



National Institute of Technology Andhra Pradesh (Department of Civil Engineering)

NATIONAL INSTITUTE OF TECHNOLOGY ANDHRA PRADESH



PROPOSED SCHEME OF INSTRUCTION AND SYLLABI FOR M.TECH. PROGRAM IN GEOTECHNICAL ENGINEERING

DEPARTMENT OF CIVIL ENGINEERING



NATIONAL INSTITUTE OF TECHNOLOGY ANDHRA PRADESH

DEPARTMENT OF CIVIL ENGINEERING

Vision

- ❖ To develop into a distinguished department of civil engineering worldwide by providing quality technical education and conducting high-end research that can produce sustainable solutions to the global community.

Mission

- ❖ To design a curriculum based on the present and future challenges in civil engineering and develop high-quality ethical professionalism among the civil engineers
- ❖ To interact with industries with an emphasis on research and development and undertake innovative collaborative projects to solve real-world problems
- ❖ To provide effective consultancy services for delivering the output of the research to the society and establish centers of excellence in emerging areas of research



M.TECH. IN GEOTECHNICAL ENGINEERING

Curriculum structure: The overall credit distribution applicable for all the M.Tech. Programmes is enlisted below:

1. Overall Distribution:

Category	Category Description	Credits
PCC (T)	Programme Core Course (Theory)	18
PCC (P)	Programme Core Course (Practical)/ Seminar/ Dissertation	4
DEC (T)	Department Elective Course	8
OEC (T)	Open Elective Course (MOOCs)	2
HEC (T/P)	Humanities Elective Course	2
Diss.	Dissertation	26

2. Semester-wise distribution:

Sem.	PCC (T)	PCC (P)	DEC (T)	OEC (MOOCs)	HEC (T/P)	Diss.	Total
I	9 ± 1	2	4	2	0	0	17 ± 1
II	9 ± 1	2	4	0	2	0	17 ± 1
III	0	0	0	0	0	13	13
IV	0	0	0	0	0	13	13
Total						60	60



SCHEME OF INSTRUCTION AND EVALUATION

M. Tech. (Geotechnical Engineering) Course Structure

I - Year I – Semester

S. No.	Course Code	Course Title	L	T	P	Credits	Cat. Code
1		Advanced Soil Mechanics	3	1	0	4	PCC
2		Advanced Foundation Engineering	3	1	0	4	PCC
3		Department Elective – I	2	0	0	2	DEC
4		Department Elective – II	2	0	0	2	DEC
5		Open Elective Course (MOOCs)	2	0	0	2	OEC
6		Experimental Geotechnics	0	0	3	2	PCC (P)
		Total	15	0	3	16	

I - Year II - Semester

S. No.	Course Code	Course Title	L	T	P	Credits	Cat. Code
1		Soil Dynamics and Machine Foundations	3	1	0	4	PCC
2		Ground Improvement Methods	3	0	0	3	PCC
3		Advanced Geotechnical Exploration and Instrumentation	3	0	0	3	PCC
4		Department Elective – III	2	0	0	2	DEC
5		Department Elective - IV	2	0	0	2	DEC
6		Humanities Elective Course	2	0	0	2	HEC
7		Computational Laboratory	0	0	3	2	PCC (P)
		Total	16	0	3	18	

II - Year I – Semester

S. No.	Course Code	Course Title	L	T	P	Credits	Cat. Code
1		Dissertation Part A				13	Diss.
		Total				13	

II - Year II – Semester

S. No.	Course Code	Course Title	L	T	P	Credits	Cat. Code
1		Dissertation Part B				13	Diss.
		Total				13	



LIST OF ELECTIVES

Department Elective – I & II

S. No.	Course Code	Course Title	L	T	P	Credits
1		Environmental Geotechniques	2	0	0	2
2		Rock Mechanics	2	0	0	2
3		Finite Element Method in Civil Engineering	2	0	0	2
4		Applications of Geosynthetics	2	0	0	2
5		Earth and Rockfill Dams	2	0	0	2
6		Geotechnics of Waste and Waste Containment	2	0	0	2
7		Earth Retaining Structures	2	0	0	2

Department Elective – III & IV

S. No.	Course Code	Course Title	L	T	P	Credits
1		Soil Structure Interaction	2	0	0	2
2		Transportation Geotechnics	2	0	0	2
3		Remote sensing in Geotechnics	2	0	0	2
4		Offshore Geotechnics	2	0	0	2
5		Tunneling Technology	2	0	0	2
6		Critical State Soil Mechanics	2	0	0	2
7		Computational Geomechanics	2	0	0	2

Commented [HC1]: Suggestion: To map with the respective courses and place it appropriate section.
Response: This course has been mapped to all related subjects and moved from Semester I to Semester II.

Commented [HC2]: Suggestion: This course must be shifted from list of DEC (I & II) to DEC (III & IV).
Response: The course has been shifted to the DEC III & IV list of electives.



I: Year I – Semester



Pre-requisites: None

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

CO1	Analyze effective stress for different field conditions.
CO2	Calculate settlement of soils using one dimensional and three-dimensional consolidation theories.
CO3	Estimate shear strength of saturated and partially saturated soils.
CO4	Analyze the stability of slope for different field conditions

Detailed syllabus:

Effective Stress: The principle of effective stress, Inter-granular pressure, Pore pressure, capillary pressure, problems, effective stress principle for partially saturated soils, seepage in soils, stress distribution: Boussinesq's Theory and Westergaard's theory.

Consolidation: Principle of consolidation-compressibility, pressure-void ratio relationships, Terzaghi's one dimensional consolidation parameters, pre-consolidation pressure, Estimation of total Settlement. Two- and three-dimensional consolidation, radial consolidation, nonlinear consolidation, Secondary compression.

Shear Strength: Basic concepts, shear strength of soil under plane strain and general stress system. Mohr-Coulomb theory; measurement of shear strength, drainage conditions, pore pressure parameters. Stress paths in p-q space; Direct shear box test, Triaxial test, stress state and analysis of UC, UU, CU, CD, and other special tests, stress paths in triaxial and octahedral plane

Strength of Cohesionless Soils: Friction between solid surfaces, Frictional behaviour of minerals, strength of granular soil, Factors affecting strength and deformation, Dilatancy, critical void ratio, Liquefaction.

Strength of Saturated Cohesive Soils: Effective stress-water content relationship, stress history, structure, strain rate, sensitivity, Thixotropy, Hvorslev's strength parameters.

Partially saturated soils: State variables, measurement of pore air and pore water pressure. Strength and deformation characteristics.

Stability of Slopes: Stability analysis of a slope and finding critical slip surface; Sudden Draw down condition, effective stress and total stress analysis, Seismic displacements in marginally stable slopes

Commented [HC3]: Suggestion: Cohesion less word is a single word
Response: It has been modified as one single word i.e. cohesionless



Learning Resources:

Text Books:

1. B.M. Das, “Advanced Soil Mechanics”, Taylor & Francis, 2013.
2. Muni Budhu, “Soil Mechanics and Foundations”, John Wiley & Sons, Inc., 2010.
3. W. Powrie, “Soil Mechanics concepts and applications”, Spon Press, Taylor & Francis, 2002.
4. K. Terzaghi, R.B. Peck, and G. Mesri, “Soil Mechanics in Engineering Practice”, 1996.
5. T.W. Lambe and R.V. Whitman, “Soil Mechanics”, John Wiley & Sons, 1991.

Commented [HC4]: Suggestion: Add recent textbooks with latest edition
Response: Recent textbooks with latest edition have been included

Reference Books:

1. Gopal Ranjan and Rao ASR, “Basic and applied soil mechanics”, New age Publications, Delhi, 3rd Edition, 2016.
2. Richard L Handy, "Foundation Engineering – Geotechnical Principles & Practical applications”, Mc Graw Hill, New York, 2020.
3. S. Helwany, “Applied Soil Mechanics with ABAQUS Applications”, John Wiley & Sons, INC, 2007.
4. IS 2720 (Part 1 to 41): Methods of tests for Soil’s.
5. IS 8009: Code of Practice for calculation of Settlement of Foundations, 1976.

