sequence of construction, Design of wall and wall supports; tunnels and shafts, pressure distribution, design of tunnel lining, methods of tunnelling, ground loss.

Text / Reference Books:

1. Basic & Applied soil mechanics – Gopal Ranjan & ASR Rao, New Age International Publishers, 2011.
2. Embankment Dams by Sharma Hd, Publisher: India Book House(IBH) Limited,1991
3. Engineering for Embankment Dams By B. Singh & R. S. Varshney, A A Balkema Publishers, 1995
4. Foundation design by W. C. Teng, Prentice Hall,1962
5. Analysis and design of foundations by Bowles. J. W McGraw Hill, 4th edition, 1955.
6. Earth and Rock-Fill Dams: General Design and Construction Considerations by United States Army Corps of Engineers, University Press of the Pacific,2004
7. Soil mechanics in engineering and practice by Karl Terzaghi, Ralph B. Peck, Gholamreza Mesri, 3rd Edition. Wiley India Pvt Ltd, 2010.

CO – PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	2	3	2	1	2	3
CO2	3	-	3	3	2	1
CO3	1	2	1	2	1	2
CO4	-	1	3	-	-	3

OFFSHORE STRUCTURES
(CODE: GTE 203C)
L: 3 T: 1 P: 0
TOTAL CONTACT HOURS: 48
CREDIT: 4

Course Outcomes:

CO1: To develop the knowledge and skills to carry out basic tasks regarding structural design and dimensioning of marine structures.

CO2: To understand the layout of marine structures from functional and safety requirements.

CO3: To perform fundamental stability checks of various floating and bottom supported offshore structures.

Course Contents

Module 1

Types of offshore structures and conceptual development - Analytical models for jacket structures - Materials and their behaviour under static and dynamic loads - Statutory regulations - Allowable stresses - Various design methods and Code Provisions - Design specification of API, DNV, Lloyd's and other classification societies - Construction of jacket and gravity platforms

Module 2

Operational loads - Environmental loads due to wind, wave, current and buoyancy - Morison's Equation - Maximum wave force on offshore structure - Concept of Return waves - Principles of Static and dynamic analyses of fixed platforms - Use of approximate methods - Design of structural elements.

Module 3

Introduction to tubular joints - Possible modes of failure - Eccentric connections and offset connections - Cylindrical and rectangular structural members – In plane and multi plane connections - Parameters of in-plane tubular joints - Kuang's formulae - Elastic stress distribution - Punching shear Stress - Overlapping braces - Stress concentration - Chord collapse and ring stiffener spacing - Stiffened tubes - External hydrostatic pressure - Fatigue of tubular joints - Fatigue behaviour - S-N curves - Palmgren-Miner cumulative damage rule - Design of tubular joints as per API Code

Module 4

Corrosion - Corrosion mechanism - Types of corrosion - Offshore structure corrosion zones – Biological corrosion - Preventive measures of Corrosion - Principles of cathode protection systems - Sacrificial anode method and impressed current method – Online corrosion monitoring - Corrosion fatigue

Text / Reference Books:

1. Dawson, T. H., Offshore Structural Engineering, Prentice Hall, 1983.
2. API RP 2A., Planning, Designing and Constructing Fixed Offshore Platforms, API.
3. McClelland, B & Reifel, M. D., Planning & Design of fixed Offshore Platforms, Van Nostrand, 1986.
4. Graff, W. J., Introduction to Offshore Structures, Gulf Publ. Co.1981.
5. Reddy, D. V & Arockiasamy, M., Offshore Structures Vol.1 & 2, Kreiger Publ. Co.1991.
6. Morgan, N., Marine Technology Reference Book, Butterworths, 1990.
7. B.C Gerwick, Jr. Construction of Marine and Offshore Structures, CRC Press, Florida, 2000.

CO – PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	2	2	3	3	2	2
CO2	1	3	2	2	3	3
CO3	1	2	2	3	3	3

SOIL DYNAMICS AND MACHINE FOUNDATION
(CODE: GTE 204A)
L: 3 T: 1 P: 0
TOTAL CONTACT HOURS: 48
CREDIT: 4

Course Outcomes:

CO1 : Understand the dynamic behaviour of foundations.
CO2 : Design foundations and isolation systems subjected to different kinds of vibrations.
CO3 : Determine dynamic properties of soils by using laboratory and non-destructive field tests.
CO4 : Design machine foundations.
CO5 : Assess the liquefaction potential of a given site.

