Government College of Engineering, Chhatrapati Sambhajianagar

(An Autonomous Institute of Government of Maharashtra)

Station Road, Osmanpura, Chh. Sambahjinagar – 431005 (M.S.)

Phone – (0240) 2366101, 2366111, Fax (0240) 2332835

Master of Technology
(Geotechnical Engineering)

Curriculum for

M. Tech. Geotechnical Engineering

(NEP Compliant)

(With effect from academic year 2026-27 onwards)

Dr. S. S. Koranne
Head, Civil Engg.

Dr. Anil Karwankar
Dean , Academics

M.Tech. Geotechnical Engineering Curriculum
With effect from Academic Year 2026–2027
Approved in the 32nd Academic Council Meeting, dated 28th July 2026

Vision of the Institute

To be globally recognized leader in technical education through industry integration and societal wellbeing.

Mission of the Institute

1. To build career-ready graduates through multidisciplinary learning and industry-sync curricula.
2. To promote ecosystem for cutting-edge research, patents, publications, IPR, innovation, technology transfer and entrepreneurship.
3. To be a premier trusted partner of government allied bodies, industries, and society.

Motto of the Civil Engineering Department

To Build Strong Nation through Dedication.

Vision of the Civil Engineering Department

"To developed Civil Engineers with global standards through industry integration, innovation for sustainable infrastructure and societal wellbeing".

Mission of the Civil Engineering Department

1. To impart industry-oriented and multidisciplinary Engineering education.
2. To encourage research, publications, innovation, patents and sustainable Civil Engineering practices.
3. To actively engage with industry, Government and society through consultancy, projects and outreach activities.

Program Outcomes

After the successful completion of the master's programme in geotechnical engineering, the graduates will be able to:

1. Independently carry out research/investigation and development.
2. Write and present a substantial technical report/document.
3. Demonstrate a degree of mastery over the area as per the specialization of the program. The mastery should be at a level higher than the requirements in the appropriate bachelor program.

Program Specific Outcomes

After the successful completion of the master's programme in geotechnical engineering, the graduates will be able to:

1. Apply advanced laboratory and in situ testing methods to interpret complex soil and rock behavior for engineering design.
2. Utilize specialized geotechnical software and numerical methods to simulate and predict soil-structure interaction under diverse loading.

M. Tech Geotechnical Engineering Programme Components

Components		Total Credits
Programme Core Course (PCC)	Program Courses	20
Programme Elective Course (PEC)	Program Electives	10
Open Elective (OEC) Other than a particular program	Open Electives	02
Vocational and Skill Enhancement Course (VSEC)	Skill Courses	02
Ability Enhancement Course (AEC) Technical Presentation	Humanities Social Science and Management (HSSM)	02
Entrepreneurship/Economics/Management Courses (EEM)		02
Indian Knowledge System (IKS)		02
Research Methodology (RMC)	Experiential Learning Courses	02
Dissertation/Project/Internship (DIS/INT)		20
Co-curricular Courses (CC)	Liberal Learning Courses	Audit
	Total Credits	62

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Department of Civil Engineering

Teaching and Evaluation Scheme for NEP Compliant Curriculum

M. Tech (Geotechnical Engineering) Full Time

(From 2026-2027 onwards)

Semester -I											
			Teaching Scheme (Hrs/Week)			Continuous Evaluation in terms of Marks					
Category	Course Code	Course Name	TH	T	PR	Credits	ISE I	ISE II	ISE III	ESE	Total
ELC	CEELC5101	Research Methodology	2	0	0	2	10	10	-	30	50
PCC	CEPCC5101	Computational and Statistical Methods	3	0	0	3	20	20	-	60	100
PCC	CEPCC5110	Advanced Soil Engineering	3	0	0	3	20	20	-	60	100
PEC	CEPEC5101, CEPEC5121, CEPEC5122, CEPEC5123	Program Elective Course -I	3	0	0	3	20	20	-	60	100
PEC	CEPEC5124 TO CEPEC5127	Program Elective Course -II	3	0	0	3	20	20	-	60	100
VSEC	CEVSE5102	Mini Project	0	0	4	2	-	25	-	25	50
PCC	CEPCC5111	Geotechnical Engineering Laboratory – I	0	0	4	2	-	25	-	25	50
CC	INCCC5101	Audit Course (Stress Management by Yoga/Club Activity)	0	0	2	0	-	-	-	-	-
Total			**14**	**0**	**10**	**18**	**90**	**140**		**320**	**550**
Semester -II											
Category	Course Code	Course Name	TH	T	PR	Credits	ISE I	ISE II	ISE III	ESE	Total
PCC	CEPCC5212	Advanced Foundation Engineering	3	-	0	3	20	20	-	60	100
PCC	CEPCC5213	Ground Improvement Techniques	3	-	0	3	20	20	-	60	100
PCC	CEPCC5214	Soil Dynamics and Machine foundations	3	-	0	3	20	20	-	60	100
OE		Open Elective	2	-	0	2	10	10	-	30	50
PEC	CEPEC5228 TO CEPEC5231	Program Elective Course -III	4	0	0	4	20	20	-	60	100
PCC	CEPCC5215	Geotechnical Engineering Laboratory – II	0	0	2	1	-	25	-	25	50
PCC	CEPCC5216	Lab- Ground Improvement Techniques	0	0	2	1	-	25	-	25	50
AEC	CEAEC5202	Seminar	0	0	4	2	-	25	-	25	50
DIS	CEDIS5203	Dissertation-I	0	0	4	2	-	50	-	50	100
Total			**15**	**0**	**12**	**21**	**90**	**215**	**-**	**395**	**700**

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Teaching and Evaluation Scheme for NEP Compliant Curriculum

M. Tech (Geotechnical Engineering) Full Time

(From 2026-2027 onwards)

Semester -III											
			Teaching Scheme (Hrs/Week)			Continuous Evaluation in terms of Marks					
	Course Code	Course Name	TH	T	PR	Credits	ISE I	ISE II	ISE III	ESE	Total
EEM	CEEEM6101	AI For Earth Observation	2	0	0	2	10	10	-	30	50
IKS	CEIKS6101	Ancient Water Management Practices	2	0	0	2	10	10	-	30	50
DIS	CEDIS6104	Dissertation-II	0	0	16	8	-	100	-	150	250
PCC	CEPCC6117	Lab - Geotechnical Explorations & Advanced Soil Testing	0	0	2	1	-	25	-	25	50
Total			**04**	**0**	**18**	**13**	**20**	**145**	**-**	**235**	**400**
Semester -IV											
	Course Code	Course Name	TH	T	PR	Credits	ISE I	ISE II	ISE III	ESE	Total
OJT	CEOJT6202	Industrial Training	-	-	-	10	-	100	-	-	100
Total			**-**	**-**	**-**	**10**	**-**	**100**	**-**	**-**	**100**
Grand Total			**33**	**0**	**40**	**62**	**200**	**600**	**-**	**950**	**1750**

Note: The internship/Industrial Training of not less than 2 months' duration should be completed by the students in vacations.

Sr. No.	PEC-I	PEC-II	PEC-III
1	CEPEC5101: Groundwater Engineering	CEPEC5124: Reinforced Earth Structures	CEPEC5228: Forensic Geotechnical Engineering
2	CEPEC5121: Offshore Geotechnical Engineering	CEPEC5125: Pavement Analysis and Design	CEPEC5229: Applications of Geosynthetics in Geotechnical Engineering
3	CEPEC5122: Geology For Geotechnical applications	CEPEC5126: Geophysical Exploration Methods	CEPEC5230: Software Applications in Geotechnical Engineering
4	CEPEC5123: Environmental Geotechnology	CEPEC5127: Earth and Rockfill dam and Slope stability	CEPEC5231: Geotechnical Engineering for Underground Structures

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List of Open Electives I to be offered in PG Semester II (First Year)

Sr. No	Course code	Open Elective Course	Course offering department
1	AMOEC5214	Basics of Finite Element Method	Applied Mechanics
2	CSOEC6002	Data Science	CSE
3	CEOEC5201	Disaster Management	Civil
4	MEOEC6104	Additive Manufacturing	Mechanical
5	EEOEC5101	Data Science for Engineering Applications	Electrical
6	ECOEC5007	Artificial Intelligence of Things	E&TC

List of Humanities I to be offered in PG Semester III (Second Year)

Sr. No.	Course code	Humanities Course	Course offering Department
1	MEEEM6101	Entrepreneurship Skills	Mechanical
2	MEEEM6103	Industrial Management	Mechanical
3	ECEEM6004	AI Governance & Ethics	E&TC
4	CEIKS6101	Ancient Water Management Practices	Civil
5	INIKS6001	Vedic Approach To Mathematics	Applied Mathematics
6	EEEEM5101	Energy Audit & Management	Electrical
7	EEIKS5101	Vedic Approach To Mathematics	Electrical

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CEELC5101: Research Methodology		
Teaching Scheme	**Examination Scheme**	
Lectures: 02 Hrs. / Week	**ISE I**	**10 Marks**
Credits: 02	**ISE II**	**10 Marks**
	End Semester Examination	**30 Marks**
	TOTAL	**50 Marks**

Prerequisite: Nil

Course Description:

To guide students from understanding foundational research concepts to critically formulating research problems, culminating in the adept creation of comprehensive research plans and literature reviews. To develop a comprehensive understanding of various research methods, both qualitative and quantitative. To facilitate students in analyzing, evaluating, and creating research proposals. To attain mastery in data collection methods, sampling, data analysis techniques, and result interpretation for robust research outcomes. To equip students with the skills to proficiently create and present diverse research reports, encompassing various formats, oral delivery, technical writing, and ethical awareness regarding plagiarism.

Course Outcomes:

After completing the course students will able to;

Course Outcomes	
CO1	explain the fundamental concepts of research methodology, including research approaches, research design, literature review, and problem formulation to identify and define research problems effectively.
CO2	select and apply appropriate qualitative and quantitative research methods, sampling techniques, and data collection tools for conducting research in diverse domains.
CO3	develop a research proposal with clear objectives and hypotheses, analyze qualitative and quantitative data using appropriate statistical techniques, interpret research findings, and prepare comprehensive research reports.

Detailed Syllabus:

Unit 1	**Introduction to Research Methodology:** Meaning of Research, Objectives of Research, Research Approaches, Significance of Research, Research Methods versus Methodology, Research and Scientific Method, Research Process, Criteria of Good Research, Defining the Research Problem, Selecting the Problem, Techniques Involved in Defining a Problem, Research Design, Important Concepts Relating to Research Design, Developing a Research Plan, Literature Review.
Unit 2	**Methods of Research and Data Collection:** Qualitative and Quantitative Methods of Research like Historical, Case Study, Ethnography, Ex Post Facto, Documentary and Content Analysis, Survey (Normative, Descriptive, Evaluative, etc.), Field and Laboratory Experimental Studies. Characteristics of Research Methods and their Implications in Research Area. Concept of Sampling and other Concepts related to Sampling. Probability and Non-Probability Samples, their Characteristics and Implications. Tools of Data Collection, their Types, Attributes and Uses. Designing and Redesigning Research Tools like Questionnaire, Opinionnaire, Observation, Interviews, Scales and Tests, etc.

Unit 3	**Development of Research Proposal and Data Analysis:** Research Proposal and its Elements. Formulation of Research Problem—Criteria, Sources and Definition. Development of Objectives and Characteristics of Objectives. Development of Hypotheses and their Applications. Methods of Data Analysis: Analysis of Qualitative Data based on Various Tools. Analysis of Quantitative Data and its Presentation using Tables, Graphs, etc. Statistical Tools and Techniques of Data Analysis—Measures of Central Tendency and Dispersion. Decision Making with Hypothesis Testing through Parametric and Non-Parametric Tests. Validity and Delimitations of Research Findings.

Text and Reference Books

1. Garg B. L., Karadia R., Agarwal F. and Agarwal U. K., An introduction to Research Methodology, RBSA Publishers, 2002
2. Kothari C. R., Research Methodology: Methods and Techniques. New Age International, 1990.
3. Merriam S. B., Tisdell E. J., Qualitative Research: A Guide to Design and Implementation, 4th edition, John Wiley & Sons, 2016.
4. Creswell J. W., Research Design: Qualitative, Quantitative and Mixed Methods Approaches, 4th edition, SAGE Publications, Inc, 2014.
5. Olsen C., Devore J., Peck R., Introduction to Statistics and Data Analysis, 5th edition, Brooks/Cole, 2015.
6. Panneerselvam R., Research Methodology, 2nd edition, PHI Learning, 2014.

Mapping of Course outcome with Program Outcomes

Course Outcome	PO1	PO2	PO3	PSO1	PSO2
CO1	2	1	1	-	3
CO2	1	-	1	-	-
CO3	1	-	3	1	2

1 – Low 2 – Medium 3 – High

Assessment:

ISE I: Based on unit I and unit II

ISE II : Teacher's Assessment: Teachers Assessment of 10 marks is based on one of the / or combination of few of following:

1. Assignments
2. Power point presentation
3. Question & answer, interaction
4. Technical quiz
5. Attendance in the class

Assessment Pattern

Assessment Pattern Level No.	Knowledge Level	ISE I	ISE II	ISE III	End Semester Examination
K1	Remember	5	5		5
K2	Understand	5	5		5
K3	Apply				10
K4	Analyze				10
K5	Evaluate				
K6	Create				
Total Marks 50		10	10		30

Assessment table

Assessment Tool	K1	K2	K3	K4
	CO1, CO2, CO3	CO1, CO2, CO3	CO1, CO2, CO3	CO1, CO2, CO3
ISE I (10 Marks)	5	5		
ISE II(10 Marks)	5	5		
ISE III				
ESE Assessment (30 Marks)			15	15
Total Marks 50	10	10	15	15

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CEPCC5101: Computational and Statistical Methods		
Teaching Scheme	**Examination Scheme**	
Lectures: 03 Hrs. / Week	**ISE I**	**20 Marks**
Credits: 03	**ISE II**	**20 Marks**
	End Semester Examination	**60 Marks**

Course Description:

The objective of this course is to introduce the students to various methods of numerical solutions of ordinary differential equations such as Taylor's Series, Euler's Method, Runge Kutta Method. The course also develops the knowledge of Correlation and Regression Analysis, Skewness, Moments and Kurtosis. Students will gain an understanding of classification and presentation of data, probability theory and analysis. The course exposes students to the Finite difference methods, FEM, fuzzy and genetic algorithm and its applications to geotechnical engineering which are widely required to solve engineering problems.

Course Outcomes:

After completing the course students will be able to;

Course Outcomes	
CO1	apply various differential equations methods to the engineering.
CO2	apply regression and correlation analysis.
CO3	classify and also apply the knowledge of probability and probability theory.
CO4	develop FDM and FEM model and apply the knowledge of various soft computing tools such as fuzzy logic, neural network and genetic algorithm.
CO5	apply various differential equations methods to the engineering.

Detailed Syllabus:

Unit 1	**Introduction Numerical Solution:** Numerical Solution of Ordinary Differential Equations: Solution by Taylor's Series, Euler's Method, Runge Kutta Method, Newton Raphson Method, Bisection Method. Gauss-Jordan Method, Method of Leading Coefficient. Relaxation Method.
Unit 2	**Regression Analysis:** Simple Linear Regression, Evaluation of Regression – Confidence Intervals and Tests of Hypothesis – Multiple linear Regression – Correlation and Regression Analysis. Skewness, Moments and Kurtosis.
Unit 3	**Probability Techniques:** Classification and Presentation of data, Basic Concepts of Probability, Probability Axioms, Analysis and Treatment of Data, Population and Samples, Measures of Dispersions, Measures of Symmetry Discrete and Continuous Probability Distribution Functions.
Unit 4	**Finite difference methods:** Finite difference methods and their applications to water resources Engineering. Introduction to FEM and its applications to water resources Engineering.

Unit 5	**Fuzzy logic:** Fuzzy Mathematical Operations, Neural Networks, Mathematical Model of Neuron, Architecture. Introduction to genetic algorithm, Operators, Applications.

Text and Reference Books

1. Gupta. S.P., " Statistical Methods", S. Chand & Sons, New Delhi
2. Kothari C.R., "Research Methodology-Methods and Techniques", New Age International Publishers, New Delhi.
3. Gupta S.L. and Gupta Hitesh, “Research Methodology-Text and cases with SPSS applications” International Book
   House Pvt. Ltd., New Delhi.
4. Rao V and Rao H., “C++, Neural Networks and Fuzzy Logic”, BPB Publications, New Delhi.
5. Goldberg, D.E., “Genetic Algorithms in Search, Optimization & Machine Learning”, Addison Wesley Longman
   (Singapore) Pte. Ltd., Indian Branch, Delhi.
6. Klir George J. and Yuan Bo, “Fuzzy Sets and Fuzzy Logic”, PHI Learning Pvt. Ltd, New Delhi
7. Panneerselvam R., Research Methodology, 2nd edition, PHI Learning, 2014

Mapping of Course Outcome with Program Outcomes

Course outcome	PO1	PO2	PO3	PSO1	PSO2
CO1	2	3	3	1	1
CO2	1	2	1	1	2
CO3	-	2	3	1	1
CO4	-	3	3	1	2
CO5	2	2	3	1	2

3-High, 2- Medium, 1 - Low

Assessment:

ISE I: Based on unit I and unit II

ISE II : Teacher’s Assessment: Teachers Assessment of 20 marks is based on one of the / or combination of few of following:

1. Assignments
2. Power point presentation
3. Question & answer, interaction
4. Technical quiz
5. Attendance in the class

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Assessment Pattern:

Assessment Pattern Level No.	Knowledge Level	ISEI	ISEII	ISEIII	End Semester Examination
K1	Remember	05	05	-	12
K2	Understand	05	05	-	12
K3	Apply	10	10	-	12
K4	Analyze	-	-	-	12
K5	Evaluate	-	-	-	12
Total Marks 100		20	20		60

Assessment table:

Assessment Tool	K1, K2, K3	K1, K2, K3	K1, K2, K3	K1, K2, K3	K1, K2, K3
	CO1	CO2	CO3	CO4	CO5
ISEI(20 Marks)	10	10	-	-	-
ISEII (20 Marks)	-	-	10	10	-
ESE Assessment (60Marks)	12	12	12	12	12
Total Marks 100	22	22	22	22	12

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CEPCC5110: Advanced Soil Engineering		
Teaching Scheme	**Examination Scheme**	
Lectures: 03 Hrs. / Week	**ISE I**	**20 Marks**
Credits: 03	**ISE II**	**20 Marks**
	End Semester Examination	**60 Marks**

Course Description: This course focuses on study of soil properties and classification of soils, calculation of stresses, shear strength, and earth pressure**,** identification of expansive soils.