Commented [HC5]: Suggestion: Add recent textbooks in references section
Response: Recent textbooks have been included.

Commented [HC6]: Suggestion: Move from textbook section to reference section
Response: Modified as per the suggestion

Other Suggested Readings:

1. <https://nptel.ac.in/courses/105/104/105104162/>
2. <https://ocw.mit.edu/courses/civil-and-environmental-engineering/1-361-advanced-soil-mechanics-fall-2004>



PCC CEXX ADVANCED FOUNDATION ENGINEERING L-T-P (C)
3- 1- 0 (4)

Pre-requisites: None

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

CO1	Analyze and interpret soil properties for foundation design
CO2	Analyze bearing capacity and settlement of foundations.
CO3	Design suitable foundations to satisfy the project requirement
CO4	Analyze and suggest remedial measures against foundation failures.

Detailed syllabus:

Theories of Bearing Capacity: Art and principles of foundation engineering, Theories of bearing capacity - Theories of Terzaghi, Meyerhof, Hansen, Vesic, Skempton, Field tests: Penetration tests, Plate load tests, Influence of various factors on bearing capacity

Settlement Analysis: Stress distribution in soil due to structural loads, Calculation of immediate and consolidation settlements, settlement analysis for different ground conditions, Techniques for controlling excessive settlements

Design of Shallow Foundations: Foundation classification, Choice of foundations, Isolated and combined footings, Raft foundations: necessity, types, and design considerations; Bearing capacity and settlement of rafts, eccentrically loaded footings, Foundation on Slopes, IS Code Procedures

Pile Foundations: Types, uses and classification of piles, Load-carrying capacity of single pile, pile load tests, pull-out resistance of pile, laterally loaded piles: behavior and analysis; Pile groups and group efficiency, settlement of single pile and pile groups, negative skin friction. Structural design of piles including pile caps; Design of pile groups. Pile load tests- Under reamed Pile- Pile Raft- IS Code Procedures

Well Foundations: Caissons – types, advantages/disadvantages, shapes and components, Grip length, bearing capacity, and settlement, Forces acting on well foundations, Sinking process and rectification of tilts and shifts, Lateral stability - Terzaghi's method and IRC method – IS Code Procedures

Foundation Failures and Remedial Measures: Types and causes of foundation failures, Construction aspects and quality control, Remedial techniques: shoring, underpinning, Groundwater control and drainage systems, Field instrumentation and monitoring

Commented [HC7]: Suggestion: Change the topic name of bearing capacity as theories of bearing capacity
Response: Topic name has been modified

Commented [HC8]: Suggestion: Modify the module name of shallow foundation as **Design of Shallow Foundations**
Response: The module name has been modified



Special Foundations: Foundation solutions for problematic and contaminated soils, Foundations for offshore and buried structures, Earthquake-resistant foundation design

Learning Resources:

Text Books:

1. B.M. Das, "Principles of Foundation Engineering", Cengage Learning, 2013
2. J. E. Bowles, "Foundation Analysis & Design", McGraw Hill Book Co, 2001.
3. M. Tomlinson, "Foundation Design and Construction", ELBS, Longman Group Ltd, 2001.
4. H.G. Poulos, and E.H. Davis, "Pile foundation analysis and design", John Wiley & Sons Inc, 1980.
5. R. Katzenbach, S. Leppla and D. Choudhury, "Foundation Systems for High-Rise Structures" CRC Press, Taylor & Francis Group, 2016.
6. V.N.S. Murthy, "Advanced Foundation Engineering", CBS Publishers and Distributors, 2007.

Reference Books:

1. An-Bin Huang and Hai-Sui Yu., "Foundation Engineering Analysis and Design", CRC Press, Taylor and Francis group, 1st Edition, 2018.
2. Gopal Ranjan and Rao ASR, "Basic and applied soil mechanics", New Age Publications, Delhi, 3rd Edition, 2016.
3. IS 6403-1981 (Reaffirmed 2002): Code of Practice for determination of Bearing Capacity of Shallow Foundations.
4. N.V. Nayak, "Foundation Design Manual", Dhanpat Rai Publications, 2018.
5. IS 1080-1985 (Reaffirmed 2002): Code of Practice for Design and Construction of Shallow Foundations in Soils.

Other Suggested Readings:

1. <https://nptel.ac.in/courses/105/104/105104162/>
2. <https://ocw.mit.edu/courses/civil-and-environmental-engineering/1-36-advanced-geotechnical-engineering-fall-2003>
3. D. Choudhury, "Foundation Engineering", NPTEL Web Course, MHRD, Govt. India, 2006.

Commented [HC9]: Comment: to add specific textbook
Response: Specific textbook has been included

Commented [HC10]: Suggestion: Formatting error
Response: The formatting error has been corrected

Commented [HC11]: Suggestion: To maintain consistency in representation of textbook
Response: Consistency in the representation of textbooks has been maintained as per the suggestion

Commented [HC12]: Suggestion: Move from text book section to reference section
Response: Modified as per the suggestion



National Institute of Technology Andhra Pradesh (Department of Civil Engineering)

4. K. Deb, “Advanced Foundation Engineering”, NPTEL Video Course, MHRD, Govt. India, 2013.

Commented [HC13]: Suggestion: Move from reference section to other suggested books
Response: Modified as per the suggestion



PCC CEXX EXPERIMENTAL GEOTECHNICS

L-T-P (C)
0- 1-2 (2)

Pre-requisites: None

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

CO1	Determine index and engineering properties
CO2	Find the critical void ratio of a given sand sample
CO3	Find the swell properties of expansive clays
CO4	Conduct standard penetration test, plate load test and pile load test

Detailed syllabus:

Review of Index properties: Atterberg limits, specific gravity, differential swell tests, determination of density.

Review of engineering properties: Compaction and California Bearing Ratio (CBR) test; unconfined compression tests; Permeability test - Constant head and falling head methods

Consolidation and Swell tests: Estimation of settlement, compression index parameter, rate of settlement, coefficient of consolidation, Swell Pressure.

Shear strength tests: Direct Shear Test (Drained for cohesion less and undrained test on cohesive soil); Triaxial Compression Test - Unconsolidated - Undrained Tests, Consolidated Undrained Tests with Pore pressure measurement, Consolidated Drained Tests.

Field based tests: Standard Penetration Test, Cone Penetration Test, Plate load Test, Pile Load Test and Large Direct Shear Test.

Learning Resources:

Text Books:

1. Braja M Das, "Soil Mechanics Laboratory Manual", Oxford University Press, 6th Edition, 2002.
2. S. Mittal, and J. P. Shukla, "Soil Testing for Engineers", Khanna Publications, 2014.
3. K. H., Head, "Manual of Soil Laboratory Testing", CRC Press, 3rd Edition, Vol 1 & 2, 2006.

Commented [HC14]: Suggestion: Modify the LTP structure with respective to the credits
Response: LTP structure has been modified

Commented [HC15]: Suggestion: Modified the title of the module and include the CPT topic
Response: Module title is modified as Field based tests and CPT topic is included



National Institute of Technology Andhra Pradesh (Department of Civil Engineering)

Reference Books:

1. IS 2720 (Part 1 to 41): Methods of tests for Soils

Other Suggested Readings:

1. <https://nptel.ac.in/courses/105/104/105104162/>
2. <https://ocw.mit.edu/courses/civil-and-environmental-engineering/1-322-soil-behavior-spring-2005>



I: Year II – Semester



PCC CEXXX SOIL DYNAMICS AND MACHINE FOUNDATIONS

**L-T-P (C)
3-1-0 (4)**

Pre-requisites: None

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

CO1	Apply theory of vibrations to solve dynamic soil problems
CO2	Determine the dynamic properties of soils using laboratory and field tests
CO3	Design the reciprocating and rotating machine foundations
CO4	Design various vibration isolation systems

Detailed syllabus:

Introduction: Importance of soil dynamics, nature and types of dynamic loading, concept of dynamic loading, Simple harmonic motion, degrees of freedom, types of vibration, free and forced vibration, decay of motion, vibration measuring instruments.