Course Contents

Strength and deformation of soil under dynamic loads; Determination of dynamic coefficients, shear modulus and elastic constants of soil; Transient/shock loading on cohesionless soil; Damping in soil – geometrical and internal damping; Elastic wave propagation theory.
Vibration theory related to machine foundations; design of foundation for reciprocating and rotary machines, foundation for impact type loading; vibration isolation technique. Dynamic analysis of Pile Foundation. Dynamic Analysis of T.G. Foundation.

Text / Reference Books:

Sl no	Name	Author	Publishers
1	Foundation Analysis & Design	J.E. Bowels	McGraw Hill
2	Principles of Foundation Engineering	B.M. Das	Thomson Book
3	Foundation Design Manual	N. V. Nayak	Dhanpat Rai Publication Pvt. Ltd
4	Foundations for Machines: Analysis and design	ShamsherPrakash, Vijay K Puri	Wiley Series in Geotechnical Engineering
5	Advance Foundation Engineering	N. Som& S. C. Das	
6	Hand Book of Machine Foundation	P. Sirinivashalu& C.V.Vaiddyanathan	Tata McGraw Hill

CO – PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	3	2	2	2	1
CO2	3	3	1	2	2	3
CO3	3	3	2	2	3	3
CO4	3	3	1	3	1	2
CO5	3	3	1	1	2	1

ADVANCED GROUND WATER HYDROLOGY
(CODE: GTE 204B)
L: 3 T: 1 P: 0
CREDIT: 4

Course Outcomes:

CO1-To make students understand concepts of Soil Water
CO2-To provide brief explanation on groundwater identification techniques
CO3-To explain in detail Ground water Hydraulics

Course Contents

Introduction: Role of groundwater in the hydrologic cycle, problems and perspectives. Occurrence and movement of groundwater, hydrogeology of aquifers, Darcy's law, general flow equations. Groundwater and Well Hydraulics: steady and unsteady radial flows in aquifers, partially penetrating wells, characteristic well losses, specific capacity. Surface and Subsurface investigations of Groundwater: Geologic methods, remote sensing, geophysical exploration, electrical resistivity and seismic refraction, logging techniques. Water wells: methods of construction, yield tests, protection and rehabilitation of wells. Management of Groundwater: concepts of basin management, conjunctive use, mathematical modelling, artificial groundwater recharge: concepts, recharge methods, recharge mounds, induced recharge. Saline water intrusion in aquifers

Text / Reference Books:

1. Todd D.K., Mays L.W, Groundwater Hydrology, Wiley, (2004).
2. Raghunath H.M., Ground Water , New Age International Publishers, (2007).
3. Schwarz F., Zhang H., Fundamentals of Ground Water, Wiley, (2002).
4. Fitts C., Groundwater Science, Academic Press, (2012).
5. Bear J., Hydraulics of Groundwater, Dover Publications, (2007).

CO – PO Mapping:

COs	PO1	PO2	PO3	PO4	PO5	PO6
CO1	2	3	2	1	2	3
CO2	3	-	3	3	2	1
CO3	1	2	1	2	1	2
CO4	-	1	3	-	-	3

GEOSYNTHETICS ENGINEERING
(CODE: GTE 204C)
L: 3 T: 1 P: 0
CREDIT: 4

Course Outcomes:

On completing the course, students will be able to

CO1 Select different geosynthetics for intended purpose.

CO2 Evaluate properties of geosynthetics.

CO3 Design with geosynthetics for intended purpose.

CO4 Apply geocomposite systems to solve contemporary geotechnical problems.

Course Contents

Module 1: Introduction: An overview on the development and applications various geosynthetics – the geotextiles, geogrids, geonets, geomembranes and geocomposites.

Module 2: Designing with geotextiles: Geotextile properties and test methods, functions, designing for separation, reinforcement, stabilization, filtration, drainage.

Module 3: Designing with geogrids: Geogrid properties and test methods – physical properties, mechanical properties, endurance properties and environmental properties, designing for grid reinforcement and bearing capacity.