Course Outcomes:

After completing the course students will be able to;

Course Outcomes	
CO1	interpret soil properties and classify the soils.
CO2	carry out calculations of stresses, shear strength, and earth pressure.
CO3	carry out settlement computations.
CO4	analyze the stability of slopes, retaining walls.
CO5	suggest drainage systems for different site conditions, Identify expansive soils and modification of expansive soil.

Detailed Syllabus:

Unit 1	**Introduction to soil engineering:** Civil engineering problems related to soils, Complexity of soil nature, Soil formation and soil types, regional soil deposits of India, Soil as a multiphase material, Important relationships, Consistency of clays, Soil aggregate properties, Applications of soil classification.
Unit 2	**Soil structure and fabric:** Clay minerals, Structure and engineering behavior of compacted soils, Elastic methods of stress distribution in soils, Approximate stress distribution methods for loaded areas, Shear strength behavior of sand and clays, Drainage conditions and strength parameters. Soil sampling and degree of disturbance.
Unit 3	**Steady state flow:** Seepage, Laplace equation, Flow nets, Prevention of erosion, Compressibility and consolidation, Three dimensional consolidation, Settlement computations and analysis, Compression index, Empirical correlations, Sand drains.
Unit 4	**Stability of slopes:** Limiting equilibrium method and critical stages in stability, Total and effective stress method of analysis, Use of stability coefficients, Effect of earthquake force-Pseudo static analysis, Earth pressure theories, Design considerations for retaining walls.
Unit 5	**Drainage and De-watering and Wells:** Design of dewatering system, Adverse effects of drainage, Identification of expansive soils, Parameters, Classification, Moisture changes, Effects of swelling, Preventive measures and modification of expansive soil, Liquefaction, Rheology.

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Text and Reference Books

1. Joseph E. Bowels, "Physical and Geotechnical Properties of Soil", Tata Mc. Graw-Hill.
2. Braja M. Das, "Advanced Soil Mechanics", Tata Mc. Graw-Hill.
3. R.F. Scot, "Principles of Soil Mechanics", Addison and Wesley.
4. Gopal Ranjan and A. S. R. Rao, "Basic and Applied Soil Mechanics", New Age International Publishers.
5. Gulhati S. K. and Manoj Datta, "Geotechnical engineering", Tata Mc. Graw-Hill.

Mapping of Course Outcome with Program Outcomes

Course outcome	PO1	PO2	PO3	PSO1	PSO2
CO1	1	3	1	3	2
CO2	3	2	3	2	2
CO3	2	1	2	3	1
CO4	1	2	3	3	1
CO5	3	3	3	2	2

3-High, 2- Medium, 1 - Low

Assessment:

ISE I: Based on unit I and unit II

ISE II: Teacher's Assessment: Teachers Assessment of 20 marks is based on one of the / or combination of few of following:

1. Assignments
2. Power point presentation
3. Question & answer, interaction
4. Technical quiz
5. Attendance in the class

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Assessment Pattern:

Assessment Pattern Level No.	Knowledge Level	ISEI	ISEII	ISEIII	End Semester Examination
K1	Remember	05	05	-	12
K2	Understand	05	05	-	12
K3	Apply	10	10	-	12
K4	Analyze	-	-	-	12
K5	Evaluate	-	-	-	12
Total Marks 100		20	20	-	60

Assessment table:

Assessment Tool	K1, K2, K3	K1, K2, K3	K1, K2, K3	K1, K2, K3	K1, K2, K3
	CO1	CO2	CO3	CO4	CO5
ISEI(20 Marks)	10	10	-	-	-
ISEII (20 Marks)	-	-	10	10	-
ESE Assessment (60Marks)	12	12	12	12	12
Total Marks 100	22	22	22	22	12

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CEPEC 5101 : Ground Water Engineering		
Teaching Scheme	**Examination Scheme**	
Lectures: 03 Hrs. / Week	**ISE I**	**20 Marks**
Credits: 03	**ISE II**	**20 Marks**
	End Semester Examination	**60 Marks**

Course Description:

This course introduces different aspects of ground water engineering, determination of permeability and transmissibility by Theim and Dupuit's theory. It also evaluates aquifer properties for confined aquifer by Theis's method, Jacob and Chow's method. Topics range from construction of well, water well design, drilling, components of ground water, ground water flow and ground water development and management.

Course Outcomes:

After completing the course students will be able to;

Course Outcomes	
CO1	demonstrate the different terminologies related with groundwater hydrology.
CO2	identify suitable method of determination of aquifer parameters.
CO3	choose suitable ground water exploration techniques and assess ground water potential.
CO4	compare and contrast suitable ground water development and management methods.
CO5	estimate ground water recharge.

Detailed Syllabus:

Unit 1	**Ground Water:** porosity, retention of water in rocks, yield of rock, compressibility of rock, zone of aeration and saturation, fluctuation of water table and piezometric surfaces, storage coefficients of aquifers, specific yield, specific retention, unconfined and confined aquifer, ground water potential in India, geophysical methods for groundwater explorations.
Unit 2	**Ground water flow:** Laminar and turbulent flow, Darcy's law, Reynolds number, permeability and transmissibility, Groundwater flow potential, Ground water theory for one-, two- and three-dimensional problem, Differential equations governing groundwater flow for steady and unsteady state problems, Theim and Dupuit's theory for unconfined and confined aquifers, use of finite difference method to solve simple ground water flow problem.
Unit 3	**Evaluation of Aquifer Properties:** aquifer tests, control well, observation well, Solution of aquifer parameters for confined aquifer by Theis method, Jacob and Chow's method, Theis' recovery method, bounded aquifer, interference among wells, aquifer properties for bounded aquifers by theory of images.
Unit 4	**Construction of Wells and Ground Water Modeling:** types of wells and method of construction, tube well design and well drilling: well screen, development and completion of wells, well performance test, well loss, Rotary drilling and Rotary percussion drilling, maintenance of wells. Groundwater Modeling: Groundwater flow, sand models , membrane model, thermal model, electric analog model and mathematical models.

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Unit 5	**Groundwater Recharge, Development and Management:** Components of ground water balance, estimation of recharge component, ground water storage changes, conjunctive use, artificial recharge of groundwater- different methods, subsurface dam, recharge by urban storm runoff, percolation from tanks, recharge from irrigated fields, groundwater quality, estimation of ground water discharge, ground water resource evaluation in India.

Text and Reference Books:

1. Todd, D.K. "Ground Water Hydrology", John Wiley & Sons, Singapore.
2. Raghunath, H.M. "Ground Water" New Age International (P) Limited, New Delhi.
3. Karanth, K. R. “Ground Water Assessment Development and Management”, Tata McGraw Hill Publishing Company Limited, New Delhi
4. Domenico "Concepts and Models in Groundwater Hydrology", McGraw Hill Inc., NewYork
5. L. Harvil and F. G. Bell, *Ground Water Resources and Development*, Butterworth’s, London.
6. Herbert F Wang and Mary P. Anderson “Introduction to Ground Water Modeling”, W.H. Freeman and Company, NewYork

Mapping of Course Outcome with Program Outcomes

Course outcome	PO1	PO2	PO3	PSO1	PSO2
CO1	2	3	1	3	2
CO2	3	1	1	2	1
CO3	1	3	2	3	2
CO4	1	3	2	3	1
CO5	3	3	2	2	1

3-High, 2- Medium, 1 - Low

Assessment:

ISE I: Based on unit I and unit II

ISE II : Teacher’s Assessment: Teachers Assessment of 20 marks is based on one of the / or combination of few of following

1. Assignments
2. Power point presentation
3. Question & answer, interaction
4. Technical quiz,
5. Attendance in the class

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M.Tech. Geotechnical Engineering Curriculum
With effect from Academic Year 2026–2027
Approved in the 32nd Academic Council Meeting, dated 28th July 2026

Assessment Pattern:

Assessment Pattern Level No.	Knowledge Level	ISEI	ISEII	ISEIII	End Semester Examination
K1	Remember	05	05	-	12
K2	Understand	05	05	-	12
K3	Apply	10	10	-	12
K4	Analyze	-	-	-	12
K5	Evaluate	-	-	-	12
Total Marks 100		20	20	-	60

Assessment table:

Assessment Tool	K1, K2, K3	K1, K2, K3	K1, K2, K3	K1, K2, K3	K1, K2, K3
	CO1	CO2	CO3	CO4	CO5
ISEI(20 Marks)	10	10	-	-	-
ISEII (20 Marks)	-	-	10	10	-
ESE Assessment (60Marks)	12	12	12	12	12
Total Marks 100	22	22	22	22	12

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M.Tech. Geotechnical Engineering Curriculum
With effect from Academic Year 2026–2027
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CEPEC 5121: Offshore Geotechnical Engineering		
Teaching Scheme	**Examination Scheme**	
Lectures: 03 Hrs. / Week	**ISE I**	**20 Marks**
Credits: 03	**ISE II**	**20 Marks**
	End Semester Examination	**60 Marks**

Course Description:

This course focuses on understanding the behavior of seabed soils under marine conditions and applying geotechnical principles to design safe and stable foundations for offshore structures like oil and gas platforms, offshore wind turbines, subsea pipelines, and marine structures.

Course Outcomes:

After completing the course students will be able to;

Course Outcomes	
CO1	understand offshore site investigations like sampling and sampling disturbance.
CO2	know in situ testing, wireline technology.
CO3	understand stability of submarine slopes and stability of submarine pipelines.
CO4	offshore pile foundations for jacket type structures.
CO5	suggest foundations for gravity structures.

Detailed Syllabus:

Unit 1	**Submarine soils:** Origin, nature and distribution, Terrigenic and pelagic soils, Submarine soils of India.
Unit 2	**Engineering behavior of submarine soils:** Engineering behavior of submarine soils: under-consolidated soils.
Unit 3	**Soils:** Calcareous soils, cemented soils, corals.
Unit 4	**Offshore site investigations:** Sampling and sampling disturbance, insitu testing, wireline technology. Offshore pile foundations for jacket type structures.
Unit 5	**Foundations:** Foundations of gravity structures, Foundations for jackup rigs.

Text and Reference Books:

1. E.T. Richard Dean. Offshore Geotechnical Engineering, ICE, UK, London, 2009.
2. Mark Randolph and Susan Gourvenec. Offshore Geotechnical Engineering, CRC Press, 2011.
3. H. G. Poulos. Marine Geotechnics, Unwin Hyman, 1988.
4. Susan Gourvenec and Mark Cassidy. Frontiers in Offshore Geotechnics, Taylor & Francis, 2005.
5. William O. McCarron. Deepwater Foundations and Pipeline Geomechanics, J. Ross

Mapping of Course Outcome with Program Outcomes

Course outcome	PO1	PO2	PO3	PSO1	PSO2
CO1	2	3	3	1	3
CO2	3	1	3	-	2
CO3	2	1	3	1	3
CO4	2	1	3	1	3
CO5	3	3	3	1	2

3-High, 2- Medium, 1 – Low

Assessment:

ISE I: Based on unit I and unit II

ISE II : Teacher's Assessment: Teachers Assessment of 20 marks is based on one of the / or combination of few of following

1. Assignments
2. Power point presentation
3. Question & answer, interaction
4. Technical quiz
5. Attendance in the class

Assessment Pattern:

Assessment Pattern Level No.	Knowledge Level	ISEI	ISEII	ISEIII	End Semester Examination
K1	Remember	05	05	-	12
K2	Understand	05	05	-	12
K3	Apply	10	10	-	12
K4	Analyze	-	-	-	12
K5	Evaluate	-	-	-	12
Total Marks 100		20	20		60

Assessment table:

Assessment Tool	K1, K2, K3	K1, K2, K3	K1, K2, K3	K1, K2, K3	K1, K2, K3
	CO1	CO2	CO3	CO4	CO5
ISEI(20 Marks)	10	10	-	-	-
ISEII (20 Marks)	-	-	10	10	-
ESE Assessment (60Marks)	12	12	12	12	12
Total Marks 100	22	22	22	22	12

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M.Tech. Geotechnical Engineering Curriculum
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CEPEC 5122: Geology for Geotechnical Applications		
Teaching Scheme	**Examination Scheme**	
Lectures: 03 Hrs. / Week	**ISE I**	**20 Marks**
Credits: 03	**ISE II**	**20 Marks**
	End Semester Examination	**60 Marks**

Course Description: This course provides the knowledge and skills in assessing the quality of foundation rocks, their aggregates and building materials derived from rock and assessing the geological suitability of sites.

Course Outcomes:
After completing the course students will able to;

Course Outcomes	
CO1	assess the suitability of a construction site and the construction materials with respect to the geological parameters.
CO2	do engineering classification of rocks.
CO3	apply logging techniques.
CO4	suggest geological solution for slope stability in landslides area.
CO5	give geological solution for slope stability in landslides areas.

Detailed Syllabus:

Unit 1	**Engineering Properties of Rocks and Minerals:** Geology for foundation engineering – Types of rocks, rock description-texture, structure, composition and its relation to quality and strength of rocks, engineering classification of rocks –weathering grade and its significance in engineering site-Engineering properties of rocks - Physical and chemical properties of minerals and its relation to strength and durability of rock. Geotechnical properties of rocks of Maharashtra.
Unit 2	**Surface And Subsurface Geological Investigations:** Field investigations - electrical and seismic geophysical methods in subsurface geological investigations for foundation engineering, applications of GPR in subsurface strata studies, Description of structural discontinues, Strike and dip of rocks, folds, faults and joints.
Unit 3	**Drill Hole And Core Logging:** Logging techniques – Resistivity log, Neutron log, sonic log, gamma log. Rock core logging – rocks description, weathering grade, RMR, RQD and sampling methods for rock strength, and composition studies.
Unit 4	**Mapping Techniques:** Preparation of profiles from contour map; lithological and structural mapping of shallow and deep excavated sites. Hand on exercises.
Unit 5	**Geological Investigations for Foundation Engineering:** Ground stability studies - Scour and erosion studies-stability of slopes and geological solution for slope stability in landslides areas.

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M.Tech. Geotechnical Engineering Curriculum
With effect from Academic Year 2026–2027
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Text and Reference Books:

1. Varghese P.C. Engineering Geology for civil engineers, PHI learning Pvt.Ltd. New Delhi-1, 2012
2. Krynine and Judd Principles of Engineering Geology and Geotechnology McGraw Hill, New York 1962.
3. Bell FG. by Engineering Geology, Second Edition, Butterworth-Heinemann, Oxford, 2007
4. Sathya Narayanaswami, Engineering Geology, Dhanpat Raj and Co.1710, Nai Sarak, Delhi-110 006, 2000.
5. Waltham, A.C. Foundations of Engineering Geology, Blackie Academic Professional Pub.1 Ed.UK.1994
6. Venkata Reddy. D., Engineering geology, Vikas Publishing Home, Noida, 2010.
7. Chenna Kesavulu. N., Text book of engineering geology, II edition, MacMillan Publishers India Ltd. Delhi, 2009.

Mapping of Course Outcome with Program Outcomes

Course outcome	PO1	PO2	PO3	PSO1	PSO2
CO1	3	2	3	2	1
CO2	2	2	2	1	1
CO3	2	2	3	1	1
CO4	1	1	3	1	2
CO5	1	3	2	2	2

3-High, 2- Medium, 1 - Low

Assessment:

ISE I: Based on unit I and unit II

ISE II : Teacher's Assessment: Teachers Assessment of 20 marks is based on one of the / or combination of few of following

1. Assignments
2. Power point presentation
3. Question & answer, interaction
4. Technical quiz
5. Attendance in the class

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M.Tech. Geotechnical Engineering Curriculum
With effect from Academic Year 2026–2027
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Assessment Pattern:

Assessment Pattern Level No.	Knowledge Level	ISEI	ISEII	ISEIII	End Semester Examination
K1	Remember	05	05	-	12
K2	Understand	05	05	-	12
K3	Apply	10	10	-	24
K4	Analyze	-	-	-	12
K5	Evaluate	-	-	-	-
Total Marks 100		20	20	-	60

Assessment table:

Assessment Tool	K1, K2, K3	K1, K2, K3	K1, K2, K3	K1, K2, K3	K1, K2, K3,K4
	CO1	CO2	CO3	CO4	CO5
ISEI(20 Marks)	10	10	-	-	-
ISEII (20 Marks)	-	-	10	10	-
ESE Assessment (60Marks)	12	12	12	12	12
Total Marks 100	22	22	22	22	12

CEPEC 5123: Environmental Geotechnology		
Teaching Scheme	**Examination Scheme**	
Lectures: 03 Hrs. / Week	**ISE I**	**20 Marks**
Credits: 03	**ISE II**	**20 Marks**
	End Semester Examination	**60 Marks**

Course Description:
This course includes the geotechnical aspects of the design and management of industrial and domestic waste disposal systems.