Wave propagation in soil: Elastic response of continua, Wave propagation in soil media, Earthquake waves – P-wave, S-wave, Rayleigh wave and Love wave, Waves in layered and saturated soils, Seismic travel time curve, Three-circle method of estimation of earthquake epicentre.

Dynamic soil properties: Stresses in soil element, concept of soil stiffness, Elastic constants of soil; Damping of soil; General factors affecting shear modulus and damping, techniques for estimation of dynamic soil properties from field (intrusive and non-intrusive testing) and laboratory testing. Laboratory tests- resonant column test, cyclic simple shear test, cyclic torsional shear test, cyclic triaxial test, Field tests- cyclic plate load test, block vibration test, standard penetration test, seismic bore hole surveys, Wave propagation tests, Correlation for obtaining various geotechnical parameters.

Liquefaction and lateral spreading: Concept of liquefaction (static and cyclic), cyclic mobility, estimation of liquefaction potential of soil from field and laboratory testing data, cyclic stress ratio of soil and its importance, post liquefaction lateral spreading of soil, effect of liquefaction on various geotechnical structures.

Design of machine foundations: General principles of machine foundation design, Types of machines and foundations, General design requirements of machine foundation, Modes of vibration, Vertical, sliding, torsional (yawing) and rocking (and pitching) modes of oscillations, Design guidelines as per codes, Typical design problems.



Vibration isolation: Introduction, Active and passive isolation, Methods and design of vibration isolation system

Learning Resources:

Text Books:

1. Das B M and Ramana G V, "Principles of Soil Dynamics", Cengage Learning, 2010.
2. Saran S, "Soil Dynamic and Machine Foundations", Galgotia Publications Pvt. Ltd., 2016.
3. Bharath B P, "Soil Dynamics and Earthquake Engineering", PHI, New Delhi, 2010.
4. Prakash S, "Soil Dynamics", McGraw Hill Book Co., New York, 1999.

Commented [HC16]: Suggestion: shift the referenced textbook from reference section to textbook section
Response: The referenced textbook has been moved from the 'References' section to the 'Textbooks' section

Commented [HC17]: Suggestion: shift the referenced textbook from reference section to textbook section
Response: The referenced textbook has been moved from the 'References' section to the 'Textbooks' section

Reference Books:

1. Richart F E, Holland J R and Woods R D, "Vibrations of Soils and Foundations", 1970.
2. IS: 2974 (Part 1)-Code of Practice for Design and Construction of Machine Foundations, Bureau of Indian Standards, New Delhi, 1982.
3. Sreenivasulu P, and Vidyanathan C V, "Hand Book of Machine Foundation", Tata McGraw Hill, New Delhi, 2017.

Other Suggested Readings:

1. <https://nptel.ac.in/courses/105/101/105101005/>



Pre-requisites: None

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

CO1	Identify difficult ground conditions in engineering practice.
CO2	Identify different ground improvement techniques.
CO3	Select Site specific method of improvement and its design.
CO4	Promote wider use of techno – economical construction techniques such as Reinforced soil structures, Gabion walls and soil confinement methods.

Detailed syllabus:

Introduction to Ground Modification: Need and objectives of Ground Improvement, Classification of Ground Modification Techniques – suitability and feasibility, Emerging Trends in ground improvement.

Mechanical Modification: Methods of compaction, Shallow compaction, Deep compaction techniques – Vibro-floatation, Blasting, Dynamic compaction, preloading and Precompression sand compaction piles, Lab and Field compaction control.

Hydraulic Modification: Methods of dewatering – open sumps and ditches, Well-point system, Electro-osmosis, Vacuum dewatering wells; pre-loading without and with sand drains, strip drains and rope drains, Design of pre-fabricated vertical drains.

Chemical modification: Stabilisation with admixtures like cement, lime, calcium chloride, fly ash and bitumen; Grouting: Categories of grouting, Art of grouting, Grout materials, Grouting techniques and control.

Reinforced Earth Technology: Concept of soil reinforcement, reinforcing materials, and Backfill criteria, Art of reinforced earth technology, Design and construction of reinforced earth structures.

Ground Anchors: Types of ground anchors and their suitability, Uplift capacity of anchors.

Soil Confinement Systems: Concept of confinement, Gabion walls, Crib walls, Sand bags and Geotubes, Evergreen systems and fabric form work.

Miscellaneous Techniques: Expansive Soil Problems and Foundation Techniques, Construction and applications of stone columns in soft clays.



Learning Resources:

Text Books:

1. Manfred R. Haussmann, “Engineering principles of ground modification”, Pearson Education Inc. New Delhi. 2008.
2. Jie Han, “Principles and Practice of Ground Improvement”, John Wiley & Sons, Inc., 2007.
3. Bell, F.G. E& FN Spon, “Engineering Treatment of Soils”, New York, 2006.
4. Purushothama Raj, “Ground Improvement Techniques”, P. Laxmi Publications (P) Limited, 2006.

Commented [HC18]: Suggestion: shift the referenced textbook from reference section to textbook section
Response: The referenced textbook has been moved from the 'References' section to the 'Textbooks' section

Reference Books:

1. Anjan Patel, “Geotechnical Investigations and Improvement of Ground Conditions”, Woodhead Publishing Series in Civil and Structural Engineering, 1st Edition, 2006.
2. Klaus Kirsch and Alan Bell, “Ground Improvement”, Taylor and Francis 3rd Edition, 2004

Other Suggested Readings:

1. <https://nptel.ac.in/courses/105/108/105108075/>



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CEXX ADVANCED GEOTECHNICAL EXPLORATION AND INSTRUMENTATION

L-T-P (C)
3- 0-0 (3)

Pre-requisites: None

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

CO1	Prepare bore logs for different soil strata.
CO2	Implement various exploration methods in soil and rock.
CO3	Work with relevant instrumentation required for characterizing the soil and Rock with interdisciplinary approach
CO4	Interpret field and laboratory data and prepare soil investigation report

Detailed syllabus

Introduction: Soil Formation, types of soils, physical and biological weathering, soil transport, deposition and stratification phenomena and Soil and Rock Classification.

Soil & Rock Exploration: Soil Exploration Programme for different Civil Engineering Projects- Number and Depth of Boreholes

Exploration Methods: Methods of Boring, Auguring and Drilling. Machinery used for drilling, types of augers and their usage for various projects.

Soil Sampling: sampling methods, types of samples, storage of samples and their transport. Sample preparation, sample sizes, types of sampler’s specifications for testing.

Borehole Logging: Logging of Boreholes-logging methods- Ground water observations – water table fluctuations and effects - Preparation of soil profiles – calculations

Field testing of soils & Rocks: methods and specifications – visual identification tests, Geo Physical Test- vane shear test, penetration tests (SPT, CPT, DMT, PMT), Plate Load Test, CBR Test, Block Vibration Test, analysis of test results.

Report writing: Soil exploration Reports- identification, calculations and preparation.

Field Instrumentation & Monitoring: All the Advanced Field instrumentation and Monitoring techniques (that used for various geotechnical applications and ground response).

Learning Resources:

Text Books:

1. Clayton C. R., Matthews M. C and Simons N. E., “Site Investigation”, Blackwell Science, 2005

Commented [HC19]: Suggestion: shift this course to first semester- if possible
Response: The course title has been revised to 'Advanced Geotechnical Exploration and Instrumentation' in place of 'Geotechnical Exploration and Instrumentation'. This change was made to retain the course in the same semester while preserving the logical sequence of foundation-related courses

Commented [HC20]: Suggestion: Rename the title of the module as field instrumentation & monitoring
Response: Module title named has been rename as per the suggestions



National Institute of Technology Andhra Pradesh (Department of Civil Engineering)

2. John Dunn cliff, "Geotechnical Instrumentation for Monitoring Field Performance", Wiley-Interscience, 2008.
3. A.S. Rao and Gopal Ranjan, "Basic and Applied Soil Mechanics"- New Age International.