Module 4: Designing with geonets: Geonet properties and test methods – physical properties, mechanical properties, hydraulic properties, endurance properties and environmental properties, designing geonet for drainage.

Module 5: Designing with geomembranes: Geomembrane properties and test methods – physical properties, mechanical properties, chemical properties and biological hazard, applications for geomembranes.

Module 6: Designing with geocomposites: Geocomposites in separation, reinforcement, reinforced geotextile composites, reinforced geomembrane composites, reinforced soil composites using discontinuous fibres and meshes, continuous fibres and three – dimensional cells, geocomposites in drainage and filtration.

Text / Reference Books:

1. G. L. Sivakumar Babu, “An Introduction to Soil Reinforcement and Geosynthetics”, University Press.
2. R. M. Koerner, “Designing with geosynthetics”, Pearson Education Inc.
3. S. K. Shukla & Jian-Hua Yin, “Fundamentals of Geosynthetic Engineering”, Taylor & Francis.

CO – PO Mapping:

COs	PO1	PO2	PO3	PO4	PO5	PO6
CO1	2	1	3	2	3	2
CO2	2	2	2	2	3	3
CO3	3	1	3	3	2	3
CO4	2	3	3	3	3	2

DISASTER MANAGEMENT
(CODE: GTE 205)
L: 1 T: 0 P: 0
CREDIT: 0

Course Outcomes:

Students will be able to:

1. learn to demonstrate a critical understanding of key concepts in disaster risk reduction and humanitarian response.
2. critically evaluate disaster risk reduction and humanitarian response policy and practice from multiple perspectives.
3. develop an understanding of standards of humanitarian response and practical relevance in specific types of disasters and conflict situations.
4. critically understand the strengths and weaknesses of disaster management approaches, planning and programming in different countries, particularly their home country or the countries they work in.

Course Contents

Module 1: Introduction Disaster: Definition, Factors And Significance; Difference Between Hazard And Disaster; Natural And Manmade Disasters: Difference, Nature, Types And Magnitude.

Module 2: Repercussions Of Disasters And Hazards: Economic Damage, Loss Of Human And Animal Life, Destruction Of Ecosystem.
Natural Disasters: Earthquakes, Volcanisms, Cyclones, Tsunamis, Floods, Droughts And Famines, Landslides and Avalanches, Man-made disaster: Nuclear Reactor Meltdown, Industrial Accidents, Oil Slicks and Spills, Outbreaks Of Disease And Epidemics, War and Conflicts.

Module 3: Disaster Prone Areas In India Study Of Seismic Zones; Areas Prone To Floods And Droughts, Landslides And Avalanches; Areas Prone To Cyclonic And Coastal Hazards With Special Reference to Tsunami; Post-Disaster Diseases And Epidemics

Module 4: Disaster Preparedness and Management
Preparedness: Monitoring of Phenomena Triggering a Disaster or Hazard;
Evaluation of Risk: Application Of Remote Sensing, Data From Meteorological And Other Agencies, Media Reports: Governmental And Community Preparedness.

Module 5: Risk Assessment
Disaster Risk: Concept and Elements, Disaster Risk Reduction, Global and National Disaster Risk Situation. Techniques of Risk Assessment, Global Co-Operation In Risk Assessment and Warning, People's Participation in Risk Assessment. Strategies for Survival.

Module 6: Disaster Mitigation
Meaning, Concept and Strategies of Disaster Mitigation, Emerging Trends In Mitigation. Structural Mitigation and Non-Structural Mitigation, Programs Of Disaster Mitigation In India.

Text / Reference Books:

Sl No.	Name	Author
1	Disaster Management in India: Perspectives, issues and strategies	R. Nishith, Singh AK, New Royal book Company
2	Disaster Mitigation Experiences And	Sahni, Pardeep Et.Al. (Eds.),

	Reflections	Prentice Hall Of India, New Delhi.
3	Goel S. L. , Disaster Administration And Management Text And Case Studies	Deep &Deep Publication Pvt. Ltd., New Delhi.