Course Outcomes: After successful completion of the course, students will be able to;

Course Outcomes	
CO1	characterization and regulatory requirements for disposal of hazardous, nonhazardous and domestic waste.
CO2	sources and effects of subsurface contamination.
CO3	do waste management.
CO4	plan and design aspects related to waste disposal in landfills.
CO5	suggest use of geosynthetics in waste disposal design.

Detailed Syllabus:

Unit 1	**Identification, Characterization and regulatory requirements for disposal of hazardous, nonhazardous and domestic waste:** Sources and effects of subsurface contamination, Physical, Chemical and biological characteristics of solid waste, Soil-waste interaction, Cation exchange reactions and effect of pollutants on soil properties, Erodability of soil in relation to moisture content, Containment transport, Laboratory and field evaluation of permeability, Factors affecting, Design of dewatering.
Unit 2	**Waste management:** Recycling, Composting, Incineration, and various disposal Sources and effects of subsurface contamination l methods, Site Selection, Leachate collection and detection system. Types of landfills – Silting criteria, Waste containment principle, Types of barrier materials.
Unit 3	**Planning and design aspects relating to waste disposal in landfills:** Landfills – Ash ponds and Tailing ponds and in rocks, Environmental monitoring around landfills – Detection, Control and remediation of subsurface containment.
Unit 4	**Engineering properties and Geotechnical reuse of waste, Demolition of waste.** Types of waste used in geotechnical engineering (industrial waste, construction and demolition waste, municipal solid waste), Physical properties of waste materials: density, moisture content, specific gravity, particle size distribution, Mechanical properties: shear strength, compressibility, permeability, compaction characteristics, Chemical properties affecting soil behaviour, Environmental considerations and contamination potential.
Unit 5	**Reclamation of old waste dumps:** Regulation, Case studies, Single and double lined landfill, Applications of Geosynthetics in waste disposal design, Landfill construction, Construction quality control and performance monitoring.

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M.Tech. Geotechnical Engineering Curriculum
With effect from Academic Year 2026–2027
Approved in the 32nd Academic Council Meeting, dated 28th July 2026

Text and Reference Books:

1. Geotechnical Practices for Waste Disposal, D.E Daniel, Chapman and Hall, London.
2. Geo-environmental Engineering Principles and Application, L.N. Reddy and H.F. Inyang, Marceal Dekker Inc
3. Introduction to Environmental Geotechnology, Hsai-Yang Fang, CRC Press,
4. Geotechnical and Geoenvironmental Engineering Handbook, R. K Rowe, Klower Academic Publishers.
5. Waste Containment Systems, Waist stabilization and Landfills, Design and Evaluation, H. D. Sharma and S. P. Lewis, John Willey and Sons.
6. Geoenvironmental Engineering, H. D. Sharma and K. R. Reddy, John Willey and Sons.
7. Geoenvironmental Engineering, R N Yong and H R Thomas, Thomas Telford.

Mapping of Course Outcome with Program Outcomes

Course outcome	PO1	PO2	PO3	PSO1	POS2
CO1	3	2	3	1	1
CO2	2	2	2	2	1
CO3	2	-	3	1	1
CO4	1	1	3	1	2
CO5	1	3	2	2	2

3-High, 2- Medium, 1 - Low

Assessment:

ISE I: Based on unit I and unit II

ISE II : Teacher's Assessment: Teachers Assessment of 20 marks is based on one of the / or combination of few of following

1. Assignments
2. Power point presentation
3. Question & answer, interaction
4. Technical quiz
5. Attendance in the class

Assessment Pattern:

Assessment Pattern Level No.	Knowledge Level	ISEI	ISEII	ISEIII	End Semester Examination
K1	Remember	05	05	-	12
K2	Understand	05	05	-	12
K3	Apply	10	10	-	24
K4	Analyze	-	-	-	12
K5	Evaluate	-	-	-	-
Total Marks 100		20	20		60

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With effect from Academic Year 2026–2027
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Assessment table:

Assessment Tool	**K1, K2, K3**	**K1, K2, K3**	**K1, K2, K3**	**K1, K2, K3**	**K1, K2, K3**
	CO1	CO2	CO3	CO4	CO5
ISEI(20 Marks)	10	10	-	-	-
ISEII (20 Marks)	-	-	10	10	-
ESE Assessment (60Marks)	12	12	12	12	12
Total Marks 100	22	22	22	22	12

CEPEC 5124: Reinforced Earth Structures		
Teaching Scheme	**Examination Scheme**	
Lectures: 03 Hrs. / Week	**ISE I**	**20 Marks**
Credits: 03	**ISE II**	**20 Marks**
	End Semester Examination	**60 Marks**

Course Description:
This course introduces different earth reinforcing materials.

Course Outcomes:
After successful completion of the course, students will be able to;

Course Outcomes	
CO1	suggest use of different reinforcing materials as per field conditions.
CO2	gaining knowledge of different types geosynthetics.
CO3	design with geosynthetics.
CO4	design with geogrids and geonets.
CO5	design of soil reinforcements- geotextile reinforced walls.

Detailed Syllabus:

Unit 1	**Reinforced soil:** Mechanism, reinforcement, reinforcement- soil interaction, applications, reinforced soil structures with vertical faces, reinforced soil embankments, open excavation using soil nails, stabilization of slopes using soil nails.
Unit 2	**Geosynthetics:** Types- Geotextiles, Geogrids, Geonets, Geomembranes, Geosynthetic clay liners, Geopipe, Geocomposite, Geo-others, Polymeric material: Brief overview, polymer identification- manufacture and current uses of Geosynthetics materials.
Unit 3	**Designing with Geotextiles:** Design methods - design by cost and availability, Design by specification, Design by function , Geotextiles functions and mechanisms- separation , reinforcement, filtration, drainage, liquid barrier and combined functions.
Unit 4	**Designing with Geogrids and Geonets:** Geogrid properties and test methods, physical properties, mechanical properties, degradation properties, allowable strength consideration, designing for geogrid reinforcement-paved roads, unpaved roads, embankments, design critique, Construction methods using geogrids, Geonet-properties and test methods, physical and mechanical properties, hydraulic properties, environmental properties, designing for geonet drainage, design critique, construction methods using geonets.
Unit 5	**Designing for roadway reinforcement**: Unpaved roads, overview, manufacturer's methods, analytic method, laboratory method, designing for soil reinforcements- Geotextile reinforced walls, construction details, and design methods.

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With effect from Academic Year 2026–2027
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Text and Reference Books

1. Robert M. Koerner - "Designing with Geosynthetics" Prentice Hall, Upper Saddle River, New Jersey 07458
2. Proceedings of various Inter-national and national conferences on geosynthetics
3. Geotextiles and Geomembranes, Journal of International Geosynthetics Society, Elsevier Publication
4. Shashi Gulathi and Manoj Datta "Geotechnical Engineering", Tata McGraw-Hill Publishing Company Limited, New Delhi

Mapping of Course Outcome with Program Outcomes

Course outcome	PO1	PO2	PO3	PSO1	PSO2
CO1	3	2	3	1	1
CO2	2	2	2	2	1
CO3	2	1	3	1	1
CO4	1	1	3	1	-
CO5	1	3	2	2	-

3-High, 2- Medium, 1 – Low

Assessment:

ISE I: Based on unit I and unit II

ISE II : Teacher's Assessment: Teachers Assessment of 20 marks is based on one of the / or combination of few of following

1. Assignments
2. Power point presentation
3. Question & answer, interaction
4. Technical quiz
5. Attendance in the class

Assessment Pattern:

Assessment Pattern Level No.	Knowledge Level	ISEI	ISEII	ISEIII	End Semester Examination
K1	Remember	05	05	-	12
K2	Understand	05	05	-	12
K3	Apply	10	10	-	24
K4	Analyze	-	-	-	12
K5	Evaluate	-	-	-	
Total Marks 100		20	20	-	

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With effect from Academic Year 2026–2027
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Assessment table:

Assessment Tool	**K1, K2, K3**	**K1, K2, K3**	**K1, K2, K3**	**K1, K2, K3**	**K1, K2, K3, K4**
	CO1	CO2	CO3	CO4	CO5
ISEI(20 Marks)	10	10	-	-	-
ISEII (20 Marks)	-	-	10	10	-
ESE Assessment (60Marks)	12	12	12	12	12
Total Marks 100	22	22	22	22	12

CEPEC 5125: Pavement Analysis and Design		
Teaching Scheme	**Examination Scheme**	
Lectures: 03 Hrs. / Week	**ISE I**	**20 Marks**
Credits: 03	**ISE II**	**20 Marks**
	End Semester Examination	**60 Marks**

Course Description: In this course students gain knowledge on designing rigid and flexible pavements for different serviceability conditions of roads.

Course Outcomes:
After successful completion of the course, students will be able to;

Course Outcomes	
CO1	evaluate stresses and strains for various loading and environmental conditions for flexible and rigid pavements.
CO2	design flexible and rigid pavements.
CO3	analyze and evaluate pavement distresses and select the best suited rehabilitation techniques.
CO4	design reinforced flexible pavement, students are able to design different new pavements and rehabilitate the existing roads using recent technology.
CO5	identify causes of failures in flexible and rigid pavements.

Detailed Syllabus:

Unit 1	**Concepts:** Historical development of pavements: types, classification, components and principle of load transfer, Approaches to pavement design, vehicle and traffic considerations, behavior of road materials under repeated loading, Stresses and deflections in layered systems
Unit 2	**Flexible Pavement:** Factors affecting flexible pavements material characterization for analytical pavement design, AASHO, CBR, group index methods, Importance of Resilient modulus, Fatigue subsystem, failure criteria for bituminous pavements, IRC- 37 2012 design guidelines.
Unit 3	**Rigid Pavement:** Factors affecting rigid pavements, Design procedures for rigid pavement, Slab thickness, dowel bar, tie bar, spacing of joints, IRC-58 guidelines, AASHO method, Airfield pavements, Comparison of highway and airfield pavements.
Unit 4	**Pavement Evaluation And Rehabilitation:** Pavement evaluation, surface and structural, causes and types of failures in flexible and rigid pavements , Present serviceability index of roads, Overlay design, pavements maintenance, management and construction, Drainage and its importance in pavements.
Unit 5	**Stabilization Of Soils For Road Constructions**: Need for a stabilized soil, Design criteria, Mechanisms, factors influencing choice of stabilizers, Testing and field control, Applications of Geosynthetics in road construction, Case studies.

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With effect from Academic Year 2026–2027
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Text and Reference Books:

1. Wright, P.H., Highway Engineers, John Wiley & Sons, Inc., New York, 1996.
2. Khanna S.K and Justo C.E.G, Highway Engineering, Eighth Edition, New Chand and Brothers, Roorkee, 2001.
3. Yoder R.J and Witchak M.W., Principles of Pavement Design, John Wiley, 2000.
4. Croney, D., Design and Performance of Road Pavements, HMO Stationary Office, 1979.
5. Design and Specification of Rural Roads (Manual), Ministry of rural roads, Government of India, New Delhi, 2001.
6. Guidelines for the Design of Flexible Pavements, IRC:37 - 2001, The Indian roads Congress, New Delhi.
7. Guideline for the Design of Rigid Pavements for Highways, IRC:58-1998, The Indian Roads Congress, New Delhi.
8. O' Flaherty, C.A., Highways – The location, Design, Construction & Maintenance of Pavements, Fourth Edition, Elsevier, 2006.
9. Bell. P.S., Developments in Highway Engineering, Applied Sciences publishers

Mapping of Course Outcome with Program Outcomes

Course outcome	PO1	PO2	PO3	PSO1	PSO2
CO1	3	2	3	1	-
CO2	2	1	2	1	1
CO3	2	1	2	1	1
CO4	1	1	2	1	1
CO5	1	3	2	2	-

3-High, 2- Medium, 1 – Low

Assessment:

ISE I: Based on unit I and unit II

ISE II : Teacher's Assessment: Teachers Assessment of 20 marks is based on one of the / or combination of few of following

1. Assignments
2. Power point presentation
3. Question & answer, interaction
4. Technical quiz
5. Attendance in the class

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M.Tech. Geotechnical Engineering Curriculum
With effect from Academic Year 2026–2027
Approved in the 32nd Academic Council Meeting, dated 28th July 2026

Assessment Pattern:

Assessment Pattern Level No.	Knowledge Level	ISEI	ISEII	ISEIII	End Semester Examination
K1	Remember	05	05	-	12
K2	Understand	05	05	-	12
K3	Apply	10	10	-	12
K4	Analyze	-	-	-	12
K5	Evaluate	-	-	-	12
Total Marks 100		20	20		60

Assessment table:

Assessment Tool	K1, K2, K3	K1, K2, K3	K1, K2, K3	K1, K2, K3	K1, K2, K3
	CO1	CO2	CO3	CO4	CO5
ISEI(20 Marks)	10	10	-	-	-
ISEII (20 Marks)	-	-	10	10	-
ESE Assessment (60Marks)	12	12	12	12	12
Total Marks 100	22	22	22	22	12

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M.Tech. Geotechnical Engineering Curriculum
With effect from Academic Year 2026–2027
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CEPEC5126: Geophysical Exploration Methods		
Teaching Scheme	**Examination Scheme**	
Lectures: 03 hrs/ week	**ISE I**	**20 Marks**
Credits: 03	**ISE II**	**20 Marks**
	END SEMESTER EXAMINATION	**60 Marks**

Course description:
This course provides a comprehensive understanding of geophysical methods with emphasis on electrical, seismic, gravity, magnetic, radar, and well logging techniques used for subsurface characterization. The course introduces the physical principles, instrumentation, data acquisition, processing, and interpretation of geophysical data for applications in geotechnical engineering, environmental studies, groundwater exploration, and engineering investigations. Advanced topics such as 3D electrical resistivity tomography, induced polarization, electromagnetic and airborne methods, seismic inversion, MASW, satellite-based gravity missions, radar techniques, surface nuclear magnetic resonance, and AI-based geophysical software are also covered.

Course Outcomes:
After successful completion, students will be able to;

	Course Outcome
CO1	understand the scope, principles, and classification of geophysical methods for subsurface investigations.
CO2	describe the relationship between electrical properties of earth materials and subsurface conditions.
CO3	identify and compare different electrical resistivity array configurations and their advantages.
CO4	interpret resistivity data using 1D, 2D, and 3D interpretation techniques.
CO5	apply electrical resistivity methods for environmental and geotechnical problem solving.

Detailed Syllabus:

Unit 1	**Introduction to Geophysical Methods and Electrical Methods:** Overview, scope and applications in geotechnical, environmental, and groundwater investigations. Introduction to Electrical Methods and its relation to subsurface properties. **Electrical Resistivity Methods:** Resistivity data Acquisition: Array Configurations and Their Advantages; Different Data Interpretation Techniques; 3D Resistivity Tomography; Application in Environmental and Geotechnical investigations.
Unit 2	**Application of Resistivity & Self-Potential Methods:** Case studies on the application of resistivity method on groundwater, field demonstration, Self-Potential Methods, Principles, field procedures and interpretation. **Induced Polarization and Electromagnetic methods:** Principle, Time-domain and frequency-domain techniques. Instrumentation and survey design. Data processing and interpretation for subsurface characteriza National Aquifer Mapping.

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M.Tech. Geotechnical Engineering Curriculum
With effect from Academic Year 2026–2027
Approved in the 32nd Academic Council Meeting, dated 28th July 2026

Unit 3	**Seismic Methods -I** Principles of seismic wave propagation. Sources of seismic explosion, Travel velocity in various geological formations. Seismic data acquisition and data reduction techniques. **Seismic Methods -II** Refraction and Reflection surveys, Determination of formation thickness, attitude and depth, seismic inversion techniques, application of seismic method on tunneling, borehole seismic, geotechnical application and case studies. **Seismic Methods -III,** Seismic Reflection Case studies, Assessment of ground improvement, Multichannel Analysis of Surface Waves (MASW)-introduction.
Unit 4	**Gravity Methods:** Introduction and principle of gravity method, gravimeters: Types and field procedures. Corrections in gravity surveys, Qualitative interpretation of gravity anomalies. **Applications and Advanced Gravity Techniques:** Quantitative interpretation of gravity data. Applications, Gravity surveys in environmental and engineering investigations, GRACE Mission. **Magnetic Methods:** Earth's magnetic field and components. Magnetometers: Types, principles and field operations. Qualitative interpretation of magnetic anomalies, Applications.
Unit 5	**Radar Techniques:** Ground penetrating radar methods; Synthetic aperture radar imaging for land deformation studies; Other emerging methods: Surface nuclear magnetic resonance methods. **Radioactivity Methods and Well Logging:** Electrical and radioactivity logging methods, calliper, NMR and other miscellaneous logging methods; field procedure and interpretation of data. Demonstrations of AI-based geophysical software for real-time subsurface characterization.