Reference Books:

1. Muni Budhu, "Soil mechanics and Foundation engineering", John Wiley and sons, 3rd Edition, 2010.
2. M.D.Desai, "Ground Property Characterization from In-Situ Testing", IGS-Surat Chapter, 2005.
3. All the Relevant Practice Codal provisions

Other Suggested Readings:

1. <https://nptel.ac.in/courses/105/105/105105039/>
2. K. Deb, "Advanced Foundation Engineering", NPTEL Video Course, MHRD, Govt. India, 2013

Commented [HC21]: Suggestion: Modify the Author name: Muni Budhu
Response: The author's name has been updated



PCC CEXX COMPUTATIONAL LABORATORY

**L-T-P (C)
0- 1-2 (2)**

Pre-requisites: None

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

CO1	Soil data analysis and visualization
CO2	Finite element programming for geotechnical engineering applications.
CO3	Numerical modelling using finite element and finite difference tools

Detailed syllabus

- Soil Data Analysis and Visualization: Basics of numerical computation and plotting (for geotechnical experiments), geotechnical data handling (bore log interpretation, lab test data processing)
- Finite element modelling of geotechnical problems: 1D consolidation model, Simulation of stress distribution and settlement, Seepage analysis, Frequency and amplitude response analysis, Settlement and bearing capacity analysis, Hands-on practice using geotechnical engineering software.

Learning Resources:

Text Books:

1. R. V. Hogg, A. Craig, and J. W., McKean, "Introduction to Mathematical statistics", 6th edition, Pearson Education, 2004.
2. S. P. Washington, M. G. Karlaftis, F. L. Mannering, "Statistical and Econometric Methods for Transportation Data Analysis", 2nd Edition, CRC Press, 2010.

References:

1. Manuals of the relevant computational tools and softwares.

Other Suggested Readings:

2. <https://www.edx.org/learn/matlab>



II: Year I & II – Semester



PCC CEXXX DISSERTATION PART – A

13 Credits

Pre-requisites: None.

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

CO1	Identify topics in thrust areas of Geotechnical engineering
CO2	Take up critical review of literature on the chosen topic
CO3	Carry out independent research work on the topic by experimental / analytical approaches
CO4	Document and present the results of research work

Detailed Syllabus:

Students are required to search, collect and review various research articles published in chosen area of research. A student has to select a topic for his dissertation, based on his/her interest. A student shall be required to submit a dissertation report on the research work carried out by him/her.

Learning Resources:

Text Books:

1. Journal Publications
2. Conference / Seminar Proceedings
3. Handbooks / Research Digests



PCC

CEXXX

DISSERTATION PART – B

13 Credits

Pre-requisites: Dissertation Part-A

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

CO1	Identify topics in thrust areas of Geotechnical engineering
CO2	Take up critical review of literature on the chosen topic
CO3	Carry out independent research work on the topic by experimental / analytical approaches
CO4	Document and present the results of research work

Detailed Syllabus:

Students are required to search, collect and review various research articles published in chosen area of research. A student has to select a topic for his dissertation, based on his/her interest. A student shall be required to submit a dissertation report on the research work carried out by him/her.

Learning Resources:

Text Books:

1. Journal Publications
2. Conference / Seminar Proceedings
3. Handbooks / Research Digests

Commented [HC22]: Suggestion: Dissertation part A & B must represent on Separate sheet
Response: Dissertation Part A and Part B have been presented on separate sheets



I- SEMESTER
DEPARTMENT ELECTIVE- I & II



DEC CEXX ENVIRONMENTAL GEOTECHNICS

**L-T-P (C)
2- 0-0 (2)**

Pre-requisites: None

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

CO1	Consider possible susceptibility of soil properties to Environmental effects
CO2	Identify contaminant transport mechanisms in soils
CO3	Estimate environmental influences on engineering properties of soil to be used in design
CO4	Apply environmental changes to soil stabilization and landfill engineering

Detailed syllabus:

Introduction: Soil-the three-phase system, Clay - the most active soil fraction, Clay-water interactions, Causes of soil deterioration, Scope and importance of environmental geotechnics.

Ground Contamination: Sources of contamination, chemical diffusion in soils, practical range of flow parameters, simultaneous flow of water, current and salts through a soil, Electro kinetic phenomenon, coupled influences on chemical flow, chemical compatibility and hydraulic conductivity

Classification of Soil and Susceptibility to Environment: Susceptibility to environment, mineralogy, formation and isomorphism substitution, Factors affecting surface activity of soils, Ion-exchange and its mechanics, Theories of ion-exchange, clay-organic interactions, atomic absorption spectroscopy analysis, Mechanisms controlling the index properties of fine-grained soils.

Engineering Properties of Soil due to Changing Environment: Engineering properties and environment, Permeability and its mechanisms, volume change behaviour, Basic mechanisms controlling compressibility, Quasi pre compression, compression behaviour of saturated Kaolinitic and Montmorillonitic clays with different pore fluids, shear strength Behaviour of Kaolinitic and Montmorillonitic clays with different pore fluids, components of shear strength and their mechanisms

Soil Modification by Environmental Changes: Stabilisation of soil by environmental changes, use of additives and their basic mechanisms, effect of lime on sulphate bearing clays, effect of phosphoric acid, use of flyash in soil modification, use of hydroxy-aluminium in clay stabilization, stabilization by chemical transport



Learning Resources:

Text Books:

1. James K. Mitchell and Kenichi Soga, “Fundamentals of Soil Behavior”, John Wiley & Sons, Inc. New York, 3rd Edition, 2014.
2. R W Sarsby, “Environmental Geotechnics”, Thomas Telford, 2000.

Reference Books:

1. Claudio Cameselle, Jeffrey A. Adams, and Krishna R. Reddy, “Sustainable Engineering: Drivers, Metrics, Tools, and Applications”, Wiley, 2019.
2. Laxmi N Reddy, Hilary N Inyang, “Geo-Environmental Engineering – Principles and Foundations”, CRC Press, 1st Edition, 2000.

Other Suggested Readings:

1. <https://ocw.mit.edu/courses/civil-and-environmental-engineering/1-725j-chemicals-in-the-environment-fate-and-transport-fall-2004/>



DEC

CEXX ROCK MECHANICS

L-T-P (C)
2- 0-0 (2)

Pre-requisites: None

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

CO1	Conduct laboratory and field testing for a given project / construction
CO2	Choose appropriate methods to improve stability of rock mass
CO3	Estimate foundation capacity of rock mass
CO4	Design of tunnel excavation and support systems

Detailed syllabus:

Introduction: Development of rock mechanics, problems of rock mechanics, applications and scope of rock mechanics.

Laboratory Testing: Rock sampling, Determination of density, Porosity and Water absorption, Uni axial Compressive strength, Determination of elastic parameters, Tensile strength, Shear Strength, Flexural strength, Strength criterion in rocks, Swelling and slake durability, permeability, point load strength, Dynamic methods of testing, Factors affecting strength of rocks.

Rock Mass Classification: Classification by Rock Quality Designation, Rock structure Rating, Geo mechanics and NGI classification systems.

In – situ testing: Necessity and Requirements of in – situ tests – Types of in – situ tests– Flat jack Technique – Hydraulic Fracturing Technique, pressure Tunnel Test, Plate Load Test, Shear Strength Test, Radial Jack Test, Goodman Jack Test and Dilatometer Test.

Methods of Improving Rock Mass properties: Rock Reinforcement – Rock bolting – Mechanism of Rock bolting – Principles of design – Types of rock bolts. Pressure grouting – grout curtains and consolidation grouting.

Stability of Rock Slopes: Causes of landslides, Modes of failure, Methods of analysis, Prevention and control of rock slope failure, Instrumentation for Monitoring and Maintenance of Landslides.

