Curriculum Structure for M. Tech. Programmes

(In light of NEP 2020)

NCrF Level 7

For students admitted in 2023-24 onwards

Govt. College of Engineering, Amravati

(*An Autonomous Institute of Govt. of Maharashtra*)

Near Kathora Naka, Amravati, Maharashtra

PIN 444 604

www.gcoea.ac.in

Member Secretary | BoS Chairperson | Dean (Academics) | Principal

Govt. College of Engineering, Amravati

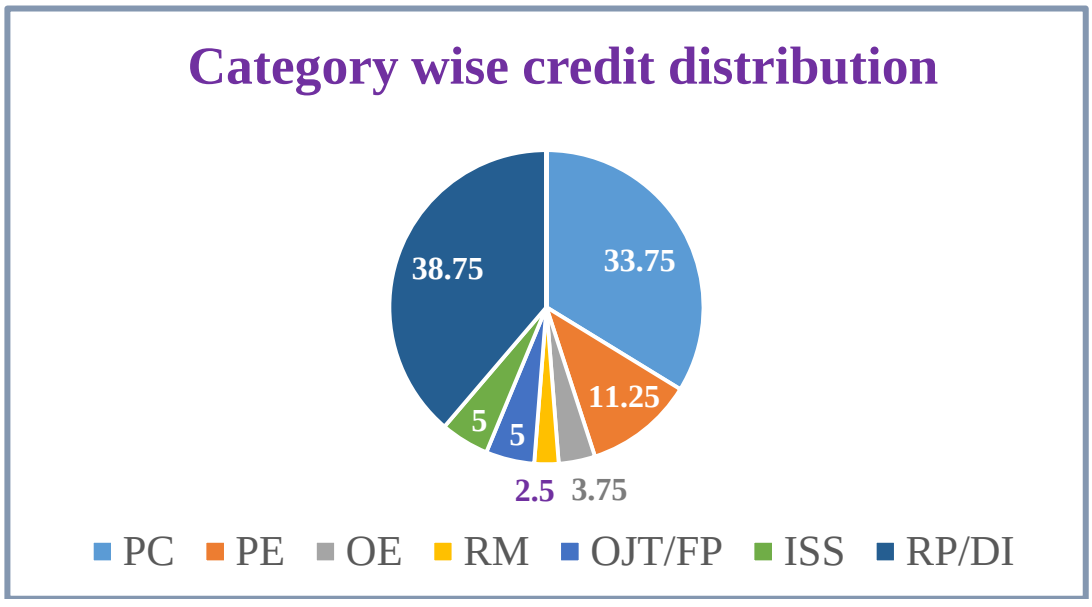
(An Autonomous Institute of Govt. of Maharashtra)

Curriculum Structure for M. Tech. Geotechnical Engineering (In light of NEP 2020)

Category wise credit distribution:

Semester	PC	PE	OE	RM	OJT / FP	ISS	RP / DI	Total
I	15	03	---	---	---	02	---	20
II	12	03	---	02	04	02	---	23
III	---	03	03	---	---	---	13	19
IV	---	---	---	---	---	---	18	18
Total	**27**	**09**	**03**	**02**	**04**	**04**	**31**	**80**

SN	Abbreviation	Meaning	Credits	Percentage
01	PC	Programme Core	27	33.75
02	PE	Programme Elective	09	11.25
03	OE	Open Elective	03	03.75
04	RM	Research Methodology	02	02.50
05	OJT	On-Job Training/ Internship	04	05.00
06	FP	Field Projects		
07	ISS	Independent Study & Seminar	04	05.00
08	RP	Research Project	31	38.75
09	DI	Dissertation		
		Total	80	100.00



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General Instructions:

1) 10% content of syllabus of each theory course of first, second and third semesters shall be completed by the students with self-study. The 10% portion of each course (for self-study) shall be declared by the concerned course-coordinator at the beginning of teaching of the course.

2) Student can complete any two theory courses of second semester, if desired, in "online" mode, offered through SWAYAM/ NPTEL. In this case –

i) Students can register and completethese online courses any time after beginning of first semester, however, the student must successfully complete and pass the course, and submit the score card/ certificate before declaration of result of second semester.

ii) In case if a student registers for a course in online mode but fails in the course the student will have to register for the course in the institute whenever it is offered. In this case, the student will have to attend the classes of the course (in order to satisfy the minimum attendance criteria), appear for all the examinations (MSE, TA, ICA, ESE etc) of the course, and successfully complete the course with at least D grade.