Text and Reference Books:

1. "Geophysical Methods: Fundamentals, Applications, and Case Studies" — O. P. Mishra & D. C. Naskar**, CRC Press,** 2025 (1st edition)
2. "Gravity and Magnetic Methods for Geological Studies: Principles, Integrated Exploration and Plate Tectonics"— Dinesh Chandra Mishra**,** Latest edition (2025)
3. "Natural Electromagnetic Fields in Pure and Applied Geophysics" — Kalyan Kumar Roy — **Springer,** 2020
4. "Environmental and Engineering Geophysics"— P. V. Sharma

Mapping of Course Outcome with Program Outcomes

Course outcome	PO1	PO2	PO3	PSO1	PSO2
CO1	3	2	3	1	1
CO2	2	2	2	2	1
CO3	2	2	1	1	1
CO4	1	1	3	1	-
CO5	1	3	2	2	-

3-High, 2- Medium, 1 – Low

Assessment:

ISE I: Based on unit I and unit II

ISE II : Teacher's Assessment: Teachers Assessment of 20 marks is based on one of the / or combination of few of following

1. Assignments
2. Power point presentation
3. Question & answer, interaction
4. Technical quiz
5. Attendance in the class

Assessment Pattern:

Assessment Pattern Level No.	Knowledge Level	ISEI	ISEII	ISEIII	End Semester Examination
K1	Remember	05	05	-	12
K2	Understand	05	05	-	12
K3	Apply	10	10	-	12
K4	Analyze	-	-	-	12
K5	Evaluate	-	-	-	12
Total Marks 100		20	20	-	60

Assessment table:

Assessment Tool	K1, K2, K3	K1, K2, K3	K1, K2, K3	K1, K2, K3	K1, K2, K3
	CO1	CO2	CO3	CO4	CO5
ISEI(20 Marks)	10	10	-	-	-
ISEII (20 Marks)	-	-	10	10	-
ESE Assessment (60Marks)	12	12	12	12	12
Total Marks 100	22	22	22		

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M.Tech. Geotechnical Engineering Curriculum
With effect from Academic Year 2026–2027
Approved in the 32nd Academic Council Meeting, dated 28th July 2026

CEPEC5127: Earth and Rockfill Dam and Slope Stability		
Teaching Scheme	**Examination Scheme**	
Lectures: 03 hrs./week	**ISE I**	**20 Marks**
Credits:03	**ISE III**	**20Marks**
	End Semester Examination	**60 Marks**

Prerequisites: Nil

Course Description: To understand the principles of design, construction, and performance evaluation of earth and rockfill dams. To analyze the stability of slopes and embankments under different loading conditions. To assess seepage control mechanisms in dams and slopes. To apply numerical and analytical methods for slope stability analysis. To familiarize students with case studies and real-world challenges in dam and slope stability engineering.

Course Outcomes:

After completion of this course, students will be able to;

Course Outcomes	
CO1	classify different types of earth and rockfill dams and explain their design principles
CO2	analyze seepage problems in embankments and apply techniques for seepage control.
CO3	evaluate slope stability using different analysis methods (limit equilibrium, finite element, etc.)
CO4	design and implement reinforcement and stabilization techniques for slopes and embankments
CO5	interpret case studies of dam failures and landslides to recommend preventive measures.

Detailed Syllabus:

Unit 1	**Introduction to Earth and Rockfill Dams:** Types of dams: Earth dams, Rockfill dams, and Hybrid structures**,** Selection of site and materials for construction**,** Principles of design and stability criteria**,** Construction methods and quality control**,** Instrumentation and monitoring of embankment dams
Unit 2	**Seepage through Dams and Slopes:** Darcy's Law and flow nets**,** Seepage forces, uplift pressures, and piping failure, Drainage systems and filters in embankment dams**,** Methods for seepage control: Cutoff walls, grouting, clay blankets**,** Case studies of seepage failures in dams
Unit 3	**Stability of Slopes and Embankments:** Types and causes of slope failures**,** Shear strength parameters of soil and rock**,** Methods of slope stability analysis: Infinite and finite slope analysis**,** Swedish Circle method, Bishop's method, Janbu's method**,** Factor of safety and stability charts
Unit 4	**Reinforcement and Stabilization of Slopes:** Ground improvement techniques for slope stability**,** Reinforced soil slopes and geosynthetics applications**,** Rock bolting, soil nailing, and retaining structures**,** Landslide hazard assessment and mitigation techniques**,** Case studies of slope stabilization projects
Unit 5	**Failure Analysis and Case Studie:** Common causes of dam failures (seepage, liquefaction, foundation failure)**,**Landslide case studies: causes, impact, and remediation**,** Numerical and analytical modelling for slope and dam stability**,** Recent advancements in dam and slope stability research**,** Environmental and legal considerations in dam engineering

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M.Tech. Geotechnical Engineering Curriculum
With effect from Academic Year 2026–2027
Approved in the 32nd Academic Council Meeting, dated 28th July 2026

Text and Reference Books

1. **Das, B. M.** – "Principles of Geotechnical Engineering" (Cengage Learning)
2. **Duncan, J. M., Wright, S. G., and Brandon, T. L.** – "Soil Strength and Slope Stability" (Wiley)
3. **Terzaghi, K., Peck, R. B., and Mesri, G.** – "Soil Mechanics in Engineering Practice" (Wiley)
4. **Sowers, G. F.** – "Introductory Soil Mechanics and Foundations" (Macmillan) Lambe, T. W. and Whitman, R. V. – "Soil Mechanics" (Wiley)

Mapping of Course Outcome with Program Outcomes

Course outcome	PO1	PO2	PO3	PSO1	PSO2
CO1	3	2	2	1	-
CO2	2	2	2	3	-
CO3	2	1	1	1	-
CO4	1	1	2	1	1
CO5	2	3	2	1	1

3-High, 2- Medium, 1 – Low

Assessment:

ISE I: Based on unit I and unit II

ISE II : Teacher's Assessment: Teachers Assessment of 20 marks is based on one of the / or combination of few of following

1. Assignments
2. Power point presentation
3. Question & answer, interaction
4. Technical quiz
5. Attendance in the class

Assessment Pattern:

Assessment Pattern Level No.	Knowledge Level	ISEI	ISEII	ISEIII	End Semester Examination
K1	Remember	05	05	-	12
K2	Understand	05	05	-	12
K3	Apply	10	10	-	24
K4	Analyze	-	-	-	12
K5	Evaluate	-	-	-	-
Total Marks 100		20	20	-	60

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M.Tech. Geotechnical Engineering Curriculum
With effect from Academic Year 2026–2027
Approved in the 32nd Academic Council Meeting, dated 28th July 2026

Assessment table:

Assessment Tool	**K1, K2, K3**	**K1, K2, K3**	**K1, K2, K3**	**K1, K2, K3**	**K1, K2, K3**
	CO1	CO2	CO3	CO4	CO5
ISEI(20 Marks)	10	10	-	-	-
ISEII (20 Marks)	-	-	10	10	-
ESE Assessment (60Marks)	12	12	12	12	12
Total Marks 100	22	22	22	22	12

CEVSE 5102: Mini Project		
Teaching Scheme	**Examination Scheme**	
Practicals: 04 Hrs. / Week	**ISE I**	**-**
Credits: 02	**ISE II**	**25 Marks**
	End Semester Examination	**25 Marks**
	Total	**50 Marks**

Course Description: The student shall collect, review, compile, comprehend, present research literature and identify the problem for the dissertation.

Course Outcomes:

After successful completion of the course, students will be able to;

Course Outcomes	
CO1	to search literature from different sources to appraise the state-of-the-art.
CO2	to compile and prepare a technical report from the collected literature.
CO3	to present the literature in a comprehensive manner and identify the problem for the dissertation

Detailed Syllabus:

Term Work:

The Mini Project with Seminar shall consist of collection of literature from a chosen field of Structural Engineering from various sources such as refereed journals, proceedings of national international conferences, PG/PhD theses etc. Based on the literature survey, case studies, data collection, surveys, pilot studies, mathematical/analytical modeling, etc., as necessary the candidate shall define the problem for the dissertation.

The candidate shall prepare a technical report in a prescribed format and present it before a panel of examiners consisting of guide and at least one faculty member of the department.

ISE II:

Mid-Term Evaluation: A mid-term evaluation shall be done as per the schedule given in the institute academic calendar. Students should prepare a power point presentation and present before the panel of examiners and class students and should be able to answer questions asked by the panelof examiners and class students. The panel of examiners consists of guide as internal examiner and one faculty member appointed by the DCoE as external examiners. The panel of examiner will assess the contents and presentation and give the suggestions, if any and assigns the marks out of 10. In this phase students are expected to collect and present substantial literature.

ESE:

Student should prepare technical report in prescribed format duly incorporating suggestions of Part-I and present power point presentation before the panel of examiners and class students. The student should be able to answer the questions asked. The panel of examiner will assess the seminar contents and seminar presentation and assign the marks out of 25. In this phase the students are expected to define the problem for dissertation through further literature survey, case studies, data collection, surveys, pilot studies, mathematical/analytical modeling, etc., as nece

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Assessment:

ISE II: The assessment is divided in two parts;
It will be based on continuous assessment of submission of the term work and interaction with the students.

ESE: The assessment shall be based on oral/practical examination conducted by the course coordinator and external examiner.

Mapping of Course Outcome with Program Outcomes

Course outcome	PO1	PO2	PO3	PSO1	PSO2
CO1	2	2	2	3	3
CO2	2	2	2	3	3
CO3	2	1	3	3	3

3-High, 2- Medium, 1 – Low

Assessment pattern:

Assessment Pattern Level No.	Knowledge Level	ISE II	End Semester Examination
S1	Imitation	10	10
S2	Manipulation	10	10
S3	Precision	5	5
S4	Articulation	-	-
S5	Naturalization	-	-
Total Marks		25	25

Assessment Table:

Assessment Tool	CO1, CO2, CO3
	S1, S2, S3
ISE II:(25 Marks)	25
ESE Assessment (25 Marks)	25
Total Marks (50)	50

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M.Tech. Geotechnical Engineering Curriculum
With effect from Academic Year 2026–2027
Approved in the 32nd Academic Council Meeting, dated 28th July 2026

CEPCC 5111: Geotechnical Engineering Laboratory – I		
Teaching Scheme	**Examination Scheme**	
Practical: 04 Hrs. / Week	**ISE I**	**-**
Credits: 02	**ISE II**	**25 Marks**
	End Semester Examination	**25 Marks**
	Total	**50 Marks**

Course Description: This course covers principles, applications and performance of experiments.

Course Outcome: After the successful completion of the course student will be able to;

Course Outcomes	
CO1	execute experiments for determination of index properties of soil.
CO2	determine engineering properties of soil.
CO3	classify the soil.

Detailed Experiment List:

I - A report of the experimental work based on any **six** of the following:

Experiment 1	To classify the given soil sample according to the Indian Standard Soil Classification System (IS: 1498) by determining its grain size distribution and consistency characteristics, and to identify its engineering properties for civil engineering applications.
Experiment 2	To determine the consistency limits of the given soil sample, namely Liquid Limit (LL), Plastic Limit (PL), Shrinkage Limit (SL), and Plasticity Index (PI), in accordance with relevant Indian Standard specifications for assessing the plasticity and classification of fine-grained soils.
Experiment 3	To determine the in-situ (field) density and dry density of soil using the Sand Replacement Method/Core Cutter Method as per relevant Indian Standard procedures, and to evaluate the degree of compaction achieved in the field.
Experiment 4	To determine the coefficient of permeability of the given soil sample using the Constant Head Test or Falling Head Test, as applicable, in accordance with Indian Standard specifications, and to assess the drainage characteristics of the soil.
Experiment 5	To determine the Optimum Moisture Content (OMC) and Maximum Dry Density (MDD) of the given soil sample by the Standard Proctor Compaction Test in accordance with IS: 2720, and to study the relationship between moisture content and dry density.
Experiment 6	To determine the shear strength parameters (cohesion, c, and angle of internal friction, φ) of the given soil sample using the Direct Shear Test or Unconfined Compression Test, as applicable, in accordance with relevant Indian Standard procedures.
Experiment 7	To determine the swelling characteristics of expansive soil by conducting tests such as the Free Swell Index Test and Swell Pressure Test, and to evaluate the potential of the soil for volume change due to moisture variation in accordance with relevant Indian Standard specifications.

II - Writing assignments for any two Soil engineering problems, such as Lateral earth pressure, Stress distribution, Seepage, model analysis (design experiment). Candidates are required to submit the duly completed journals before the end of semester. Examination shall consist of ISE-II with practical work and viva-voce for ESE.

Text and Reference Books:

1. J. E. Bowles, "Physical and Geotechnical Properties of soils", McGraw Hill International publication.
2. T.W. Lambe, "Soil Testing for Engineers", Wiley Publication.
3. Compendium of Indian Standards on Soil Engineering, SP-36 (Part-1)

Assessment: Based on the practical performance, interaction of students till the term end.

Mapping of Course Outcome with Program Outcomes

Course Outcome	PO1	PO2	PO3	PSO1	PSO2
CO1	3	3	3	2	-
CO2	1	2	3	1	-
CO3	3	3	3	3	-

3-High, 2- Medium, 1 – Low

Assessment pattern:

Assessment Pattern Level No.	Knowledge Level	ISE II	End Semester Examination
S1	Imitation	10	10
S2	Manipulation	10	10
S3	Precision	5	5
S4	Articulation	-	-
S5	Naturalization	-	-
Total Marks		25	25

Assessment Table:

Assessment Tool	CO1, CO2, CO3
	S1, S2, S3
ISE II:(25 Marks)	25
ESE Assessment (25 Marks)	25
Total Marks (50)	50

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M.Tech. Geotechnical Engineering Curriculum
With effect from Academic Year 2026–2027
Approved in the 32nd Academic Council Meeting, dated 28th July 2026

INCCC5101: Stress Management Through Yoga	
Teaching Scheme	**Examination Scheme**
Practice : 2 hr/week	**Credits: Audit Course**

Course Description:

This course aims at enabling students:

1. To get awareness of Physical, Mental, Social and Spiritual health.
2. To learn to manage the Stress through art of Yoga.
3. Understand and perform skill of Yoga Asanas.
4. Gain knowledge and benefits of Pranayam and Dhyan.
5. Importance of diet, food and nutrition.

Course Outcomes: After successful completion of the course, students will be able to;

Course Outcomes	
CO1	aware regarding healthy and peaceful living.
CO2	understand the cause of stress and its relief.
CO3	perform skill of yoga asanas and meditation.
CO4	bring peace and harmony in the society at large.
CO5	aware of yogic diet, food and nutrition.

Detailed Syllabus:

Unit 1	Introduction, meaning and definition of health, various dimensions of health, like, Physical, Mental, Social and Spiritual health
Unit 2	Concept of stress according to yoga, causes and consequences of stress, stress management through Yoga.
Unit 3	Introduction and definition of yoga, Fundamental concept of yoga, relationship of yoga and health.
Unit 4	Yogic sukshma vyayam, Maharshi Patanjali Ashtang Yog sutra, different types and benefits of asanas (min. five in each pose), Suryanamaskar, different types and benefits of Pranayam (min. Five), Meaning and importance of dhyan .
Unit 5	Importance of yogic diet, food and nutrition.
List of Practice Sessions	Practice of Yogic Sukshma Vyayam Practice of different Asanas Practice of different Pranayam Practice of Dhyan

Text and Reference Books:

1. K, N, Udupa, Stress and its Management by Yoga, Motilal Banaridas Publishers
2. Acharya Yetendra, Yoga and Stress Management, Finger print Publications
3. B. K. S. Iyengar, Light on Yoga, Harper Collins Publisher, New Delhi, 2005
4. Swami Vivekanand, Patanjali Yog Sutra, Geeta Press, Gorakhpur
5. Swami Ramdev, Pranayam Rahasya, Divya Prakashan, 2009

CEPCC5212: Advanced Foundation Engineering		
Teaching Scheme	**Examination Scheme**	
Lectures: 03 hrs/ week	**ISE I**	**20 Marks**
Credits:3	**ISE II**	**20 Marks**
	END SEMESTER EXAMINATION	**60 Marks**

Prerequisite: Nil

Course Description: This course introduces different site investigation methods, Types of foundations, loading conditions and suitability

Couse Outcomes: After successful completion of the course student will be able to;

	Course Outcomes
CO1	Suggest and prepare plan to be adopted for exploration of soil depending on the field condition.
CO2	Design of foundation under different loading conditions.
CO3	Evaluate bearing capacity for varied site conditions.
CO4	Select methodologies to be adopted for foundations on expansive soil.
CO5	understand and apply cofferdam design, selection and construction for safe foundation work.