Foundations on Rock: Shallow foundations, Pile and well foundations, Basement excavation, Foundation construction, Allowable bearing pressure. Tunnels: Rock stresses and deformation around tunnels, Rock support interaction, Tunnel driving methods, Design of tunnel lining.



Learning Resources:

Text Books:

1. T. Ramamurthy, “Engineering in Rocks for slopes, foundations and tunnels”, PHI Learning Pvt. Limited, 2010.
2. K. Mogi, “Experimental Rock Mechanics” Taylor & Francis Group, UK, 2007.
3. Jaeger J. C., Cook N. G. W., and Zimmerman R. W, “Fundamentals of Rock Mechanics”, Wiley Blackwell, 2007.
4. W. Wittke, “Rock Mechanics” Springer Verlag, New York, 1990.
5. R. E. Goodman, “Introduction to Rock Mechanics” John Wiley & Sons, New York, 1989.

Commented [HC23]: Suggestion: To change the order of Text book
Response: The order of textbooks has been revised.

Reference Books:

1. R Goel, Bhawani Singh, “Engineering Rock Mass Classification”, Elsevier, 2011.
2. Central Board of Irrigation and Power - Manual on Rock Mechanics, 1988.

Commented [HC24]: Suggestion: To shift the manual from textbook section to reference section
Response: Following the suggestion, the manual has been repositioned.

Other Suggested Readings:

https://onlinecourses.nptel.ac.in/noc21_ce34/preview



PCC CEXX **FINITE ELEMENT METHOD IN CIVIL ENGINEERING** L-T-P (C)
2- 0-0 (2)

Pre-requisites: None

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

CO1	Apply numerical methods to solve partial differential equations with application to structural engineering problems.
CO2	Derive constitutive relations and solve structural engineering problems with Appropriate mathematical models.
CO3	Apply FE Models to solve trusses, beams, plates, shells and structural dynamics.
CO4	Develop the shape functions for different elements.

Detailed syllabus:

Introduction - Background and general description of the method – Applications

Methods of Structural Analysis - Review of various classical methods of Structural Analysis- Matrix methods- Stiffness and Flexibility methods.

Numerical methods of Structural analysis - Variational method- Weighted residual method- Sub domain and Impulse methods- Galerkins method – Least squares method- Application to bending problems- Strong and Weak formulation.

Basic introduction to constitutive relations.

Theory of Finite Element method - Discretisation concept- Concept of element – various elements shapes – displacement models – Convergence- shape functions – condensation of internal degrees of freedom-Summary of analysis procedure.

Finite Element Analysis - Development of shape functions for different elements-Spring-Truss-Beam-Plane elements- Plane stress and plane strain-Assemblage of elements construction of stiffness matrix and loads – boundary conditions –patch test-solution of overall problem.

Isoparametric Formulation -Concept of Isoparametric element – One- and Two-dimensional Elements-Natural coordinates- Numerical integration-Gaussian Quadrature-Development of Higher order elements- Lagrange –Serendipity –Interpolation-formulation of element stiffness and loads.

Application to Solid Mechanics problems - Analysis of Trusses – Beams – Frames-Plates- Axisymmetric Elements-Shells

Commented [HC25]: Suggestion: This course shouldn't go parallelly with computational Geomechanics
Response: Computational Geomechanics is now listed as an elective (III & IV) in the second semester.



Learning Resources:

Text Books:

1. O.C. Zeinkiewicz, “Finite Element Method: Its Basic and Fundamentals”, Butterworth Heinemann, 6th Edition, 2007.
2. R. D. Cook, “Concepts and Applications of Finite Element Analysis”, Willey Publication, 1995.
3. Y.M. Desai, T.I. Eldho and A.H.Shah, “Finite Element Method with Application in Engineering’ Pearson, 2011.

Reference Books:

1. S.S. Rao, “The Finite Element Method in Engineering”, Elsevier Publication, 2009.
2. C. Belegundu, “Finite Element Method”, McGraw-Hill, 1997.
3. P. Seshu, “Textbook of Finite Element Analysis”, PHI, 1st Edition, 2009.

Other Suggested Readings:



DEC CEXX APPLICATIONS OF GEOSYNTHETICS L-T-P (C)
2- 0-0 (2)

Pre-requisites: None

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

CO1	Select different geosynthetics for intended purpose.
CO2	Evaluate properties of geosynthetics.
CO3	Design geosynthetics for intended purpose.
CO4	Apply geocomposite systems to solve contemporary geotechnical problems

Detailed syllabus:

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

Designing with geotextiles: Geotextile properties and test methods – functions - Designing for separation, reinforcement, stabilization, filtration, drainage

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

Designing with geonets: Geonet properties and test methods – Physical properties, mechanical properties, hydraulic properties, endurance properties and environmental properties - Designing geonet for drainage

Designing with geomembranes: Geomembrane properties and test methods – physical properties, mechanical properties, chemical properties and biological hazard - Applications for geomembranes.

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

Learning Resources:

Text Books:

1. Sanjay Kumar Shukla and Jian-Hua Yin, “Fundamentals of Geosynthetics Engineering”, CRC Press, 1st edition, 2017.



2. Koerner, R.M., “Designing with geosynthetics”, Pearson Education Inc., 6th edition, 2012.

Reference Books:

1. Mandal, J.N., “Geosynthetics Engineering: in Theory and Practice”, Research Publishing, Singapore, 1st edition 2018.
2. Swami Saran, “ Reinforced Soil and its Engineering Applications”, I.K. International Publishing House Pvt. Ltd., 1st edition, 2019.
3. Jonathan T.H. Wu, “Geosynthetic Reinforced Soil (GRS) walls”, Wiley Black Well, 1st edition, 2019.
4. IS:13162-1992; IS:14293& 94-1995; IS:14324-1995; IS:14714-1999, Geotextiles – Methods of Tests.
5. IS: 13325-1992: Determination of tensile properties of extruded polymer geogrids using the wide width strip.
6. IS:16352-2020: Testing of HDPE Geomembrane liners.
IRC: SP:102-2014: Guidelines for design and construction of reinforced soil walls

Other Suggested Readings:

1. <https://nptel.ac.in/courses/105/101/105101143/>
2. <https://freevidelectures.com/course/3352/geosynthetics>
3. <https://www.swayamprabha.gov.in>



DEC

CEXX EARTH AND ROCKFILL DAMS

L-T-P (C)
2- 0-0 (2)

Pre-requisites: None

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

CO1	Select a suitable site, materials and equipment for construction of earth/rock fill dams
CO2	Analyze seepage through a given earth/rock fill dam section and select effective seepage control measures for the prevailing site conditions.
CO3	Analyze stability of slopes and evaluate the failure criteria.
CO4	Design earth and rock fill dams.

Detailed syllabus

Introduction: Classification of dams- Selection of Site-Basic design requirements-Preliminary section.

Seepage Through Dam Section and Its Control: fundamentals of seepage flow, flow nets, seepage through dam section and foundation, seepage control filters, Impervious core, and drainage- Critical Hydraulic Gradient.

Control of Seepage Through Foundations: Types of foundations, cut-off trenches, Internal Drainage Arrangement, upstream impervious blanket, horizontal drainage blanket, relief wells, drainage trenches, cut-off walls, downstream loading berm- Embankment on pervious soils.

Foundation treatment: treatment of pervious, impervious and rock foundations, core contact treatment, grouting, foundation excavation. Stability analysis: critical slip surfaces, test conditions, strength parameters, pore pressures, stability analysis-method of slices, Bishop's method, Morgenstern- Price method, Janbu method.

Construction of earth dams: construction equipment, procedures for pervious, semi-pervious, impervious and earth and rock fill sections, Quality Control and construction supervision.

Failures and damages of earth dams: nature of failures – piping, settlement cracks, slides, earthquake & miscellaneous damages –case studies.

Rock fill dams: general characteristics, rock fill materials, foundation, construction, deformations, and types of dams.