CO – PO Mapping:

COs	PO1	PO2	PO3	PO4	PO5	PO6
CO1	2	2	3	3	2	2
CO2	1	3	2	2	3	3
CO3	1	2	2	3	3	3
CO4	2	2	2	3	2	3

GEOTECHNICAL LAB- II
(CODE: GTE291)
L: 0 T: 0 P: 3
TOTAL CONTACT HOURS: 36
CREDIT:2

Course Outcomes:

CO1_Ability to evaluate various soil characteristics
CO2_Ability to measure shear strength of soil

Course Contents

1. Determination of Relative density
2. Determination of Different Geotextile Properties
(a) Thickness test
(b) Sieve test
(c) Tensile strength test
(d) Tear resistance test
(e) Puncture test
(f) Cone drop test

CO – PO Mapping:

COs	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	2	-	2	3	2
CO2	3	1	-	1	3	2

FIELD GEOTECHNICAL INVESTIGATION & PREPARATION OF REPORT
(CODE: GTE292)
L: 0 T: 0 P: 3
TOTAL CONTACT HOURS: 36
CREDIT:2

Course Outcomes:

CO1: To enable students to design various geotechnical structures such as Slopes, embankments, retaining walls and foundation subjected to dynamic loading

CO2: To analysis and design slopes, embankments, retaining walls
CO3: To calculate bearing capacity of soil used in dynamic analysis for foundation

Course Contents

1. Site exploration by Auger Boring
2. Bored pile installation in field
3. Plate load test
4. Standard penetration test
5. Static Cone penetration test
6. Dynamic Cone penetration test
7. Preparation of soil test reports with foundation design

CO – PO Mapping:

COs	PO1	PO2	PO3	PO4	PO5	PO6
CO1	2	3	2	3	1	2
CO2	3	3	3	-	3	1
CO3	2	1	-	2	2	3

MINI PROJECT WITH SEMINAR
(CODE: GTE281)
L: 0 T: 0 P: 2
TOTAL CONTACT HOURS: 24
CREDIT: 2

Course Outcomes:
At the end of the course:
1. Students will get an opportunity to work in actual industrial environment if they opt for Internship.
2. In case of mini project, they will solve live problem using software /analytical / computational tools.
3. Students will learn to write technical reports.
4. Students will develop skills to present and defend their work in front of technically qualified audience.

Course Contents

Students can take up small problems in the field of geotechnical engineering as mini project. It can be related to solution to an engineering problem, verification and analysis of experimental data available, conducting experiments on various engineering subjects, material characterization, studying a software tool for the solution of an engineering problem etc.

CO – PO Mapping:

COs	PO1	PO2	PO3	PO4	PO5	PO6
CO1	2	1	3	2	3	2
CO2	2	2	2	2	3	3
CO3	3	1	3	3	2	3
CO4	2	3	3	3	3	2

3rd Semester							
Course Code	Subject Code	Subject Name	Contact Hours / Week				Credit Points
			L	T	P	Total	
A: THEORY:							
PE	GTE301	A. Geotechnical Earthquake Engineering B. Remote Sensing and its application in Geo Technical Engineering C. Reinforced Earth	3	1	0	4	4
OE	GTE302	A. Industrial Safety B. Operations Research C. Cost Management of Engineering Projects D. Waste to Energy	3	1	0	4	4
C: SESSIONAL							
Thesis/ Dissertation	GTE381	Dissertation- Stage I	0	0	24	24	12
Total of Theory, Practical & Sessional							20

Syllabus-3rd Semester

GEOTECHNICAL EARTHQUAKE ENGINEERING
(CODE: GTE 301A)
L: 3 T: 1 P: 0
TOTAL CONTACT HOURS: 52
CREDIT: 4

Course Outcomes:

CO1_Ability to characterize various ground motions
CO2_Ability to study seismograph data and analysis
CO3_Ability to analyse and design of earthquake resistance buildings
CO4_Ability for reinforcement detailing of RC members and joints based on code provisions

Course Contents

Introduction, Seismology and earthquakes, continental drift and plate tectonics, elastic Rebound theory, location and size of earthquakes.
Strong Ground Motion -Strong motion measurement, ground motion parameters & their estimation.
Seismic Hazard Analysis - Deterministic and Probabilistic.
Wave Propagation - Waves in a Semi- infinite body, layered body. Attenuation of stress waves.
Ground Response Analysis - one-, two- and three-dimensional ground response analysis.
Liquefaction - various phenomena, evaluation of liquefaction hazards, liquefaction susceptibility initiations and effect of liquefaction.
Seismic Slop Stability.
Seismic Design of Retaining Walls.
Soil Improvement for remediation of Seismic hazards.