Detailed Syllabus:

Unit 1	**Soil Site investigations:** Methods of exploration, Methods of boring, Soil samples, Number and disposition of trial pits and borings, Depth of exploration, Ground water observations, Field Tests, Geophysical methods, Borehole logs, Site investigation report.
Unit 2	**Shallow foundations:** Types of foundations, Location and depth of foundation, bearing capacity of shallow foundations, Bearing capacity from building codes, Effect of water table on bearing capacity, Proportioning of footings. Settlement of shallow foundations, Loading conditions.
Unit 3	**Pile foundation:** Introduction, Uses of piles, Classification of piles, Selection of pile type, Pile driving, Pile capacity, Pile groups, Negative skin friction, Load test on piles, Static pile load formulae, Dynamic pile formulae, Laterally loaded piles, Batter piles.
Unit 4	**Cofferdams, Caissons:** Cofferdams uses and features, Types of caissons, Components of a well foundation, Shapes of wells, Forces acting on well foundation, Construction and sinking of a well, Rectification of tilts and shifts.
Unit 5	**Foundations on expansive and collapsible soils:** Parameters of expansive soil, Identification of expansive soils, Free swell test, Differential free swell test, Swelling pressure tests, Field conditions that favor swelling, Effects of swelling on a structure, Foundation techniques.

Text and Reference Books

1. J V.N.S.Murthy, "Soil mechanics and foundation engineering"Vol.1, Saikrupa Technical Consultants, Bangalore.
2. J.E.Bowles, Foundation analysis and design, McGraw Hill International, New York.
3. Wayne C. Teng, "Foundation Design" Prentice Hall of India, New Delhi.
4. K.R. Arora, "Soil Mechanics and Foundation Engineering" Standard Publishers Distributors

5. Shashi K. Gulhati and Manoj Datta, "Geotechnical Engineering"Tata McGraw Hill Publication, Latest edition.
6. T.W. Lambe, Soil Testing for Engineers, John Wiley Publication.
7. Gopal Ranjan,A.S.R.Rao, " Basic and Applied Soil Mechanics", New Age International Publishers, New Delhi.
8. Relevant Indian Standard Specifications and Codes

Mapping of Course Outcome with Program Outcomes

Course outcome	PO1	PO2	PO3	PSO1	PSO2
CO1	3	2	3	1	1
CO2	2	2	1	1	1
CO3	2	1	3	1	1
CO4	1	1	3	1	1
CO5	1	3	2	2	1

3-High, 2- Medium, 1 – Low

Assessment:

ISE I: Based on unit I and unit II

ISE II : Teacher's Assessment: Teachers Assessment of 20 marks is based on one of the / or combination of few of following

1. Assignments
2. Power point presentation
3. Question & answer, interaction
4. Technical quiz
5. Attendance in the class

Assessment Pattern:

Assessment Pattern Level No.	Knowledge Level	ISEI	ISEII	ISEIII	End Semester Examination
K1	Remember	05	05	-	12
K2	Understand	05	05	-	12
K3	Apply	10	10	-	12
K4	Analyze	-	-	-	12
K5	Evaluate	-	-	-	12
Total Marks 100		20	20	-	60

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M.Tech. Geotechnical Engineering Curriculum
With effect from Academic Year 2026–2027
Approved in the 32nd Academic Council Meeting, dated 28th July 2026

Assessment table:

Assessment Tool	**K1, K2, K3**	**K1, K2, K3**	**K1, K2, K3**	**K1, K2, K3**	**K1, K2, K3**
	CO1	CO2	CO3	CO4	CO5
ISEI(20 Marks)	10	10	-	-	-
ISEII (20 Marks)	-	-	10	10	-
ESE Assessment (60Marks)	12	12	12	12	12
Total Marks 100	22	22	22	22	12

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M.Tech. Geotechnical Engineering Curriculum
With effect from Academic Year 2026–2027
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CEPCC5213: Ground Improvement Techniques		
Teaching Scheme	**Examination Scheme**	
Lectures: 03 hrs/ week	**ISE I**	**20 Marks**
Credits:03	**ISE II**	**20 Marks**
	END SEMESTER EXAMINATION	**60 Marks**

Prerequisite: Nil

Course Description: This course exposes the students to basic methodologies and techniques of ground improvement techniques. The course provides detailed knowledge on stabilization of soil and its methods.

Couse Outcomes: After successful completion of the course student will be able to;

	Course Outcomes
CO1	gain the concepts behind a range of ground improvement and soil remediation techniques.
CO2	explain different ground improvement method.
CO3	analyze and suggest techniques for ground improvement.
CO4	apply the knowledge to solve field problems related to ground improvement.
C05	design with geosynthetics.

Detailed Syllabus:

Unit-1	**Clay mineralogy –** Atomic bonds, Clay minerals. Clay-water relations, Electrical effects, cation exchange, Clay mineral identification, Classification of stabilizing agents and stabilizing process. Nature and surface characteristics of soil particles. Concepts of surface area and contact points. Necessity of soil Stabilization.
Unit-2	**Soil stabilization –** Principle, Different methods of soil stabilization Chemical stabilization - Principle, Different methods, Different chemicals used, Engineering, properties and behavior of chemically stabilized soils. Cement stabilization - Types, Mechanism, Properties, Factors influencing, Applications, Laboratory testing for stabilized soil, Lime stabilization - Soil-lime reaction, Types and properties, Effectiveness of lime treatment, Mixture design, Ash and slag stabilization - Fly-ash stabilization, Bituminous stabilization - Classification, mechanism, Laboratory testing, Thermal and electro kinetic stabilization – Thermal, Heating and freezing, Electro-osmosis, Construction methods for stabilized soils.
Unit-3	**Deep Compaction of Granular soil –** Introduction, Vibration methods– Vibro-flotation, Vibro compaction, Blasting, Displacement methods.Stone-gravel and sand column, Design of stone columns, Compaction piles, Dynamic Consolidation, Preloading method.
Unit-4	**Grouting in soils, different methods of grouting-** Permanent grouting, displacement soil fracture grouting, displacement compaction grouting, jet or replacement-displacement grouting, grouted columns. Reinforced soil, Reinforcement-soil interaction, Reinforced soil structure with vertical faces, Reinforced soil with embankments.
Unit-5	**Geosynthesis-** Stabilization of slopes using soil nails, reinforcement of soil beneath foundations. Geosynthetics, Necessity of its use, Types of Geosynthetics, Function of Geosynthetics, Properties of Geosynthetics, Functional requirements, Designing with Geosynthetics.

Text and Reference Books

1. M. R. Hausmann, Engineering Principles of ground Modifications, M[illegible] Edition, 1990.

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M.Tech. Geotechnical Engineering Curriculum
With effect from Academic Year 2026–2027
Approved in the 32nd Academic Council Meeting, dated 28th July 2026

2. M. P. Moseley, Ground Improvement, Blackie Academics and Professionals, 1993
3. P. P. Xanthakos, L. W. Abramson and D. A. Bruce, Ground Improvement and Control, John Wiley & Sons, 1994.
4. R. H. Manfired, Engineering Principles of Ground Modifications, McGraw-Hill, 1990.
5. Dr. P Purushothama Raj, Ground Improvement Techniques, Laxmi Publications, New Delhi, First Edition, 1999.
6. S. K Gulati and Manoj Datta, Geotechnical Engineering, Tata McGraw Hills Publications, New Delhi, Third Reprint, 2007

Mapping of Course Outcome with Program Outcomes

Course outcome	PO1	PO2	PO3	PSO1	PSO2
CO1	3	2	2	1	-
CO2	2	2	2	2	1
CO3	2	1	3	1	1
CO4	1	1	3	1	1
CO5	1	3	2	2	1

3-High, 2- Medium, 1 – Low

Assessment:

ISE I: Based on unit I and unit II

ISE II : Teacher's Assessment: Teachers Assessment of 20 marks is based on one of the / or combination of few of following

1. Assignments
2. Power point presentation
3. Question & answer, interaction
4. Technical quiz
5. Attendance in the class

Assessment Pattern:

Assessment Pattern Level No.	Knowledge Level	ISEI	ISEII	ISEIII	End Semester Examination
K1	Remember	05	05	-	12
K2	Understand	05	05	-	12
K3	Apply	10	10	-	12
K4	Analyze	-	-	-	12
K5	Evaluate	-	-	-	12
Total Marks 100		20	20		

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M.Tech. Geotechnical Engineering Curriculum
With effect from Academic Year 2026-2027
Approved in the 32nd Academic Council Meeting, dated 28th July 2026

Assessment table:

Assessment Tool	**K1, K2, K3**	**K1, K2, K3**	**K1, K2, K3**	**K1, K2, K3**	**K1, K2, K3**
	CO1	CO2	CO3	CO4	CO5
ISEI(20 Marks)	10	10	-	-	-
ISEII (20 Marks)	-	-	10	10	-
ESE Assessment (60Marks)	12	12	12	12	12
Total Marks 100	22	22	22	22	12

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M.Tech. Geotechnical Engineering Curriculum
With effect from Academic Year 2026–2027
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CEPCC5214: Soil Dynamics and Machine Foundations		
Teaching Scheme	**Examination Scheme**	
Lectures: 03 hrs/ week	**ISE I**	**20 Marks**
Credits:3	**ISE II**	**20 Marks**
	END SEMESTER EXAMINATION	**60 Marks**

Prerequisite: Nil

Course Description: This courses includes basics of dynamics, dynamic behaviour of soils, effects of dynamic loads and the various design methods for machine foundation.

Couse Outcomes: After successful completion of the course student will be able to,

	Course Outcomes
CO1	design foundation for different machines
CO2	assess the influence of vibrations and selection of remediation methods based on the nature of vibration, properties and behaviour of soil.
CO3	methods of reducing vibration in existing foundation.
CO4	suggest remedial measures for earthquakes in existing earthen and gravity dam.
CO5	design earthen dams.

Detailed Syllabus:

Unit-1	**Theory of Vibration-** Degree of freedom system, Vibration absorber, Vibration Isolation, Spectral Response, Wave Propagation- theory and its applications, Transient and vibratory loading, Strengths and deformation characteristics of soils under dynamic loads.
Unit-2	**Dynamic Earth pressure-** Retaining walls under dynamic loading, Analytical and graphical methods. Shallow footings- Bearing capacity under dynamic loads designs
Unit-3	**Pile foundation-** Behaviour of piles under dynamic loads, Machine foundations, Special features, resonant frequency, Behaviour and design of Machine Foundation, Methods of reducing vibration in existing foundation.
Unit-4	**Hammer Foundations-** Hammer Foundations, Limiting design of hammer foundation, Dynamic compaction of soils, Various theories of compaction, Methods of compaction, case histories
Unit-5	**Earth dams-** Design criterion, Model testing and Analysis, Case histories of failure of earthen and gravity dam due to earthquake, Remedial measures for earthquakes in existing earthen and gravity dam.

Text and Reference Books

1. S. Prakash, “Soil Dynamics”, McGrawhills book company
2. B.M. Das, “Fundamentals of Soil Dynamics”, Elsevier Publications
3. S. Prakash and V.K. Puri, “Foundation for Machine: Analysis and Design”, John Wiley and sons
4. F.E, Richart, J.R. Hall and R.D. Woods, “Vibration of Soil and Foundation”, Prentice-Hal Inc., New Jersey
5. IS: 5249-1969/1975, :Method of Test for determination of In situ dynamic properties of Soils

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M.Tech. Geotechnical Engineering Curriculum
With effect from Academic Year 2026–2027
Approved in the 32nd Academic Council Meeting, dated 28th July 2026

Mapping of Course Outcome with Program Outcomes

Course outcome	PO1	PO2	PO3	PO4	PO5
CO1	3	2	3	1	1
CO2	2	2	2	2	1
CO3	2	-	2	1	1
CO4	1	1	3	1	-
CO5	1	3	2	-	-

3-High, 2- Medium, 1 – Low

Assessment:

ISE I: Based on unit I and unit II

ISE II : Teacher's Assessment: Teachers Assessment of 20 marks is based on one of the / or combination of few of following

1. Assignments
2. Power point presentation
3. Question & answer, interaction
4. Technical quiz
5. Attendance in the class

Assessment Pattern:

Assessment Pattern Level No.	Knowledge Level	ISEI	ISEII	ISEIII	End Semester Examination
K1	Remember	05	05	-	12
K2	Understand	05	05	-	12
K3	Apply	10	10	-	12
K4	Analyze	-	-	-	12
K5	Evaluate	-	-	-	12
Total Marks 100		20	20	-	60

Assessment table:

Assessment Tool	K1, K2, K3	K1, K2, K3	K1, K2, K3	K1, K2, K3	K1, K2, K3
	CO1	CO2	CO3	CO4	CO5
ISEI(20 Marks)	10	10	-	-	-
ISEII (20 Marks)	-	-	10	10	-
ESE Assessment (60Marks)	12	12	12	12	12
Total Marks 100	22	22	22	22	12

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M.Tech. Geotechnical Engineering Curriculum
With effect from Academic Year 2026–2027
Approved in the 32nd Academic Council Meeting, dated 28th July 2026

CEOEC5201: Disaster Management		
Teaching Scheme	**Evaluation Scheme**	
Theory: 2Hrs/Week	**ISE I**	**10 Marks**
	ISE II	**10 Marks**
Credits:02	**END SEMESTER EXAMINATION**	**30 Marks**
	Total	**50 Marks**

Prerequisite: Not applicable

Course Description: This course introduces the principles and practices of disaster management, focusing on understanding the natural and man-made disasters, risk and vulnerability analysis, and frameworks for disaster preparedness, response, mitigation, and recovery. It also covers emerging technologies and tools such as GIS, remote sensing, and early warning systems to enhance disaster resilience. Emphasis is placed on policy, institutional frameworks, and community-based disaster management.

Course Outcomes:

After successful completion of the course, students will be able to:

Course Outcomes	
CO1	analyze disaster risk, vulnerability, and the factors contributing to them.
CO2	evaluate post-disaster management and the role of institutional frameworks.
CO3	apply modern tools such as GIS and Remote Sensing in disaster management planning.

Detailed Syllabus:

Unit 1	**Introduction to Disaster Management** Definition: Hazard, Risk, Vulnerability, Disaster, Types and classification of disasters: Natural (Floods, Earthquakes, Cyclones, Landslides, Droughts) and Man-made (Industrial, Chemical, Biological, Nuclear, Accidents), Causes, consequences, and case studies, Disaster management cycle: Prevention, Mitigation, Preparedness, Response, Recovery, Reconstruction.
Unit 2	**Hazard and Vulnerability Analysis** Risk assessment and vulnerability mapping, Factors affecting vulnerability: Physical, Social, Economic, Environmental, Community-based vulnerability assessment, Disaster risk reduction strategies, Role of stakeholders: Government, NGOs, Communities. **Disaster Preparedness and Mitigation** Components of disaster preparedness plans, Early warning systems and forecasting, Structural and non-structural mitigation measures, Land use planning and building codes, Education and awareness generation, Role of technology and media in disaster preparedness.
Unit 3	**Response and Post-Disaster Management** Disaster response planning and implementation, Emergency operations and coordination, Search, rescue, and relief operations, Damage and needs assessment, Rehabilitation and reconstruction, Psychological and s

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Dr. Anil Karwankar
Dean , Academics

M.Tech. Geotechnical Engineering Curriculum
With effect from Academic Year 2026–2027
Approved in the 32nd Academic Council Meeting, dated 28th July 2026

	Institutional Framework & Technological Interventions Disaster Management Act 2005 and NDMA guidelines, Role of UN, NIDM, SDMA, and local bodies, Use of GIS, Remote Sensing, AI in disaster management, Mobile applications, drones, and satellite data for real-time monitoring, Integrating disaster risk reduction with climate change adaptation, Case studies on successful disaster management models.

References:

1. **Satish Modh** – *Introduction to Disaster Management*, Macmillan India
2. **Coppola D.** – *Introduction to International Disaster Management*, Elsevier
3. **Gupta, Harsh K.** – *Disaster Management*, University Press
4. **Sinha, P.C.** – *Disaster Mitigation: Experiences and Reflections*, SBS Publishers
5. **R. Subramanian** – *Disaster Management*, Vikas Publishing House
6. **NDMA Guidelines and Reports** – https://ndma.gov.in
7. **UNISDR** – *Disaster Risk Reduction Strategies and Institutional Mechanisms*
8. **Government of India** – *Disaster Management Act*,

Mapping of Course Outcome with Program Outcomes

Course Outcome	PO1	PO2	PO3	PSO1	PSO2
CO1	2	3	3	1	2
CO2	3	2	3	2	1
CO3	3	3	2	1	2

3-High 2-Medium 1-Low

Teacher's Assessment: ISE II of 10 marks may be based on one or more of the following

1. Technical quizzes
2. Application development
3. Question & answer / Numerical solution
4. Group discussion
5. Other if any

Assessment Pattern

Assessment Pattern Level No.	Knowledge Level	ISE I	ISE II	End Semester Examination
K1	Remember	5	5	10
K2	Understand	5	5	10
K3	Apply			10
K4	Analyze			
K5	Evaluate			
	Total Marks	10	10	30

Dr. S. S. Koranne
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Dr. Anil Karwankar
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M.Tech. Geotechnical Engineering Curriculum
With effect from Academic Year 2026–2027
Approved in the 32nd Academic Council Meeting, dated 28th July 2026

Assessment Table

Assessment Tool	K1, K2, K3	K1, K2, K3	K1, K2, K3
	CO1	CO2	CO3
ISEI(10 Marks)	5	5	
ISEII (10 Marks)	5	5	
ESE Assessment (30Marks)	10	10	10
Total Marks 50	20	20	10

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M.Tech. Geotechnical Engineering Curriculum
With effect from Academic Year 2026–2027
Approved in the 32nd Academic Council Meeting, dated 28th July 2026

CEPEC5228: Forensic Geotechnical Engineering		
Teaching Scheme	**Examination Scheme**	
Lectures:04hrs/week	**ISEI**	**20 Marks**
Credits:4	**ISEII**	**20 Marks**
	END SEMESTER EXAMINATION	**60 Marks**

Course Description: To understand the fundamental principles of forensic geotechnical engineering, to analyze geotechnical failures and their causes. To apply forensic investigation techniques for site assessment. To evaluate soil-structure interaction in failed structures. To develop remediation strategies for geotechnical failures.