Design of rock fill dams: design of dam section, concrete face and earth core, Nature of failures and damages, case studies.

Learning Resources:

Text Books:

1. B. Singh and R. S. Varshney, "Engineering for Embankment Dams", A.A. Balkema, 1995.
2. H.D. Sharma, "Embankment Dams", Oxford and IBH Publishing Co., 1991.

Reference Books:

1. S.K. Garg, "Irrigation Engineering and Hydraulic Structures", Khanna Publishers, 2006.
2. Christian Kutzner, "Earth and Rockfill Dams", A.A. Balkema, 1997.
3. J. L. Sherard, "Earth and Earth Rock Dams", John Wiley & Sons Inc, 1963.

Online Resources:

1. <https://nptel.ac.in/content/storage2/courses/105105110/pdf/m4l04.pdf>



DEC CEXX GEOTECHNICS OF WASTE AND WASTE CONTAINMENT

L-T-P (C)
2- 0-0 (2)

Pre-requisites: None

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

CO1	Characterize landfill materials and determine their engineering properties
CO2	Select suitable sites for constructing landfills
CO3	Design of suitable liner for landfills
CO4	Adapt to developments in landfill engineering and monitoring

Detailed syllabus:

Sources and types of wastes; Environmental and engineering properties of wastes; Solid Waste Regulations, Waste generation, Waste characterization, Physical properties of Waste, Waste separation and processing, Composting, Landfills, Incineration. New and developing government policies; Beneficial re-use of wastes;

Fundamentals of waste-soil interaction; Containment systems and basic principles; Lining and capping systems; Leachate and gas collection systems;

Landfill Gases Reclaiming potentially combustible sites – introduction to combustion process, combustion tests, use of combustion potential tests – land fill gases, principal gases and their properties – gas monitoring, data assessment and remedial solutions. Compacted soil liners; Admixed soil liners; Geosynthetic clay liners; Geomembranes; Drainage layers; Geosynthetic composites; Seepage flow; Contaminant transport; Landfill settlement; Landfill slope stability; Conventional caps, ET caps; Ground water monitoring; Landfill gas;

Post-Closure of Engineered Landfills Establishment of new landscapes, Introduction, plant requirements, soil cover, soil fertility, site preparation, establishing grass cover – establishing trees and shrubs, maintenance. Post-closure monitoring; Bioreactor landfills; Landfill mining; End-use of closed landfills; Impoundments; Integrated waste management and alternative landfills.

Learning Resources:

Text Books:

1. Sharma H.D. and Reddy K.R., “Geo-environmental Engineering: Site Remediation, Waste Containment, and Emerging Waste Management Technologies”, John Wiley, New Jersey, 2004.

Commented [HC26]: Suggestion: Detail syllabus should be represented
Response: The detailed syllabus has been included for this course



National Institute of Technology Andhra Pradesh (Department of Civil Engineering)

2. Yong, R.N. “Geoenvironmental Engineering: Contaminated Ground: Fate of Pollutions and Remediation”, Thomson Telford, 2000.
3. Reddy L.N. and Inyang, H.I., “Geoenvironmental Engineering: Principles and Applications”, Marcel Dek, 2000.
4. Datta, M., “Waste Disposal in Engineered Landfills”, Narosa Publishers, Delhi, 231 pages, 1997.

Reference Books:

1. Raju, V.S., Datta, M., Seshadri, V., and Agarwal, V.K., “Ash Ponds and Ash Disposal Systems”, Narosa Publishers, Delhi, 424 pages, 1996.
2. Datta, M., Parida, B.P., Guha, B.K. and Sreekrishnan, T., “Industrial Solid Waste Management and Landfilling Practice”, Narosa Publishers, Delhi, 204 pages, 1999.
3. David E. Daniel, “Geotechnical Practice for Waste Disposal”, Published by Chapman & Hall, London, 1993.
4. Bagchi, A., "Design of landfills and integrated solid waste management" John Wiley & Sons, Inc., USA, 2004.
5. Qian, X., R. M. Koerner, and D. H. Gray. “Geotechnical Aspects of Landfill Design and Construction”, New Jersey: Prentice Hall, Upper Saddle River, 2002.

Other Suggested Readings:

1. <https://ocw.mit.edu/courses/civil-and-environmental-engineering/1-34-waste-containment-and-remediation-technology-spring-2004/lecture-notes/>
2. https://onlinecourses.nptel.ac.in/noc21_ce57/preview
3. <https://www.epa.gov/landfills>



DEC

CEXX

EARTH RETAINING STRUCTURES

L-T-P (C)
2-0-0 (2)

Pre-requisites: None

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

CO1	Calculate earth pressures on various earth retaining structures
CO2	Select suitable retaining structure for different Engineering works
CO3	Design different earth retaining structures
CO4	Appraise state-of-the-art retaining wall structures

Detailed syllabus:

Earth Pressure: Earth pressure at rest, Basic concepts and classical lateral earth pressure theories Rankine's and Coulomb's earth pressure and limitations, graphical methods and their interpretations.

Retaining Walls: types, modes of failure, stability checks, drainage systems, Principles of design, specifications, and pressure distribution variations.

Sheet Pile Walls: use of sheet pile walls, types of sheet piles, design of cantilever sheet pile walls in granular and cohesive soils, design of anchored sheet pile walls by free earth method in granular and cohesive soils, Rowe's moment reduction theory, design of anchored sheet pile wall by fixed earth method, design of anchors-location of anchorage.

Braced Cuts and Cofferdams: lateral earth pressure on sheeting in sand and clayey soils, types of sheeting and bracing system, design of braced cuts, use of cofferdams, types of coffer dams, merits and demerits, design of coffer dams.

Recent Development in Earth Retaining Structures: Reinforced earth-applications, components, design of reinforced earth wall, Gabian walls- function, application, advantages, crib walls, nail nailing wall.

Learning Resources:

Text Books:

1. B.M. Das, "Foundation Engineering", Cengage Learning, 2007.
2. Gulhati, Shashi and M. Datta, "Geotechnical Engineering", Mc.GrawHill Book Company, 2005.
3. J.E. Bowels, "Foundation Analysis and Design", McGraw Hill Book Company, 1997.

Reference Books:

1. C.R.I. Clayton, Rick I. Woods and Andrew J.Bond, "Earth pressure and Earth-Retaining structure", Third edition, 2013.
2. Hugh books, "Basics of Retaining wall design", 11th Edition, 2018.

Commented [HC27]: Suggestion: verify course content is overlapping with ground improvement techniques/ make sure that content should not be overlapped
Response: The content has been reviewed, and less than 5% of the topics overlap with GIT.



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Other Suggested Readings:

1. <https://nptel.ac.in/courses/105/106/105106052/#>



II- SEMESTER
DEPARTMENT ELECTIVE- III & IV



**DEC CEXX SOIL STRUCTURE INTERACTION L-T-P (C)
2- 0-0 (2)**

Pre-requisites: None

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

CO1	Interpret the mechanism at the interfaces and joints in structural and foundation systems
CO2	Analyze the problems involving complex behaviour of interfaces between the soil and foundation
CO3	Apply suitable constitutive models to analyze soil structure interaction problems
CO4	Apply the concepts of soil structure interaction for earthquake resist design of buildings

Detailed syllabus:

Introduction: Stresses and displacements in soils, solids and structures, Constitutive relations, Fundamentals of soil plasticity, Mathematical modelling, Differential equations in solid mechanics and soil mechanics, Mechanics of soil-structure interaction.

Beams and plates on elastic foundation: Elastic and elasto-plastic analyses of footings and raft foundations, Numerical methods, Finite difference methods

Analysis of axially and laterally loaded single pile and pile groups, Pile-cap-pile-soil interaction, Behaviour of piled-raft foundations.

Static interaction analysis of structures founded on shallow and deep foundations.

Dynamics of foundations: Foundation input motion, Foundation embedded in a layered half space, Seismic soil-structure interaction analysis in time domain for buildings and bridges. Examples and Case studies.