Text / Reference Books:

1. S.L. Kramer, Geotechnical Earthquake Engineering, Pentice Hall, international series, Pearson Education
(Singapore) Pvt. Ltd., 2004.
2. S.Saran, Soil Dynamics and Machine Foundation, Galgotia publications Pvt. Ltd., New Delhi 1999.
3. Ansal, Recent Advances in Earthquake Geotechnical Engineering and Microzonation, Springer, 2006.
4. Towhata, Geotechnical Earthquake Engineering, Springer , 2008.

CO – PO Mapping:

COs	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	3	2	1	2	-
CO2	1	-	3	-	1	3
CO3	2	3	-	3	3	1
CO4	3	1	2	3	2	2

REMOTE SENSING AND ITS APPLICATION IN GEO TECHNICAL ENGINEERING
(CODE: GTE 301B)
L: 3 T: 1 P: 0
TOTAL CONTACT HOURS: 52
CREDIT: 4

Course Outcomes:

CO1: To provide exposure to students in gaining knowledge on concepts and applications leading to modeling of earth resources management using Remote Sensing
CO2: To acquire skills in storing, managing digital data for planning and development
CO3: To acquire skills in advance techniques and fully equipped with concepts, methodologies and applications of Remote Sensing Technology.
CO4: Acquire skills in handling instruments, tools, techniques and modeling while using Remote Sensing Technology

Course Contents

Definitions and introduction to remote sensing, components of remote sensing system. Spectral windows and spectral signatures and their significance in remote sensing. Radiometric quantities used in the collection of spectral signatures.
Remote sensing satellite orbits, image acquisition process, repeativity, row/path and ground swath and coverage. Various remote sensing platforms. Passive and active remote sensors: Radar, Lidar and SAR. Spectral and spatial resolution of various remote sensors with special relevance to Indian Remote Sensing satellites. Different types of remotely sensed data products.
Characteristics of photographic images, colour, tone and texture, photo-interpretation keys, techniques of photo interpretation.
Digital image classification techniques and extraction of thematic information.
Global Positioning System (GPS): Introduction & components of GPS, Space segment, control segment and user segment,
Elements of Satellite based surveys –Map datum's, GPS receivers, GPS observation methods and their advantages over conventional methods.
Geographic Information System (GIS) – Definition of GIS, Geographical concepts and terminology, Components of GIS,
Data acquisition, Raster and vector formats, scanners and digitizers. Advantages of GPS and GIS in the storage thematic information extracted from remotely sensed images.
Role of remote sensing and GIS in terrain investigation and advantages over conventional mapping techniques. Extraction of topographic information from remotely sensed data and generation of digital terrain model from stereo pairs of images.
Resource mapping for engineering project: selection of sites for construction materials, water resources, soil, buildings, railways, and highways etc. using remotely sensed data. Geological mapping for the geotechnical investigation of soil strata. Monitoring of areas prone to landslides using remote sensing, digital model and GIS. Application of visible, infra-red and microwave remote sensing for the identification of soil types, grain size and moisture studies.

Text / Reference Books:

1. Lillesand T.M. and Kiefer R. W., *Remote Sensing and image interpretation,* John Wiley and Sons. New York.
2. J. B. Campbell, *Introduction to remote sensing* , Taylor & Francis, London.
3. J. R.Jensen, *Introductory Digital Image Processing*, Prentice Hall International Ltd., London.

4. Kennie, T. J. M. and Matthews M. C., *Remote Sensing in Civil Engineering*, Surrey University Press, Glasgow.

CO – PO Mapping:

COs	PO1	PO2	PO3	PO4	PO5	PO6
CO1	2	3	3	2	2	3
CO2	3	3	2	1	1	2
CO3	1	2	2	2	3	-
CO4	2	-	1	3	1	3

REINFORCED EARTH
(CODE: GTE 301C)
L: 3 T: 1 P: 0
TOTAL CONTACT HOURS: 48
CREDIT: 4

Course Outcomes:

CO1: To develop knowledge about the Mechanism and concept of Reinforced Earth.
CO2: To understand cohesion theory, the sigma model and the enhanced confining pressure concept.
CO3: To understand the earth pressure, their limitations and testing methods
CO4: To understand the concept of geosynthetics, classifications and applications in civil engineering.