Couse Outcomes: After successful completion of the course student will be able to;

	Course Outcomes
CO1	identify different types of geotechnical failures and their causes.
CO2	perform forensic investigations using geotechnical testing methods
CO3	analyze soil and foundation failures using case studies.
CO4	recommend appropriate remedial measures for geotechnical failures
CO5	interpret legal and ethical aspects of forensic geotechnical engineering

Detailed Syllabus:

Unit -1	**Introduction to Forensic Geotechnical Engineering:** Definition, Scope, and Importance, Causes of Geotechnical Failures, Common Geotechnical Failure Mechanisms, Role of Geotechnical Engineers in Forensic Investigations, Ethics and Legal Aspects in Forensic Engineering.
Unit -2	**Site Investigation and Failure Analysis:** Subsurface Investigation Techniques, Soil Sampling and Laboratory Testing, Groundwater Effects on Failures, Field and Laboratory Methods for Failure Assessment, Instrumentation and Monitoring in Geotechnical Forensics.
Unit -3	**Geotechnical Failure Case Studies:** Foundation Failures (Shallow & Deep Foundations), Slope Failures and Landslides, Pavement and Retaining Wall Failures, Embankment and Dam Failures, Soil Liquefaction and Earthquake-Induced Failures.
Unit -4	**Remedial Measures and Rehabilitation:** Ground Improvement Techniques, Retrofitting and Stabilization Methods, Soil-Structure Interaction Considerations, Numerical and Analytical Modeling in Failure Analysis, Risk Assessment and Preventive Strategies.
Unit -5	**Legal and Professional Issues in Geotechnical Forensics:** Engineering Codes and Standards for Forensic Investigations, Role of Expert Witness in Legal Proceedings, Geotechnical Report Writing and Documentation, Case Histories of Landmark Failures and Legal Implications, Sustainability and Future Trends in Geotechnical Forensics.

Text and Reference Books

1. "Geotechnical Failure Analysis for Practitioners" – F. G. Bell
2. "Forensic Geotechnical Engineering" – V.V.S. Rao & G.L. Sivakumar Babu
3. "Geotechnical Engineering Investigation Handbook" – Roy E. Hunt
4. "Soil Mechanics in Engineering Practice" – Karl Terzaghi, Ralph B. Peck
5. "Principles of Geotechnical Engineering" – Braja M. Das

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M.Tech. Geotechnical Engineering Curriculum
With effect from Academic Year 2026–2027
Approved in the 32nd Academic Council Meeting, dated 28th July 2026

Mapping of Course Outcome with Program Outcomes

Course outcome	PO1	PO2	PO3	PSO1	PSO2
CO1	2	2	2	2	-
CO2	2	1	2	3	-
CO3	2	2	3	2	-
CO4	3	3	3	3	-
CO5	2	2	2	3	-

3-High, 2- Medium, 1 – Low

Assessment:

ISE I: Based on unit I and unit II

ISE II : Teacher's Assessment: Teachers Assessment of 20 marks is based on one of the / or combination of few of following

1. Assignments
2. Power point presentation
3. Question & answer, interaction
4. Technical quiz
5. Attendance in the class

Assessment Pattern:

Assessment Pattern Level No.	Knowledge Level	ISEI	ISEII	ISEIII	End Semester Examination
K1	Remember	05	05	-	12
K2	Understand	05	05	-	12
K3	Apply	10	10	-	12
K4	Analyze	-	-	-	12
K5	Evaluate	-	-	-	12
Total Marks 100		20	20	-	60

Assessment table:

Assessment Tool	K1, K2, K3	K1, K2, K3	K1, K2, K3	K1, K2, K3	K1, K2, K3
	CO1	CO2	CO3	CO4	CO5
ISEI(20 Marks)	10	10	-	-	-
ISEII (20 Marks)	-	-	10	10	-
ESE Assessment (60Marks)	12	12	12	12	12
Total Marks 100	22	22	22	22	12

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M.Tech. Geotechnical Engineering Curriculum
With effect from Academic Year 2026–2027
Approved in the 32nd Academic Council Meeting, dated 28th July 2026

CEPEC5229: Applications of Geosynthetics in Geotechnical Engineering		
Teaching Scheme	**Examination Scheme**	
Lectures:04hrs/week	**ISEI**	**20 Marks**
Credits:4	**ISEII**	**20 Marks**
	END SEMESTER EXAMINATION	**60 Marks**

Prerequisite: Nil

Course Description:

This course introduces the principles, materials, and engineering applications of geosynthetics used in geotechnical engineering projects. It covers different types of geosynthetics such as geotextiles, geogrids, geomembranes, geonets, and geocomposites, along with their properties, functions, and selection criteria. The course focuses on how geosynthetics improve soil performance through reinforcement, separation, filtration, drainage, and containment.

Couse Outcomes:

After successful completion of the course student will be able to;

	Course Outcomes
CO1	identify different types of geosynthetics and explain their properties and functions.
CO2	design geosynthetics-based solutions for soil reinforcement, drainage, filtration, and separation.
CO3	evaluate the performance of geosynthetics in embankments, retaining walls, and pavements.
CO4	analyze geosynthetic applications in landfills, erosion control, and ground improvement techniques.
CO5	apply knowledge of geosynthetics for sustainable and cost-effective geotechnical engineering solutions.

Detailed Syllabus:

Unit -1	**Introduction to Geosynthetics-** Definition and classification of geosynthetics. Types: Geotextiles, Geogrids, Geomembranes, Geonets, Geocomposites, etc. Properties of geosynthetics (physical, mechanical, hydraulic, endurance, and degradation properties). Standards and testing methods for geosynthetics.
Unit -2	**Functions and Mechanisms of Geosynthetics-** Separation, filtration, drainage, reinforcement, and containment. Behaviour of soil-geosynthetic interaction. Design considerations for different geosynthetic functions. Case studies on the use of geosynthetics in geotechnical applications.
Unit -3	**Geosynthetics in Soil Reinforcement and Stabilization-** Principles of soil reinforcement. Applications in reinforced soil walls, slopes, and embankments. Geogrid and geotextile-reinforced pavements. Stability analysis of reinforced soil structures.
Unit -4	**Geosynthetics in Environmental and Hydraulic Applications-** Use of geomembranes in landfills and containment systems, Geosynthetic clay liners (GCLs) for environmental protection. Applications in canals, reservoirs, and erosion control. Geosynthetics for drainage and groundwater control.
Unit -5	**Design and Construction Techniques-** Design methodologies for geosynthetics in various applications. Construction practices and quality control. Durability and long-term performance of geosynthetics. Recent trends and advancements in geosynthetics technology.

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Dr. Anil Karwankar
Dean , Academics

M.Tech. Geotechnical Engineering Curriculum
With effect from Academic Year 2026–2027
Approved in the 32nd Academic Council Meeting, dated 28th July 2026

Text and Reference Books

1. Koerner, R. M., "Designing with Geosynthetics", 6th Edition, Pearson Education, 2012.
2. Das, B. M., "Principles of Geotechnical Engineering", Cengage Learning, 2017.
3. Rao, G. V., "Geosynthetics in Infrastructure Engineering", Tata McGraw Hill, 2007.
4. Jewell, R. A., "Soil Reinforcement with Geotextiles", CIRIA, Butterworths, 1996.
5. Shukla, S. K., "Geosynthetics and Their Applications", ICE Publishing, 2012.

Mapping of Course Outcome with Program Outcomes

Course outcome	PO1	PO2	PO3	PSO1	PSO2
CO1	2	2	2	-	-
CO2	2	3	3	1	-
CO3	2	2	2	2	-
CO4	2	3	3	1	-
CO5	3	2	3	3	-

3-High, 2- Medium, 1 – Low

Assessment:

ISE I: Based on unit I and unit II

ISE II : Teacher's Assessment: Teachers Assessment of 20 marks is based on one of the / or combination of few of following

1. Assignments
2. Power point presentation
3. Question & answer, interaction
4. Technical quiz
5. Attendance in the class

Assessment Pattern:

Assessment Pattern Level No.	Knowledge Level	ISEI	ISEII	ISEIII	End Semester Examination
K1	Remember	05	05	-	12
K2	Understand	05	05	-	12
K3	Apply	10	10	-	12
K4	Analyze	-	-	-	12
K5	Evaluate	-	-	-	12
Total Marks 100		20	20	-	60

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M.Tech. Geotechnical Engineering Curriculum
With effect from Academic Year 2026–2027
Approved in the 32nd Academic Council Meeting, dated 28th July 2026

Assessment table:

Assessment Tool	**K1, K2, K3**	**K1, K2, K3**	**K1, K2, K3**	**K1, K2, K3**	**K1, K2, K3**
	CO1	CO2	CO3	CO4	CO5
ISEI(20 Marks)	10	10	-	-	-
ISEII (20 Marks)	-	-	10	10	-
ESE Assessment (60Marks)	12	12	12	12	12
Total Marks 100	22	22	22	22	12

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M.Tech. Geotechnical Engineering Curriculum
With effect from Academic Year 2026–2027
Approved in the 32nd Academic Council Meeting, dated 28th July 2026

CEPEC5230: Software Application in Geotechnical Engineering		
Teaching Scheme	**Examination Scheme**	
Lectures:04hrs/week	**ISEI**	**20 Marks**
Credits:4	**ISEII**	**20 Marks**
	END SEMESTER EXAMINATION	**60 Marks**

Prerequisite: Nil

Course Description:

This course introduces the use of modern software tools in geotechnical engineering for analysis, design, and simulation of soil and foundation systems. It focuses on applying computer-based programs to solve complex geotechnical problems related to soil behavior, slope stability, seepage analysis, foundation design, and earth retaining structures.

Couse Outcomes: After successful completion of the course student will be able to;

	Course Outcomes
CO1	demonstrate proficiency in using geotechnical software for soil analysis and geotechnical investigations.
CO2	apply numerical and finite element methods for geotechnical problem-solving using software tools.
CO3	analyze and design foundations, retaining structures, and slopes using specialized geotechnical software.
CO4	evaluate and interpret results from geotechnical modelling and validate with field/laboratory data.
CO5	evaluate and interpret results from geotechnical modelling and validate with field/laboratory data.

Detailed Syllabus:

Unit -1	**Introduction to Geotechnical Software-** Need for software applications in geotechnical engineering. Overview of commonly used geotechnical software: PLAXIS, GeoStudio, FLAC, MIDAS GTS, ABAQUS, ANSYS, etc. Fundamentals of numerical methods and their applications in geotechnics.
Unit -2	**Finite Element Analysis in Geotechnical Engineering-** Introduction to finite element method (FEM) and its application in soil mechanics. Basics of mesh generation, boundary conditions, and material models. Case study using PLAXIS/ABAQUS for soil behaviour modelling.
Unit -3	**Slope Stability and Retaining Wall Analysis-** Methods of slope stability analysis: Limit Equilibrium vs. FEM. Slope stability analysis using GeoStudio (SLOPE/W) and FLAC. Retaining wall analysis using software applications.
Unit -4	**Foundation Design and Soil-Structure Interaction-** Shallow and deep foundation analysis using geotechnical software. Soil-structure interaction (SSI) modelling using MIDAS GTS and PLAXIS. Application of pile foundation design using software tools.
Unit -5	**Advanced Geotechnical Applications and Case Studies-** Seepage and groundwater flow analysis using SEEP/W. Dynamic and seismic analysis of geotechnical structures. Case studies and project work on real-world geotechnical problems using software tools.

Text and Reference Books

1. **Smith, I.M. & Griffiths, D.V.** – Programming the Finite Element Method.
2. **Das, B.M.** – Principles of Geotechnical Engineering.
3. **Krahn, J.** – Stability Modeling with SLOPE/W.
4. **Zienkiewicz, O.C. & Taylor, R.L.** – The Finite Element Method.
5. Manuals and user guides of PLAXIS, GeoStudio, FLAC, and ABAQU

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Dr. Anil Karwankar
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M.Tech. Geotechnical Engineering Curriculum
With effect from Academic Year 2026–2027
Approved in the 32nd Academic Council Meeting, dated 28th July 2026

Mapping of Course Outcome with Program Outcomes

Course outcome	PO1	PO2	PO3	PSO1	PSO2
CO1	1	2	2	2	3
CO2	2	3	3	3	3
CO3	3	3	1	3	3
CO4	3	2	3	2	3
CO5	3	3	2	3	3

3-High, 2- Medium, 1 – Low

Assessment:

ISE I: Based on unit I and unit II

ISE II : Teacher's Assessment: Teachers Assessment of 20 marks is based on one of the / or combination of few of following

1. Assignments
2. Power point presentation
3. Question & answer, interaction
4. Technical quiz
5. Attendance in the class

Assessment Pattern:

Assessment Pattern Level No.	Knowledge Level	ISEI	ISEII	ISEIII	End Semester Examination
K1	Remember	05	05	-	12
K2	Understand	05	05	-	12
K3	Apply	10	10	-	12
K4	Analyze	-	-	-	12
K5	Evaluate	-	-	-	12
Total Marks 100		20	20	-	60

Assessment table:

Assessment Tool	K1, K2, K3	K1, K2, K3	K1, K2, K3	K1, K2, K3	K1, K2, K3, K4
	CO1	CO2	CO3	CO4	CO5
ISEI(20 Marks)	10	10	-	-	-
ISEII (20 Marks)	-	-	10	10	-
ESE Assessment (60Marks)	12	12	12	12	12
Total Marks 100	22	22	22		

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M.Tech. Geotechnical Engineering Curriculum
With effect from Academic Year 2026-2027
Approved in the 32nd Academic Council Meeting, dated 28th July 2026

CEPEC5231: Geotechnical Engineering for Underground Structures		
Teaching Scheme	**Examination Scheme**	
Lectures:04hrs/week	**ISEI**	**20 Marks**
Credits:4	**ISEII**	**20 Marks**
	END SEMESTER EXAMINATION	**60 Marks**

Prerequisites: Nil

Course Description:

This course focuses on the geotechnical principles and engineering practices involved in the planning, analysis, design, and construction of underground structures. It covers the behavior of soil and rock surrounding underground openings and the interaction between ground conditions and underground construction techniques.

Course Outcomes:

After successful completion of the course student will be able to,

	Course Outcomes
CO1	understand the fundamental principles of soil and rock mechanics relevant to underground structures.
CO2	analyze stress distribution, deformation, and failure mechanisms in underground excavations.
CO3	design and assess stability aspects of tunnels, caverns, shafts, and other underground facilities.
CO4	apply geotechnical investigation techniques, ground improvement methods, and numerical modeling for underground construction.
CO5	evaluate risk factors, safety measures, and construction methodologies for underground engineering projects.

Detailed Syllabus:

Unit -1	**Introduction to Underground Geotechnical Engineering-** Importance and applications of underground structures. Classification of underground structures (tunnels, caverns, subways, basements). Geotechnical considerations in underground construction.
Unit -2	**Soil and Rock Mechanics for Underground Structures-** Stress-strain behavior of soils and rocks. Shear strength and permeability considerations. Rock mass classifications (RMR, Q-system, GSI). Stress distribution and deformation analysis.
Unit -3	**Stability Analysis and Support Systems-** Failure mechanisms of underground openings. Analytical and numerical methods for stability analysis. Design of tunnel linings, rock bolts, shotcrete, and grouting. Case studies of tunnel failures and remedial measures.
Unit -4	**Geotechnical Investigations and Ground Improvement-** Site investigation techniques (boring, geophysical methods, in-situ testing). Ground improvement methods (grouting, freezing, soil reinforcement). Numerical modeling in underground geotechnical engineering.
Unit -5	**Construction Methods and Risk Management-** Conventional and mechanized tunneling (TBM, NATM, Cut & Cover). Impact of groundwater and dewatering techniques. Risk assessment and safety measures in underground construction. Monitoring and instrumentation in underground works.