Learning Resources:

Text Books:

1. C. S. Desai, and M. Zaman, “Advanced Geotechnical engineering –Soil Structure Interaction using Computer and Material Models”, CRC Press, 2013.
2. D. M. Wood, “Geotechnical Modelling”, Spon Press, London, 2004.
3. A P. S. Selvadurai, “Elastic Analysis of Soil-Foundation Interaction”, Developments in Geotech.



Engg., Elsevier, New York, 1979.

Reference Books:

1. J. A. Hemsley, "Elastic Analysis of Raft Foundations", Thomas Telford, London, 1998.
2. D. M. Potts, and L. Zdravkovic "Finite Element Analysis in Geotechnical Engineering: Application", Thomas Telford, London, 2001.

Other Suggested Readings:

1. <https://nptel.ac.in/courses/103/106/10310607>



DEC CEXX TRANSPORTATION GEOTECHNICS

**L-T-P (C)
2- 0-0 (2)**

Pre-requisites: None

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

CO1	Geotechnical Aspects of Pavements and Railroads
CO2	Subgrade Evaluation Procedures
CO3	Laboratory characterization of geo-materials for pavement and railroad applications
CO4	Stress-Dependent behaviour of geo-materials, and their effects on pavement and railroad performance

Detailed syllabus:

Introduction: Overview of pavement and railroad track design philosophies, Historical evolution of design practices, Importance and function of substructure layers

Subgrade Soils: Soil classification and desirable engineering properties, Shear strength characterization of soils, Cyclic response of subgrade soils; Modulus of subgrade reaction, Laboratory and field evaluation techniques of subgrade soils

Granular Materials: Classification and essential properties of aggregates and ballast, Design of aggregate gradation, Shear strength and resilient behavior of aggregates and railroad ballast under cyclic loads, Resilient modulus testing and model development, Anisotropic behavior of unbound aggregates and its impact on performance

Embankment Construction: Effects of traffic loads, natural forces, and material quality, Stage construction techniques, Use of reinforced earth for embankment stability

Design Practices: Principles and theoretical concepts of rigid, flexible pavements and railroads, Permanent deformation testing and modeling, Current design practices

Learning Resources:

Text Books:

1. Li, D., Hyslip, J., Sussmann, T., & Chrismer, S. "Railway geotechnics", CRC Press, 2015.
2. Caicedo, B. "Geotechnics of roads: fundamentals", CRC Press, 2018.
3. Bandara, N., & Gunaratne, M., "Geotechnical Aspects of Pavement Engineering". Momentum Press, 2018.



Reference Books:

1. Papagiannakis, A. T., & Masad, E. A., “Pavement design and materials”, John Wiley & Sons, 2024.
2. Mallick, R. B., & El-Korchi, T., “Pavement engineering: principles and practice”, CRC Press, 2008.
3. Geotechnical Aspects of Pavements, FHWA NHI-05-037, Federal Highway Administration, U.S. Department of Transportation.
4. Koerner, R. M. “Designing with geosynthetics”, (Vol. 796). Upper Saddle River, NJ, USA: Pearson Prentice Hall, 2005.
5. Rao, G. V., “Principles of Transportation and Highway Engineering”, Tata McGraw-Hill, 1996.
6. Chakroborty, P., & Das, A. “Principles of transportation engineering”, PHI Learning Pv Ltd, 2017.

Other Suggested Readings:

1. IRC 37-2018. “Guidelines for the design of flexible pavements”. Indian code of practice, IRC, 37.
2. AASHTO, G., “Guide for design of pavement structures. American Association of State Highway and Transportation Officials”, Washington, DC, 1993.



**DEC CEXX REMOTE SENSING IN GEOTECHNICS L-T-P (C)
2-0-0 (2)**

Pre-requisites: None

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

CO1	Understand the Fundamentals of Remote Sensing.
CO2	Apply Remote Sensing Techniques in Geotechnical Engineering.
CO3	Perform Remote Sensing Data Processing and Analysis.
CO4	Evaluate Real-world Case Studies and Field Applications using GIS tools.

Detailed Syllabus:

Fundamentals of Remote Sensing: Electromagnetic Radiation, Remote Sensing Principles, Platforms, Sensors, Data Acquisition Systems, Data Reception, Processing and Image Interpretation.

Data Processing and Analysis: Image Enhancement Techniques, Image Classification, Geographic Information Systems: Georeferencing and Map Projections, Spatial Data Models, Spatial Data Analysis.

Applications in Geotechnics: Landslide Mapping and Monitoring, Slope Stability Assessment, Ground Deformation Monitoring, Material Identification and Mapping, Engineering Geology Applications, Disaster Management, Geotechnical Data Integration.

Case Studies and Field Application: Real-world examples of remote sensing applications in Geotechnical Engineering. Software and Tools: Introduction to remote sensing software and GIS tools.

Learning Resources:

Text Books:

1. Lillesand, T.M. and Kiefer, R.W., “Remote Sensing and Image Interpretation”, John Wiley 1987.
2. Kang-Tsung Chang, “Introduction to Geographic Information Systems”, Tata McGraw Hill Publishing Company Ltd, New Delhi, 2015.
3. Jensen, J.R., “Remote Sensing of the Environment an Earth Resource Perspective”, Pearson Education, Delhi, 2003.
4. Gupta, R. P, “Remote Sensing Geology”, Springer, 2005.



Reference Books:

1. Jensen, J. R. “Introductory digital image processing: A remote sensing perspective”, Prentice Hall series in geographic information science.
2. Abbott, P.L., “Natural Disasters”, McGraw Hill Education, 9th Edition, 2013.
3. Porter, M., Jakob, M., Savigny, K.W., “Geohazard Risk Management for Linear Facilities”, 310p, Springer, 2015.
4. Nicholas, C., “Geohazards: Natural and Human”, Prentice Hall, 1994.

Other Suggested Readings:

1. https://onlinecourses.nptel.ac.in/noc25_ce125/preview



DEC CEXX OFFSHORE GEOTECHNICS

L-T-P (C)
2- 0-0 (2)

Pre-requisites: None

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

CO1	Analyze index and engineering properties of marine clays
CO2	Adopt suitable investigation method and sampling techniques for these marine deposits
CO3	Analyze loads on offshore structures and select appropriate foundation for these structures
CO4	Evaluate the stability of seafloor and pipelines

Detailed syllabus:

Marine soil deposits: Offshore environment, offshore structures and foundations, Specific problems related to marine soil deposits, Physical and engineering properties of marine soils

Behaviour of soils subjected to repeated loading: Effect of wave loading on offshore foundations, Behaviour of sands and clays under cyclic loading, Laboratory experiments including repeated loading, Cyclic behaviour of soils based on fundamental theory of mechanics, Approximate engineering methods which can be used for practical cases

Site Investigation in the case of marine soil deposits: Challenges of site investigation in marine environment, Different site investigation techniques, sampling techniques, Geophysical methods, Recent advancements in site investigation and sampling used for marine soil deposits

Foundations in marine soil deposits: Different offshore and near shore foundations, Gravity platforms, Jack-up rigs, pile foundations, caissons, spudcans, anchorage systems, foundations for windmills

Seafloor Stability: causes of seafloor instability, geological features of submarine slides, mechanisms of instability, slope stability under gravity forces and wave forces, Effects of soil instability on piles, installation and stability of submarine pipelines, Identify key aspects of geotechnical pipeline design

Learning Resources:

Text Books:

Commented [HC28]: Suggestion: Elaborate topics
Response: Suggested topic has been included



National Institute of Technology Andhra Pradesh (Department of Civil Engineering)

1. Randolph M. and Susan G., “Offshore Geotechnical Engineering”, CRC Press, 1st Edition, 2017.
2. Thompson D. and Beasley D. J., “Handbook of Marine Geotechnical Engineering”, Military Bookshop, Illustrated edition, 2012.