Course Contents

Reinforced Earth: Introduction; Mechanism and concept - the andsobropis cohesion concept, the LCPC cohesion theory, the NSW cohesion theory, the sigma model, the tau model. The enhanced confining pressure concept the Greneble study, the UCLA study. Randomly reinforced soil, the limitation of laboratory studies. Application.
Reinforced Earth Structure - design and construction soil-reinforcement bend.
Geosynthetics: Introduction; Geotextile, Geojute, Geomembrane, Geogrid etc. Application of Geosynthetics in Civil Engineering, testing of geotextile.

Text / Reference Books:

1. Geo-textiles and Geo-membranes in Civil Engg. Gerard P.T.M. Van Santvrot A. A. Balkema, Oxford and
IBH publishing company, New Delhi.
2. Reinforced Soil and Geo-textiles- J. N. Mandal, proceedings FIGC- 1988, Oxford and IBH publishing
company private Ltd., New Delhi.
3. Geosynthetics: Applications, Design and construction- R. J. Tarmat, proceedings First Europian Geosynthetics Conference, Netherland A. A. Balkema, publisher-Brookfield, U.S.A.
4. Geosynthetics World. – J. N. mandal, Willey Eastern Limited, New Delhi.
5. Geotextiles. N.W.M. John, Blackie, Glasgow and London.
6. R. M. Korner, *Design with Geosynthetics*, Prentice Hall, New Jersy, 3rd Edn. 2002

CO – PO Mapping:

COs	PO1	PO2	PO3	PO4	PO5	PO6
CO1	1	3	-	3	3	1
CO2	3	1	2	3	-	3
CO3	2	2	3	-	1	2
CO4	2	-	-	1	2	3

INDUSTRIAL SAFETY
(CODE: GTE 302A)
L: 3 T: 1 P: 0
TOTAL CONTACT HOURS: 48
CREDIT: 4

Course Outcomes:

CO1: To develop knowledge about the safety rules and regulations, standards and codes applicable for engineering industry.
CO2: To understand various mechanical machines and their safety importance.
CO3: To understand the principles of machine guarding and operation of protective devices.
CO4: To analyse the working principle of engineering processes such as metal forming and joining process and their safety risks.
CO5: Developing the knowledge related to health and welfare measures in engineering industry.

Course Contents

Module 1: Industrial safety: Accident, causes, types, results and control, mechanical and electrical hazards, types, causes and preventive steps/procedure, describe salient points of factories act 1948 for health and safety, wash rooms, drinking water layouts, light, cleanliness, fire, guarding, pressure vessels, etc, Safety color codes. Fire prevention and firefighting, equipment and methods.

Module 2: Fundamentals of maintenance engineering: Definition and aim of maintenance engineering, Primary and secondary functions and responsibility of maintenance department, Types of maintenance, Types and applications of tools used for maintenance, Maintenance cost & its relation with replacement economy, Service life of equipment.

Module 3: Wear and Corrosion and their prevention: Wear- types, causes, effects, wear reduction methods, lubricants-types and applications, Lubrication methods, general sketch, working and applications, i. Screw down grease cup, ii. Pressure grease gun, iii. Splash lubrication, iv. Gravity lubrication, v. Wick feed lubrication vi. Side feed lubrication, vii. Ring lubrication, Definition, principle and factors affecting the corrosion. Types of corrosion, corrosion prevention methods.

Module 4: Fault tracing: Fault tracing-concept and importance, decision treeconcept, need and applications, sequence of fault finding activities, show as decision tree, draw decision tree for problems in machine tools, hydraulic, pneumatic,automotive, thermal and electrical equipment's like, I. Any one machine tool, ii. Pump iii. Air compressor, iv. Internal combustion engine, v. Boiler, vi. Electrical motors, Types of faults in machine tools and their general causes.