References & Textbooks:

1. **Bieniawski, Z. T.** – Engineering Rock Mass Classifications
2. **Hoek, E., & Brown, E. T.** – Underground Excavations in Rock

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Dr. Anil Karwankar
Dean , Academics

M.Tech. Geotechnical Engineering Curriculum
With effect from Academic Year 2026–2027
Approved in the 32nd Academic Council Meeting, dated 28th July 2026

3. **Das, B. M.** – Principles of Geotechnical Engineering
4. **Lambe, T. W., & Whitman, R. V.** – Soil Mechanic

Reference Standards:

1. **IS 1892**: Code of Practice for Subsurface Investigation
2. **IS 3370**: Code of Practice for Concrete Structures for the Storage of Liquids
3. **IS 456**: Code of Practice for Plain and Reinforced Concrete
4. **IS 1904**: Code of Practice for Design and Construction of Foundations

Mapping of Course Outcome with Program Outcomes

Course outcome	PO1	PO2	PO3	PSO1	PSO2
CO1	2	2	2	2	1
CO2	2	1	3	3	1
CO3	3	2	2	1	1
CO4	3	2	1	2	-
CO5	2	1	2	2	-

3-High, 2- Medium, 1 – Low

Assessment:

ISE I: Based on unit I and unit II

ISE II : Teacher's Assessment: Teachers Assessment of 20 marks is based on one of the / or combination of few of following

1. Assignments
2. Power point presentation
3. Question & answer, interaction
4. Technical quiz
5. Attendance in the class

Assessment Pattern:

Assessment Pattern Level No.	Knowledge Level	ISEI	ISEII	ISEIII	End Semester Examination
K1	Remember	05	05	-	12
K2	Understand	05	05	-	12
K3	Apply	10	10	-	12
K4	Analyze	-	-	-	12
K5	Evaluate	-	-	-	12
Total Marks 100		20	20	-	60

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M.Tech. Geotechnical Engineering Curriculum
With effect from Academic Year 2026-2027
Approved in the 32nd Academic Council Meeting, dated 28th July 2026

Assessment table:

Assessment Tool	**K1, K2, K3**	**K1, K2, K3**	**K1, K2, K3**	**K1, K2, K3**	**K1, K2, K3, K4 ,K5**
	CO1	CO2	CO3	CO4	CO5
ISEI(20 Marks)	10	10	-	-	-
ISEII (20 Marks)	-	-	10	10	-
ESE Assessment (60Marks)	12	12	12	12	12
Total Marks 100	22	22	22	22	12

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M.Tech. Geotechnical Engineering Curriculum
With effect from Academic Year 2026–2027
Approved in the 32nd Academic Council Meeting, dated 28th July 2026

CEPCC5215: Geotechnical Engineering Laboratory – II		
Teaching Scheme	**Evaluation Scheme**	
Practical: 2Hrs/Week	**ISE II**	**25 Marks**
Credits:01	**END SEMESTER EXAMINATION**	**25 Marks**
	Total	**50 Marks**

Prerequisite: Not applicable

Course Description: In Geotechnical Lab – II Students will be performing or see demonstrations of field tests.

Course Outcomes:

After completion of this course students will be able to;

	Course Outcomes
CO1	perform different field tests.
CO2	interpret test results and suggest the suitability of foundation
CO3	use available/ educational software for the analysis of soil engineering problems.

List of the Experiments

I. A report of the experimental work or demonstration of the following (any five):

Sr. No.	**Title of the Experiments**
1	Determination of Shear Strength Parameters of Soil by Large Direct Shear Test
2	Determination of Shear Strength Parameters of Soil by Triaxial Compression Test (UU/CU/CD)
3	Determination of Consolidation Characteristics of Soil by One-Dimensional Consolidation Test
4	Determination of Bearing Capacity and Settlement Characteristics of Soil by Plate Load Test
5	Determination of Soil Resistance by Standard Penetration Test (SPT)
6	Field Visit to Study Geotechnical Site Investigation, Soil Exploration, Sampling Techniques, and In-situ Testing Methods

II - Solving problems on calculation of Stresses, Shear Strength, Bearing capacity, Earth pressures, Load calculation for different types of foundations or Use of available / educational software for the analysis of Soil engineering problems.

Practical Examination shall consist of term work assessment and viva-voce.

Assessment: Based on the practical performance, interaction of students till the term end.

Mapping of Course Outcome with Program Outcomes

Course Outcome	**PO1**	**PO2**	**PO3**	**PSO1**	**PSO2**
CO1	2	3	3	2	-
CO2	2	1	3	2	-
CO3	3	3	3	2	-

3-High, 2- Medium, 1 – Low

Dr. S. S. Koranne
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Dr. Anil Karwankar
Dean , Academics

M.Tech. Geotechnical Engineering Curriculum
With effect from Academic Year 2026–2027
Approved in the 32nd Academic Council Meeting, dated 28th July 2026

Assessment pattern:

Assessment Pattern Level No.	Knowledge Level	ISE II	End Semester Examination
S1	Imitation	10	10
S2	Manipulation	10	10
S3	Precision	5	5
S4	Articulation	-	-
S5	Naturalization	-	-
Total Marks		25	25

Assessment Table:

Assessment Tool	CO1, CO2, CO3
	S1, S2, S3
ISE II:(25 Marks)	25
ESE Assessment (25 Marks)	25
Total Marks (50)	50

Dr. S. S. Koranne
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Dr. Anil Karwankar
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M.Tech. Geotechnical Engineering Curriculum
With effect from Academic Year 2026–2027
Approved in the 32nd Academic Council Meeting, dated 28th July 2026

CEPCC5216: Lab- Ground Improvement Techniques		
Teaching Scheme	**Evaluation Scheme**	
Practical: 2Hrs/Week	**ISE II**	**25 Marks**
Credits:01	**END SEMESTER EXAMINATION**	**25 Marks**
	Total	**50 Marks**

Prerequisite: Not applicable

Course Description: In Geotechnical Lab – II Students will be performing or see demonstrations of field tests

Course Outcomes:

After completion of this course students will be able to;

	Course Outcomes
CO1	understand and apply different in-situ soil improvement techniques, including densification and stabilization.
CO2	analyze and evaluate the performance of ground improvement techniques through laboratory and field testing.
CO3	implement various reinforcement techniques such as geosynthetics and stone columns for soil strengthening.

List of the Experiments

I. A report of the experimental work or demonstration of the following:

Sr. No.	**Title of the Experiments**
1	Soil Improvement through Densification and Compaction 1. Standard Proctor & Modified Proctor Test – Determination of optimum moisture content (OMC) and maximum dry density (MDD). 2. Field Density Test (Sand Replacement & Core Cutter Methods) – Evaluation of soil compaction in the field.
2	Chemical & Mechanical Stabilization Techniques 1. Soil Stabilization using Lime, Cement, and Fly Ash – Effect of chemical additives on soil strength. 2. California Bearing Ratio (CBR) Test on Stabilized Soil – Strength improvement assessment.
3	Reinforcement Techniques in Soil 1. Pull-out Test on Geosynthetics – Evaluation of geosynthetic reinforcement behavior. 2. Construction and Testing of a Small-Scale Model of Stone Columns & Reinforced Earth Structures – Performance analysis.
4	Grouting & Deep Mixing Methods 1. Permeation and Jet Grouting Experiment – Effectiveness of grouting techniques. 2. Soil-Cement Mixing Test – Strength enhancement due to deep mixing.
5	Case Studies and Software Applications 1. Case Study on Ground Improvement Techniques – Site analysis and selection of appropriate method. 2. Introduction to Plaxis & GeoStudio for Ground Improvement Analysis – Software-based simulations.

Assessment: Based on the practical performance, interaction of st

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Dr. Anil Karwankar
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M.Tech. Geotechnical Engineering Curriculum
With effect from Academic Year 2026–2027
Approved in the 32nd Academic Council Meeting, dated 28th July 2026

Mapping of Course Outcome with Program Outcomes

Course Outcome	PO1	PO2	PO3	PSO1	PSO2
CO1	1	3	3	3	-
CO2	2	1	2	2	-
CO3	2	3	3	3	-

3-High, 2- Medium, 1 – Low

Assessment pattern:

Assessment Pattern Level No.	Knowledge Level	ISE II	End Semester Examination
S1	Imitation	10	10
S2	Manipulation	10	10
S3	Precision	5	5
S4	Articulation	-	-
S5	Naturalization	-	-
Total Marks		25	25

Assessment Table:

Assessment Tool	CO1, CO2, CO3
	S1, S2, S3
ISE II:(25 Marks)	25
ESE Assessment (25 Marks)	25
Total Marks (50)	50

Dr. S. S. Koranne
Head, Civil Engg.

Dr. Anil Karwankar
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M.Tech. Geotechnical Engineering Curriculum
With effect from Academic Year 2026–2027
Approved in the 32nd Academic Council Meeting, dated 28th July 2026

CEAEC5202: SEMINAR		
Teaching Scheme	**Evaluation Scheme**	
Practical: 4Hrs/Week	**ISE II**	**25 Marks**
Credits:02	**END SEMESTER EXAMINATION**	**25 Marks**
	Total	**50 Marks**

Prerequisite: Not applicable

Course Description:
This course provides postgraduate students with an opportunity to explore recent advances in their specialization through literature survey, technical presentations, and discussions. Students develop skills in technical writing, critical analysis, presentation, and research methodology by preparing and presenting seminars on contemporary topics.

Course Outcomes:
After completion of this course students will be able to;

	Course Outcomes
CO1	conduct a comprehensive literature survey on a selected research topic.
CO2	prepare and deliver a technical seminar using effective presentation and communication skills.
CO3	analyze research findings and prepare a technical report following research ethics and citation standards.

Deatailed Syllabus:
Selection of seminar topic related to the specialization, Identification of research problem, Literature survey using journals, conference proceedings and digital libraries, Review and critical analysis of recent research papers, Research methodology, Technical writing and report preparation, Preparation of presentation slides, Data interpretation and visualization, Referencing and citation techniques, Plagiarism and research ethics, Seminar presentation, Technical discussion, Question and answer session, Peer evaluation, Final seminar report submission.

ISE-I & ISE-II: Practical Examination shall consist of term work assessment and viva-voce.

Assessment: Based on the practical performance, interaction of students till the term end.

Mapping of Course Outcome with Program Outcomes

Course Outcome	**PO1**	**PO2**	**PO3**	**PSO1**	**PSO2**
CO1	2	3	3	3	3
CO2	2	1	3	2	3
CO3	3	2	3	2	3

3-High, 2- Medium, 1 – Low

Dr. S. S. Koranne
Head, Civil Engg.

Dr. Anil Karwankar
Dean , Academics

M.Tech. Geotechnical Engineering Curriculum
With effect from Academic Year 2026–2027
Approved in the 32nd Academic Council Meeting, dated 28th July 2026

Assessment pattern:

Assessment Pattern Level No.	Knowledge Level	ISE II	End Semester Examination
S1	Imitation	10	10
S2	Manipulation	10	10
S3	Precision	5	5
S4	Articulation	-	-
S5	Naturalization	-	-
Total Marks		25	25

Assessment Table:

Assessment Tool	CO1, CO2, CO3
	S1, S2, S3
ISE II:(25 Marks)	25
ESE Assessment (25 Marks)	25
Total Marks (50)	50

Dr. S. S. Koranne
Head, Civil Engg.

Dr. Anil Karwankar
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M.Tech. Geotechnical Engineering Curriculum
With effect from Academic Year 2026–2027
Approved in the 32nd Academic Council Meeting, dated 28th July 2026

CEDIS5203: Dissertation-I		
Teaching Scheme	**Evaluation Scheme**	
Practical: 4Hrs/Week	**ISE II**	**50 Marks**
Credits:02	**END SEMESTER EXAMINATION**	**50 Marks**
	Total	**100 Marks**

Prerequisite: Not applicable

Course Description: The dissertation work is one of the key areas of post graduate education incorporating the research component in the curriculum. The student is required to study the existing literature from various sources such as referred journals, proceedings of National/International seminar/conferences, post graduate dissertation, PhD thesis, reference book etc. of Civil-Water Resources Engineering. The student would identify the problem and provide solution/s through experimental/comparative study as partial fulfillment of post graduate degree in Civil- Water resources engineering.

The Dissertation-I mainly focuses on literature survey, identification of problem and action plan with possible outcomes for the completion of Dissertation-II

Course Outcomes:

After completion of this course students will be able;

	Course Outcomes
CO1	to carry out exhaustive literature survey on chosen field of study.
CO2	to formulate/define the problem for dissertation.
CO3	to compile and prepare a technical report of the collected literature and present.
CO4	to understand the methodology case study.

Detailed Syllabus:

Term Work:

The Dissertation-I shall consist of collection of literature from a chosen field of Civil-Water resources engineering from various sources. The candidate shall formulate/define analytical and/or experimental problem for carrying out dissertation work. The candidate shall prepare a technical report in a prescribed format. The evaluation of the term work shall be through submission of report of the student in prescribed format.

Viva Voce Examination: It consists of two parts.

Part-I: Mid-Term Evaluation for 25 Marks: A mid-term evaluation for 25 marks out of 50 marks shall be done as per the schedule given in the institute academic calendar. Students should prepare a power point presentation and present before the panel of examiners and class students and should be able to answer questions asked by the panel of examiners and class students. Panel of examiner consists of guide as internal examiner and at least one faculty member appointed by the Head of

Dr. S. S. Koranne
Head, Civil Engg.

Dr. Anil Karwankar
Dean , Academics

M.Tech. Geotechnical Engineering Curriculum
With effect from Academic Year 2026–2027
Approved in the 32nd Academic Council Meeting, dated 28th July 2026

the Department as external examiner. The panel of examiner will assess the contents and presentation and gives the suggestions, if any and assigns the marks out of 25marks.

Part-II: End Semester Evaluation for 25 Marks: Students shall prepare a comprehensive report incorporating the suggestions of part-I, if any and make a power point presentation before the panel of examiners as above and class students and should be able to answer questions asked by the panel of examiners and class students. The panel of examiner will assess the contents and presentation and assigns the marks out of 25 marks.

Assessment: Based on the practical performance, interaction of students till the term end.

Mapping of Course Outcome with Program Outcomes

Course Outcome	PO1	PO2	PO3	PSO1	PSO2
CO1	2	3	3	2	3
CO2	2	2	2	2	3
CO3	3	2	2	3	3
CO4	2	2	3	2	3

3-High, 2- Medium, 1 – Low

Assessment Table:

Assessment Tool	CO1, CO2, CO3, CO4
	S1, S2, S3
ISE II:(50 Marks)	50
ESE Assessment (50 Marks)	50
Total Marks (100)	100

Dr. S. S. Koranne
Head, Civil Engg.

Dr. Anil Karwankar
Dean , Academics

M.Tech. Geotechnical Engineering Curriculum
With effect from Academic Year 2026–2027
Approved in the 32nd Academic Council Meeting, dated 28th July 2026

CEEEM6101: AI For Earth Observation		
Teaching Scheme	**Evaluation Scheme**	
Theory: 2Hrs/Week	**ISE I**	**10 Marks**
Credits:02	**ISE II**	**10 Marks**
	END SEMESTER EXAMINATION	**30 Marks**
	Total	**50 Marks**

Course Description:

This course introduces the fundamentals of Artificial Intelligence (AI) for Earth Observation (EO) using multispectral, hyperspectral, and Synthetic Aperture Radar (SAR) data. It covers AI and deep learning techniques for image classification, semantic segmentation, target detection, and change detection. The course also introduces advanced AI models, including Vision Transformers, GANs, SAM, and CLIP, with applications in agriculture, urban planning, forestry, disaster management, and environmental monitoring.

Course Outcomes:

After completion of this course students will be able to;

	Course Outcomes
CO1	Understand Earth Observation data, sensors, and AI fundamentals.
CO2	Apply AI and deep learning techniques for Earth Observation tasks.
CO3	Analyze SAR and hyperspectral imagery using AI methods.

Detailed Syllabus:

Unit -1	Fundamentals of Earth Observation Overview of Earth Observation (EO) data and sensors, Multispectral imagery: characteristics and challenges, Hyperspectral imagery: characteristics and challenges, Synthetic Aperture Radar (SAR): principles and challenges, Core EO tasks: classification, semantic segmentation, target detection, and change detection, Traditional approaches for semantic segmentation, target detection, and change detection, Multi-sensor and multi-resolution challenges, Motivation for Artificial Intelligence in Earth Observation, Learning paradigms: Supervised, Unsupervised, and Self-supervised learning.
Unit -2	Deep Learning for Earth Observation Semantic segmentation using deep learning, U-Net and other semantic segmentation architectures, Generative Adversarial Networks (GAN) and CycleGAN, SAR image processing: despeckling, classification, semantic segmentation, domain adaptation, and PolSAR analysis, Hyperspectral image analysis: classification, dimensionality reduction, spectral unmixing, and image enhancement, Multi-sensor and geographic domain adaptation, Incorporating non-image data in Earth Observation.
Unit -3	Advanced AI Models and Applications AI-based change detection: supervised, unsupervised, Early Fusion, and Siamese networks, Vision Transformers for classification and semantic segmentation, Diffusion models for Earth Observation, Vision foundation models: Segment Anything Model (SAM), CLIP, and Earth Observation-specific foundation models, SAM for segmentation, target detection, and change detection, Text-guided change detection and CLIP applications in Earth Observation, Applications of AI in Earth Observation: urban monitoring, forestry, glacier monitoring, agriculture, and land forecasting.

Dr. S. S. Koranne
Head, Civil Engg.