Reference Books:

1. Robert. M. Koerner., “Handbook of Marine Geotechnical Engineering”, Xlibris, 6th Edition, 2012.
2. Mark R. and Susan G., “Offshore Geotechnical Engineering”, CRC Press, 1st Edition, 2011.
3. Military Soils Engineering: The Official U.S. Army / U.S. Marine Corps Technical Manual TM 3-34.6 / McRp 3-17.7g, 2012.

Other Suggested Readings:

1. <https://nptel.ac.in/courses/114/106/114106042/>
2. <https://nptel.ac.in/courses/114/106/114106011/>
3. <https://nptel.ac.in/courses/114/106/114106032/>
4. <https://nptel.ac.in/courses/114/106/114106035/>
5. <https://nptel.ac.in/courses/114/105/114105002/>
6. <https://nptel.ac.in/courses/114/106/114106015/>
7. <https://nptel.ac.in/courses/105/106/105106053/>
8. <https://nptel.ac.in/courses/105/105/105105170/>



DEC CEXX TUNNELLING TECHNOLOGY

L-T-P (C)
2- 0-0 (2)

Pre-requisites: None

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

CO1	Select specific method of tunnel driving for a given ground condition
CO2	Design tunnel excavation methods.
CO3	Identify possible difficulties in different ground conditions.
CO4	Select suitable tunnel support systems and its design.

Detailed syllabus:

Tunnels in Soils and Rocks: Benefits of tunnelling, Tunnels for different purposes, Site investigation and geophysical methods adopted for tunnelling purposes, Rock rating and classification, Instrumentation on tunnels

Tunnelling methods: Drill and blast method, Tunnel boring machine, NATM, Shield tunnelling, Earth pressure method, Application of compressed air

Tunnel lining and supports: Different types of support measures adopted in tunnelling, Analysis of stresses on the tunnel lining, Design of tunnel lining and support measures

Tunnelling Mechanics: Behaviour of soils and rocks, Stress and deformation fields around tunnels, Analytical equations used and derivations, Stability problems in tunnels- Building Response to Tunneling.

Learning Resources:

Text Books:

1. Singh B. and Goel R. K., "Tunneling through weak rocks", Elsevier, 2006.
2. Heidelberg V. B., "Tunneling and Tunnel Mechanics", Springer, 2005.

Reference Books:

1. Hudson, J.A., "Rock Mechanics Principles in Engineering Practice", CIRIA, Butterworth & Co, London, 1989.
2. Hoek, E., and Brown, E., "Underground excavations in rock", CRC Press, First Edition, 1980.



Other Suggested Readings:

1. <https://nptel.ac.in/courses/105/107/105107208/>
2. <https://nptel.ac.in/courses/105/103/105103182/>
3. <https://nptel.ac.in/courses/105/106/105106055/>
4. <https://nptel.ac.in/courses/105/104/105104147/>



DEC

CEXX

CRITICAL STATE SOIL MECHANICS

L-T-P (C)
2-0-0 (2)

Commented [HC29]: Suggestion: Check Overlapping this course content with advance soil mechanics
Response: It is been verified and the course content is not similar

Pre-requisites: Advanced Soil Mechanics

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

CO1	Demonstrate basic mechanisms behind index properties and tests on soil.
CO2	Relate behaviour of soils subjected to various loading and drainage conditions within unified framework of Critical state soil mechanics
CO3	Apply theory of elasticity and plasticity to characterize the stress – strain behaviour of soils
CO4	Formulate basic elasto-plastic model based on Critical State Soil Mechanics (CSSM) like Cam-clay

Detailed syllabus

Soil Behaviour: State of stress and strain in soils, Stress and strain paths and invariants, behaviour of soils under different laboratory experiments

The Critical state line and the Roscoe surface: Families of undrained tests, Families of drained tests, the critical state line, drained and undrained surfaces, The Roscoe surface

Behaviour of Over consolidated samples: The Hvorslev surface: Behaviour of over consolidated samples, drained and undrained tests, The Hvorslev surface, complete State Boundary Surface, Volume changes and pore water pressure changes

Behaviour of Sands: The critical state line for sands, Normalized plots, the effect of dilation, Consequences of Taylor's model

Behaviour of Soils before Failure: Elastic and plastic deformations, Plasticity theory, Development of elastic-plastic model based on critical state soil mechanics, The Cam-clay model, The modified Cam-clay model

Learning Resources:

Text Books:

1. Azizi F, "Applied Analysis in Geotechnics", E & FN Spon, London, 2000.
2. Atkinson J H and Bransby P L, "The Mechanics of Soils – An Introduction to Critical State Soil Mechanics", McGraw-Hill Book Company Limited, London, 1982.
3. Schofield A N and Wroth C P, "Critical State Soil Mechanics", McGraw-Hill Book Company Ltd., London, 1968.



Reference Books:

1. Azizi F, "Engineering Design in Geotechnics", 2013.
2. Wood D M, "Soil Behaviour and Critical state Soil Mechanics", Cambridge University Press, New York, 1990.
3. Parry R H G, "Mohr Circles: Stress Paths and Geotechnics", CRC Press, 2004

Other Suggested Readings:

1. https://onlinecourses.nptel.ac.in/noc21_ce23/preview



DEC CEXX COMPUTATIONAL GEOMECHANICS

L-T-P (C)
2- 0-0 (2)

Pre-requisites: None

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

CO1	Solve linear and non-linear equations using numerical techniques.
CO2	Apply finite difference and finite element method for analysing behaviour of geotechnical structures
CO3	Apply correlation and regression analysis for the geotechnical data
CO4	Solve problem of consolidation and flow through porous media using Numerical technique

Detailed syllabus

Solution of Non-linear Equations: Bisection, False Position, Newton-Raphson, Successive approximation method, Iterative methods.

Solution of Linear Equations: Jacobi's method, Gauss Seidal method, Successive over relaxation method.

Finite Difference Method: Two point Boundary value problems – Disichlet conditions, Neumann conditions; ordinary and partial differential equations.

Finite Element Method: Fundamentals, Constitutive finite element models for soils.

Correlation and Regression Analysis: Correlation - Scatter diagram, Karl Pearson coefficient of correlation, Limits of correlation coefficient; Regression –Lines of regression, Regression curves, Regression coefficient, Differences between correlation and regression analysis. One-dimensional Consolidation - Theory of consolidation, Analytical procedures, Finite difference solution procedure for multilayered systems, Finite element formulation

Flow Through Porous Media - Geotechnical aspects, Numerical methods, Applications and Design analysis, Flow in jointed media.

Risk assessment in Geotechnical Engg. - Probabilistic site characterisation and design of foundations- Application of Various Commercially Available Geotechnical Software.

Learning Resources:

Text Books:

1. C. S. Desai and John T. Christian, "Numerical Methods in Geotechnical Engineering",

Commented [HC30]: Suggestion: Check the sequence of elective courses
Response: The sequence of all elective courses (I, II, III & IV) has been rearranged as per the suggestions.



National Institute of Technology Andhra Pradesh (Department of Civil Engineering)

Mc. Graw Hill Book Company, 1977.

2. M.K. Jain, S.R.K. Iyengar and R.K. Jain, “Numerical Methods for Scientific and Engineering computations”, Third edition, New Age International (P) Ltd. Publishers, New Delhi, 2003.
3. D.J. Naylor and G.N. Pande, “Finite Elements in Geotechnical Engineering”, Pineridge Press Ltd., UK, 1981.
4. S. Helwany, “Applied soil mechanics”, John Wiley & sons, Inc, USA, 2007.

Reference Books:

1. Alexander Puzrin, “Constitutive Modelling in Geomechanics: Introduction”, Springer, 2012.
2. Sam Helwany, “Applied Soil Mechanics with ABAQUS Applications”, John Wiley & sons Inc, USA, 2007.

Other Suggested Readings:

1. <https://nptel.ac.in/courses/103/106/10310607>



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HEC

CEXX

HUMANITIES ELECTIVE COURSE

**L-T-P (C)
2-0-0 (2)**