Module 5: Periodic and preventive maintenance: Periodic inspection-concept and need, degreasing, cleaning and repairing schemes, overhauling of mechanical components, overhauling of electrical motor, common troubles and remedies of electric motor, repair complexities and its use, definition, need, steps and advantages of preventive maintenance. Steps/procedure for periodic and preventive maintenance of: I. Machine tools, ii. Pumps, iii. Air compressors, iv. Diesel generating (DG) sets, Program and schedule of preventive maintenance of mechanical and electrical equipment, advantages of preventive maintenance. Repair cycle concept and importance

Text / Reference Books:

Sl No.	Name	Author
1	Maintenance Engineering Handbook,	Higgins & Morrow, Da Information Services
2	Maintenance Engineering,	H. P. Garg, S. Chand and Company.
3	Pump-hydraulic Compressors	Audels, Mcgrew Hill Publication
4	Foundation Engineering Handbook	Winterkorn, Hans, Chapman & Hall London.

CO – PO Mapping:

COs	PO1	PO2	PO3	PO4	PO5	PO6
CO1	1	2	2	3	2	3
CO2	2	1	1	3	2	3
CO3	2	1	3	2	3	2
CO4	3	2	3	2	3	3
CO5	1	2	2	3	3	3

OPERATIONS RESEARCH
(CODE: GTE 302B)
L: 3 T: 1 P: 0
TOTAL CONTACT HOURS: 48
CREDIT: 4

Course Outcomes:
At the end of the course, the student should be able to
1. Students should able to apply the dynamic programming to solve problems of discreet and continuous variables.
2. Students should able to apply the concept of non-linear programming
3. Students should able to carry out sensitivity analysis
4. Student should able to model the real world problem and simulate it.

Course Contents

Module 1: Optimization Techniques, Model Formulation, General L.R Formulation, Simplex Techniques, Sensitivity Analysis, Inventory Control Models

Module 2: Formulation of a LPP - Graphical solution revised simplex method - duality theory – dual simplex method - sensitivity analysis - parametric programming

Module 3: Nonlinear programming problem - Kuhn-Tucker conditions min cost flow

problem – max flow problem - CPM/PERT

Module 4: Scheduling and sequencing - single server and multiple server models – deterministic inventory models - Probabilistic inventory control models - Geometric Programming.

Module 5: Competitive Models, Single and Multi-channel Problems, Sequencing Models, Dynamic Programming, Flow in Networks, Elementary Graph Theory, Game Theory Simulation

Text / Reference Books:

Sl No.	Name	Author
1	Operations Research, An Introduction,	H.A Taha, PHI, 2008
2	Principles of Operations Research,	H.M. Wangner, PHI, Delhi 1982
3	Introduction to Optimisation: Operations Research,	J.C. Pant, Jain Brothers, Delhi, 2008
4	Operations Research	Hitler Libermann, McGraw Hill Pub. 2009

CO – PO Mapping:

COs	PO1	PO2	PO3	PO4	PO5	PO6
CO1	2	2	3	3	2	2
CO2	1	3	2	2	3	3
CO3	1	2	2	3	3	3
CO4	2	2	2	3	2	3
CO5	2	3	2	3	3	3

COST MANAGEMENT OF ENGINEERING PROJECTS
(CODE: GTE 302B)
L: 3 T: 1 P: 0
TOTAL CONTACT HOURS: 48
CREDIT: 4

Course Outcomes:

The objectives of this course are to:

CO1. To make them understand the concepts of Project Management for planning to execution of projects.

CO2. To make them understand the feasibility analysis in Project Management and network analysis tools for cost and time estimation.

CO3. To enable them to comprehend the fundamentals of Contract Administration, Costing and Budgeting.

CO4. Make them capable to analyze, apply and appreciate contemporary project management tools and methodologies in Indian context.

Course Contents

Module 1: Introduction and Overview of the Strategic Cost Management Process Cost concepts in decision-making; Relevant cost, Differential cost, Incremental cost and Opportunity
cost.
Module2: Objectives of a Costing System; Inventory valuation; Creation of a Database for operational control; Provision of data for Decision-Making.
Project: meaning, Different types, why to manage, cost overruns centres, various stages of project execution: conception to commissioning. Project execution as conglomeration of technical and nontechnical activities. Detailed Engineering activities. Pre project execution main clearances and documents

Module3: Project team: Role of each member. Importance Project site: Data required with significance. Project contracts. Types and contents. Project execution Project cost control. Bar charts and Network diagram. Project commissioning: mechanical and process

Module4: Cost Behavior and Profit Planning Marginal Costing; Distinction between Marginal Costing and Absorption Costing; Break-even Analysis, Cost-Volume-Profit Analysis. Various decision-making problems. Standard Costing and Variance Analysis.