Dr. Anil Karwankar
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M.Tech. Geotechnical Engineering Curriculum
With effect from Academic Year 2026–2027
Approved in the 32nd Academic Council Meeting, dated 28th July 2026

NPTEL LINK:
https://onlinecourses.nptel.ac.in/e-learning/preview/noc26_cs98

Text & References:

1. Saha, S., Deep Learning for Multi-sensor Earth Observation, Elsevier, 2025.
2. Del Rosso, M. P., Sebastianelli, A., and Ullo, S. L., Artificial Intelligence Applied to Satellite-Based Remote Sensing Data for Earth Observation, Institution of Engineering and Technology (IET), 2021.
3. Goodfellow, I., Bengio, Y., and Courville, A., Deep Learning, MIT Press, 2016.
4. Richards, J. A., Remote Sensing Digital Image Analysis: An Introduction, 6th Edition, Springer, 2022.
5. Lillesand, T. M., Kiefer, R. W., and Chipman, J. W., Remote Sensing and Image Interpretation, 8th Edition, Wiley, 2015.
6. Jensen, J. R., Introductory Digital Image Processing: A Remote Sensing Perspective, 4th Edition, Pearson, 2015.
7. Schowengerdt, R. A., Remote Sensing: Models and Methods for Image Processing, 3rd Edition, Academic Press, 2007.
8. Zhu, X. X., Tuia, D., Mou, L., Xia, G. S., Zhang, L., Xu, F., and Fraundorfer, F., "Deep Learning in Remote Sensing: A Comprehensive Review and List of Resources," IEEE Geoscience and Remote Sensing Magazine, Vol. 5, No. 4, pp. 8–36, 2017.
9. Camps-Valls, G., Tuia, D., Bruzzone, L., and Benediktsson, J. A., Advances in Machine Learning for Remote Sensing and Geosciences, Wiley, 2024.
10. Zhu, X. X., Tao, C., Mou, L., et al., Deep Learning for Earth Observation: Theory and Practice, Springer, 2024.

Mapping of Course Outcome with Program Outcomes

Course outcome	PO1	PO2	PO3	PSO1	PSO2
CO1	3	2	-	1	1
CO2	2	3	2	1	-
CO3	2	2	2	1	1

3-High, 2- Medium, 1 – Low

Assessment:

ISE I: Based on unit I and unit II

ISE II : Teacher's Assessment: Teachers Assessment of 10 marks is based on one of the / or combination of few of following

1. Assignments
2. Power point presentation
3. Question & answer, interaction
4. Technical quiz
5. Attendance in the class

Assessment Pattern:

Assessment Pattern Level No.	Knowledge Level	ISEI	ISEII	ISEIII	End Semester Examination
K1	Remember	05	05	-	
K2	Understand	05	05	-	10
K3	Apply	-	-	-	10
K4	Analyze	-	-	-	10
K5	Evaluate	-	-	-	
Total Marks 50		10	10	-	30

Assessment table:

Assessment Tool	K1, K2, K3	K1, K2, K3	K1, K2, K3, K4
	CO1	CO2	CO3
ISEI(10 Marks)	5	5	10
ISEII (10 Marks)	5	5	10
ESE Assessment (30Marks)			10
Total Marks 50	10	10	30

CEIKS6101: Ancient Water Management Practices		
Teaching Scheme	**Evaluation Scheme**	
Theory: 2Hrs/Week	**ISE I**	**10 Marks**
Credits:02	**ISE II**	**10 Marks**
	END SEMESTER EXAMINATION	**30 Marks**
	Total	**50 Marks**

Course Description

This course will explore various dimensions of knowledge on water resources - local, indigenous, traditional, and scientific and its criticality as a resource for development. The course explores how strategies have been evolved by mankind to create knowledge systems and societies for sustainable development of water resources. Particular emphasis of this course is on traditional knowledge for water management.

Course Outcomes: **By the end of the course, students will able to;**

Course Outcomes	
CO1	explain the dimensions of knowledge, the science–management divide, and the role of integrating traditional and contemporary knowledge for sustainable and adaptive water management.
CO2	describe the evolution of traditional water management systems in ancient civilizations and evaluate traditional water harvesting, conservation, and management practices in different ecological regions of India.
CO3	analyze traditional water conservation and management practices of Maharashtra, evaluate their institutional and socio-economic significance, and explore their application for sustainable water resources management using modern technologies.

Detailed Syllabus:

Unit 1	**Introduction to Knowledge and Water Management:** Knowledge for development; traditional, social and technical knowledge; understanding of knowledge (static, processual and historical); significance of traditional knowledge in water management. Knowledge gap: science–management divide, local and scientific knowledge, need for integration and adaptive management. Knowledge management, knowledge networks, conflict resolution and Hydraulic Societies.
Unit 2	**Traditional Knowledge and Water Management Systems:** Human–water relationship, ancient civilizations (Harappan, Vedic, Mauryan and others), hydrological knowledge in ancient India, rainfall measurement and data storage, hydraulic interlinkages, and the decline of the Harappan civilization. Traditional water management systems across different ecological zones, socio-economic and political aspects, and traditional water harvesting and conservation technologies including Talabs, Baolis, Kunds, Taankas, Kuhls, Zings, Bamboo Drip Irrigation, Jackwells, Ramtek water harvesting structures, wastewater management, and evolution of institutions.
Unit 3	**Traditional Water Conservation Practices in Maharashtra:** Contributions of Rashtrakuts, Satwahans, Yadavas, Chhatrapati Shivaji Maharaj, Rani Ahilyadevi Holkar and Chhatrapati Shahu Maharaj to water resources development. Traditional rainwater harvesting and storage structures including Kunds, Tanks, Open Wells, Baravs, Khajana Wells, Jal Mahals, Earthen Dams and Kolhapur Type Bandharas. Community-based water distribution systems such as Phad Irrigation, Warabandi and Malgujari Talav System, contemporary water use pract[illegible] management.

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M.Tech. Geotechnical Engineering Curriculum
With effect from Academic Year 2026–2027
Approved in the 32nd Academic Council Meeting, dated 28th July 2026

Text Books & References:

1. Hydrology and water resources management in ancient India by Pushpendra Kumar Singh, Pankaj Dey, Sharad Kumar Jain, and Pradeep P. Mujumdar, EGU publication Hydrology and Earth System Sciences Vol 24, Issue 10 year 2020 https://doi.org/10.5194/hess-24-4691-2020
2. Agarwal, A., & Narain, S. (1997). Dying Wisdom: Rise, fall and potential of India's traditional water harvesting systems (Vol. 4): Centre for Science and Environment New Delhi. Chapter 2. Pp 25-268.
3. Koul, D. N., Singh, S., Neelam, G., & Shukla, G. (2012). Traditional water management systems-An overview of Ahar-pyne system in South Bihar plains of India and need for its revival. Indian Journal of Traditional Knowledge, 11(2), 266-272.
4. Mosse, D. (1999). Colonial and Contemporary Ideologies of 'Community Management': The Case of Tank Irrigation Development in South India. Modern Asian Studies, 33(02), 303-338
5. Traditional water management practices of Maharashtra by Dr. D.M. More
6. Evers, H. D. (2008). Knowledge Hubs and Knowledge Clusters: Designing a Knowledge Architecture for Development, ZEF Working Paper Series 27. Bonn: Centre for Development Research.
7. Agarwal, A., & Narain, S. (1997). Dying Wisdom: Rise, fall and potential of India's traditional water harvesting systems (Vol. 4): Centre for Science and Environment New Delhi. Chapter 2. Pp 25-268.
8. Pahl-Wostl, C. (2007). Transitions towards adaptive management of water facing climate and global change. Water Resources Management, 21(1), 49-62.

Websites:

1. Development Gateway http://knowledge.developmentgateway.org
2. United Nations University Traditional Knowledge Initiative http://www.unutki.org
3. World intellectual property organization http://www.wipo.int/tk/en/indigenous/customary_law

Journals

1. Journal of environmental management
2. Ecology and society
3. Water resource management

Mapping of Course Outcome with Program Outcomes

Course Outcome	PO1	PO2	PO3	PSO1	PSO2
CO1	3	2	-	1	-
CO2	3	3	2	2	-
CO3	3	3	3	2	-

Dr. S. S. Koranne
Head, Civil Engg.

Dr. Anil Karwankar
Dean , Academics

M.Tech. Geotechnical Engineering Curriculum
With effect from Academic Year 2026–2027
Approved in the 32nd Academic Council Meeting, dated 28th July 2026

3-High, 2- Medium, 1 – Low

Assessment:

ISE I: Based on unit I and unit II

ISE II : Teacher's Assessment: Teachers Assessment of 10 marks is based on one of the / or combination of few of following

1. Assignments
2. Power point presentation
3. Question & answer, interaction
4. Technical quiz
5. Attendance in the class

Assessment Pattern:

Assessment Pattern Level No.	Knowledge Level	ISEI	ISEII	ISEIII	End Semester Examination
K1	Remember	-	-	-	10
K2	Understand	05	05	-	10
K3	Apply	05	05	-	10
K4	Analyze	-	-	-	-
K5	Evaluate	-	-	-	-
Total Marks 50		10	10	-	30

Assessment table:

Assessment Tool	K1, K2, K3	K1, K2, K3	K1, K2, K3
	CO1	CO2	CO3
ISEI(10 Marks)	5	5	
ISEII (10 Marks)	5	5	
ESE Assessment (30Marks)	10	10	10
Total Marks 50	20	20	10

Dr. S. S. Koranne
Head, Civil Engg.

Dr. Anil Karwankar
Dean , Academics

M.Tech. Geotechnical Engineering Curriculum
With effect from Academic Year 2026–2027
Approved in the 32nd Academic Council Meeting, dated 28th July 2026

CEDIS6104: Dissertation-II		
Teaching Scheme	**Evaluation Scheme**	
Practical: 16 Hrs/Week	**ISE II**	**100 Marks**
Credits:08	**ESE**	**150 Marks**
	Total	**250 Marks**

Prerequisite: **Not applicable**

Course Description:

The dissertation-II is a continuation of Dissertation-I and mainly focuses on solution of the defined problem through experimental/analytical/comparative study as planned.

Course Outcomes: After successful completion of the course, students will be able:

Course Outcomes	
CO1	to appraise the additional literature in the chosen field of water resources engineering.
CO2	to refine the formulated problem in the chosen field of water resources engineering.
CO3	to find solution to the identified problem using appropriate methodology.
CO4	to interpret, discuss, debate the solution and draw conclusions.
CO5	to write the dissertation report and present before panel of examiner and peers.

Term Work:

The Dissertation-II shall consist of a complete analytical and/or experimental work in water resources engineering containing literature survey, problem formulation, solution, results, interpretations, discussions and conclusions certified by guide and an internal evaluation committee. The candidate shall prepare a technical report in a prescribed format and submit soft bound 3-hard copies signed by the guide and submit it to the CoE for viva-voce examination. After the viva-voce examination, student shall submit 3-hard bound copies after the corrections, if any, suggested by the panel of examiners along with program exit survey in prescribed format. The evaluation of the term work shall be based on continuous assessment of the student and final submission.

Paper Publications:

A proof of publication or uploading paper to SCI, Web of Science, Scopus, Indian Citation Index journal or filling patent is mandatory requirement for submission of dissertation. However, if the dissertation work is in collaboration with industry/organization/research agency, the uploading of paper/filling a patent shall not be mandatory but desirable.

Pre submission presentation:

There shall be a pre submission presentation before a panel of experts/faculty consisting of guide and faculty/experts and PG students of the concerned class.

Dr. S. S. Koranne
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Dr. Anil Karwankar
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M.Tech. Geotechnical Engineering Curriculum
With effect from Academic Year 2026–2027
Approved in the 32nd Academic Council Meeting, dated 28th July 2026

Viva Voce Examination:

Students should prepare a power point presentation and present it before the panel of examiners consisting of guide and the external examiner appointed by the Controller of Examination. The candidate should be able to defend his work in front of the panel of examiners and peers. The panel of examiners will assess the dissertation contents and presentation and assigns the marks out of 150.

Mapping of Course Outcome with Program Outcomes

Course Outcome	PO1	PO2	PO3	PSO1	PSO2
CO1	3	1	3	2	2
CO2	3	1	2	1	3
CO3	3	2	2	1	3
CO4	1	–	3	1	3
CO5	1	2	1	2	2

Dr. S. S. Koranne
Head, Civil Engg.

Dr. Anil Karwankar
Dean , Academics

M.Tech. Geotechnical Engineering Curriculum
With effect from Academic Year 2026–2027
Approved in the 32nd Academic Council Meeting, dated 28th July 2026

CEPCC6117: Lab-Geotechnical Explorations & Advanced Soil Testing		
Teaching Scheme	**Evaluation Scheme**	
Practical: 02 Hrs/Week	**ISE II**	**25 Marks**
Credits: 01	**ESE**	**25 Marks**
	Total	**50 Marks**

Prerequisite: Not applicable

Course Description:

This laboratory course provides students with practical exposure to geotechnical site investigations and advanced laboratory testing of soils. The course focuses on the determination of engineering properties of soils through standardized laboratory and field testing procedures used in geotechnical engineering practice. Students gain hands-on experience in soil sampling, subsurface exploration, index and engineering property evaluation, and interpretation of test results for foundation design and construction projects.

Course Outcomes:

After completion of this course students will be able to;

	Course Outcomes
CO1	perform geotechnical site exploration, soil sampling, and sample preservation using standard field procedures and relevant IS codes.
CO2	conduct advanced laboratory tests to determine the index, compaction, permeability, consolidation, and shear strength characteristics of soils.
CO3	analyze and interpret laboratory and field test results to evaluate the engineering properties and behavior of soils for geotechnical applications.

List of the Experiments

I. A report of the experimental work or demonstration of the following (any five):

Sr. No.	**Title of the Experiments**
1	To carry out geotechnical site exploration, prepare a borehole log, and collect disturbed and undisturbed soil samples for laboratory testing in accordance with relevant IS codes.
2	To determine the index properties of soil, including natural moisture content, specific gravity, particle size distribution, and Atterberg limits, for soil classification.
3	To determine the Optimum Moisture Content (OMC) and Maximum Dry Density (MDD) of soil using Standard and Modified Proctor compaction tests.
4	To determine the coefficient of permeability of soil using constant head and falling head permeability tests.
5	To determine the consolidation characteristics of soil, including the coefficient of consolidation, compression index, and settlement parameters.
6	To determine the shear strength parameters of soil, namely cohesion (c) and angle of internal friction (φ), using Direct Shear and Triaxial Compression tests.
7	To determine the California Bearing Ratio (CBR) of soil for evaluating its strength and suitability as a subgrade material in pavement design.

Assessment: Based on the practical performance, interaction of s

Dr. S. S. Koranne
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Dr. Anil Karwankar
Dean , Academics

M.Tech. Geotechnical Engineering Curriculum
With effect from Academic Year 2026-2027
Approved in the 32nd Academic Council Meeting, dated 28th July 2026

Mapping of Course Outcome with Program Outcomes

Course Outcome	PO1	PO2	PO3	PSO1	PSO2
CO1	1	3	3	3	-
CO2	1	1	3	-	-
CO3	3	3	3	3	-

3-High, 2- Medium, 1 – Low

Assessment pattern:

Assessment Pattern Level No.	Knowledge Level	ISE II	End Semester Examination
S1	Imitation	10	10
S2	Manipulation	10	10
S3	Precision	5	5
S4	Articulation	-	-
S5	Naturalization	-	-
Total Marks		25	25

Assessment Table:

Assessment Tool	CO1, CO2, CO3
	S1, S2, S3
ISE II:(25 Marks)	25
ESE Assessment (25 Marks)	25
Total Marks (50)	50

Dr. S. S. Koranne
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Dr. Anil Karwankar
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M.Tech. Geotechnical Engineering Curriculum
With effect from Academic Year 2026–2027
Approved in the 32nd Academic Council Meeting, dated 28th July 2026

CEOJT6202: Industrial Training		
Teaching Scheme	**Evaluation Scheme**	
Practical -------Hrs/Week	**ISE II**	**100 Marks**
Credits: 10	**ESE**	
	Total	**100 Marks**

Course Outcomes:

After completion of this course students will be able to:

CO1	evaluate complex civil engineering challenges encountered during internship projects and develop sustainable, economical, safe, and code-compliant technical or managerial solutions using advanced engineering principles.
CO2	apply and integrate advanced civil engineering knowledge, research methods, modern analytical tools, and professional standards to investigate, design, execute, monitor, or optimize real-world engineering activities.
CO3	prepare and present a comprehensive technical internship report documenting the work performed, methodology, project analysis, results, challenges, solutions, professional practices, and advanced learning outcomes in a structured and evidence-based manner.

Scope:

Students are expected to undergo Internship for IV Semester at factory / construction site / design offices or in combination of these. Internship session shall be guided and certified by qualified engineer / architect / contractor in civil engineering.

Term work: At the conclusion of the Internship period, students will be required to submit a comprehensive final report detailing their experiences, accomplishments, and reflections during the Industrial Training. The final report should include a thorough analysis of the projects undertaken, the challenges encountered, and the lessons learned.

Practical/Viva Voce Examination: The students shall prepare presentation/ report based on their Internship and deliver it before the panel of examiners which shall consist of a supervisor and external examiner appointed by COE. The panel will examine the Report contents and presentation and award marks out of 100.

Assessment:

ISE II (100 Marks) is based on the **Internship Report** the internal assessment should focus on the quality of the report, technical learning, analysis, and documentation of the Industry Training.

Mapping of Course outcome with Program Outcomes and Program Specific Outcomes

Course outcome	PO1	PO2	PO3	PO4	PO5
CO1	3	1	3	-	1
CO2	2	3	2	3	2
CO3	2	2	3	2	2

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3-High, 2- Medium, 1 – Low

Assessment pattern:

Assessment Pattern Level No.	Knowledge Level	ISE II
S1	Imitation	40
S2	Manipulation	40
S3	Precision	20
S4	Articulation	-
S5	Naturalization	-
Total Marks		100

Assessment Table:

Assessment Tool	CO1	CO2	CO3
	S1, S2, S3	S1, S2, S3	S1, S2, S3
ISE II: (100 Marks)	20	20	60
Total Marks (100)	20	20	60

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