Module5: Pricing strategies: Pareto Analysis. Target costing, Life Cycle Costing. Costing of service sector. Just-in-time approach, Material Requirement Planning, Enterprise Resource Planning, Total Quality Management and Theory of constraints. Activity-Based Cost Management, Bench Marking; Balanced Score Card and Value-Chain Analysis. Budgetary Control; Flexible Budgets; Performance budgets; Zero-based budgets. Measurement of Divisional profitability pricing decisions including transfer pricing.

Module 6: Quantitative techniques for cost management, Linear Programming, PERT/CPM, Transportation problems, Assignment problems, Simulation, Learning Curve Theory.

Text / Reference Books:

Sl No.	Name	Author
1	Cost Accounting A Managerial Emphasis	Prentice Hall of India, New Delhi
2	Advanced Management Accounting	Charles T. Horngren and George Foster,
3	Management & Cost Accounting	Robert S Kaplan Anthony A. Alkinson,
4	Principles & Practices of Cost Accounting	Ashish K. Bhattacharya, A. H. Wheeler publisher

CO – PO Mapping:

COs	PO1	PO2	PO3	PO4	PO5	PO6
CO1	2	2	3	3	2	2
CO2	1	3	2	2	3	3
CO3	1	2	2	3	3	3
CO4	2	2	2	3	2	3
CO5	2	3	2	3	3	3

WASTE TO ENERGY
(CODE: GTE 302D)
L: 3 T: 1 P: 0
TOTAL CONTACT HOURS: 52
CREDIT: 4

Course Outcomes:

CO1: To enable students to understand of the concept of Waste to Energy.
CO2: To link legal, technical and management principles for production of energy form waste.
CO3: To learn about the best available technologies for waste to energy.
CO4: To analyze of case studies for understanding success and failures.
CO5: To facilitate the students in developing skills in the decision-making process.

Course Contents

Module 1: Introduction to Energy from Waste: Classification of waste as fuel – Agro based, Forest residue, Industrial waste - MSW – Conversion devices – Incinerators, gasifiers, digestors

Module 2: Biomass Pyrolysis: Pyrolysis – Types, slow fast – Manufacture of charcoal – Methods - Yields and application – Manufacture of pyrolytic oils and gases, yields and applications.

Module 3: Biomass Gasification: Gasifiers – Fixed bed system – Downdraft and updraft gasifiers – Fluidized bed gasifiers – Design, construction and operation – Gasifier burner arrangement for thermal heating – Gasifier engine arrangement and electrical power – Equilibrium and kinetic consideration in gasifier operation.

Module 4: Biomass Combustion: Biomass stoves – Improved chullahs, types, some exotic designs, Fixed bed combustors, Types, inclined grate combustors, Fluidized bed combustors, Design, construction and operation - Operation of all the above biomass combustors

Module 5: Biogas: Properties of biogas (Calorific value and composition) - Biogas plant technology and status - Bio energy system - Design and constructional features - Biomass resources and their classification - Biomass conversion processes - Thermo chemical conversion - Direct combustion - biomass gasification - pyrolysis and liquefaction - biochemical conversion - anaerobic digestion - Types of biogas Plants – Applications - Alcohol production from biomass - Bio diesel production - Urban waste to energy conversion - Biomass energy programme in India.

Text / Reference Books:

Sl No.	Name	Author
1	Non Conventional Energy	Desai, Ashok V., Wiley Eastern Ltd., 1990.
2	Biogas Technology - A Practical Hand Book	Khandelwal, K. C. and Mahdi, S. S., Vol. I & II, Tata McGraw Hill Publishing Co. Ltd., 1983.
3	Biomass Conversion and Technology	C. Y. Were Ko-Brobby and E. B. Hagan, John Wiley & Sons, 1996.

CO – PO Mapping:

COs	PO1	PO2	PO3	PO4	PO5	PO6
CO1	2	3	3	2	2	3
CO2	2	2	3	3	3	3
CO3	1	2	3	2	3	2
CO4	2	2	2	2	3	2
CO5	2	2	3	3	2	2