3) Student can complete the two theory courses of third semester, if desired, in "online" mode, offered through SWAYAM/ NPTEL. In this case –

i) Students can register and complete these online courses any time after beginning of first semester, however, the student must successfully complete and pass the course, and submit the score card/ certificate before declaration of result of third semester.

ii) In case if a student registers for a course in online mode but fails in the course the student will have to register for the course in the institute whenever it is offered. In this case, the student will have to attend the classes of the course (in order to satisfy the minimum attendance criteria), appear for all the examinations (MSE, TA, ICA, ESE etc) of the course, and successfully complete the course with at least D grade.

4) Students must complete On-the-job training/ Internship/ Field work for a duration of minimum four weeks during summer break, after completion of second semester of first year in the respective major subject. The company/ organization for On-job training/ Internship/ Field work must be approved by the DFB

5) Students going for industrial project or going for dissertation at some other institute (approved by DFB), during third and fourth semester, shall complete the courses Programme Elective – III and Open Elective in any one of the two modes –

i) Online courses offered through SWAYAM/ NPTEL: In this case the student must complete the course and submit the score card/ certificate before commencement of fourth semester. Students can register and complete these courses any time after beginning of first semester

In case if a student registers for a course in online mode but fails in the course the student will have to register for the course in the institute whenever it is offered. In this case, the student will have to attend the classes of the course (in order to satisfy the minimum attendance criteria), appear for all the examinations (MSE, TA, ICA, ESE etc) of the course, and successfully complete the course with at least D grade.

ii) Self-study mode: In this case the student will have to study the course of his/her own. The student shall appear for all the college assessments/ examinations (MSE, TA and ESE) personally as per the schedule declared by the institute.

6) Maximum period for completion of M. Tech. programme:

The maximum duration for completion of the PG full time programme is eight semesters from the date of initial registration. The maximum duration of the programme includes the period of withdrawal, absence and different kinds of leaves permissible to a student but it shall exclude the period of rustication of the student from the institute and it shall also exclude the period lapsed between exit after first year (second semester) and re-entry at second year (third semester). However, genuine cases on confirmation of valid reasons may be referred to Academic Council for extending this limit by additional one year.

M. Tech. Geotechnical Engineering Semester I

Category	Course Code	Name of the course	Teaching Scheme				Examination Scheme						Credits
							Theory			Practical		Total	
			Theory	Tut	Pract	Total	MSE	TA	ESE	ICA	ESE		
PC	CE2131	Analysis of Slopes	04	--	--	04	30	10	60	---	---	100	04
PC	CE2132	Ground Improvement Technology	04	--	--	04	30	10	60	---	---	100	04
PC	CE2133	Geotechnical Investigations & Construction practices	04	--	--	04	30	10	60	---	---	100	04
PE	CE2134	Program Elective – I	03	--	--	03	30	10	60	---	---	100	03
PC	CE2135	Geotechnical Engineering Lab I	--	--	06	06	--	--	--	50	50	100	03
ISS	CE2136	Seminar I	--	--	01	01	--	--	--	50	---	50	02
		Total	15	--	07	22	120	40	240	100	50	550	20

List of Programme Electives	
CE2134: Programme Elective – I	
A	Earth dam analysis & Design
B	Computational Geomechanics
C	Design of Underground structures

Note:

i) The contact hours for the students (with concerned supervisor) for Seminar – I shall be one hour per week per student, subject to maximum of four hours per week.

ii) The hours shown in the teaching scheme for Seminar I are the contact hours for the students with concerned supervisor. Each student is expected to devote at least four hours per week for Seminar I.

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M. Tech. Geotechnical Engineering Semester II

Category	Course Code	Name of the course	Teaching Scheme				Examination Scheme						Credits
							Theory			Practical		Tot al	
			Theory	Tut	Pract	Total	MSE	TA	ESE	ICA	ESE		
PC	CE2231	Advanced Foundation Engineering	03	--	--	03	30	10	60	--	--	100	03
PC	CE2232	Earth Retaining Structures	03	--	--	03	30	10	60	--	--	100	03
PC	CE2233	Highway Soil Mechanics	03	--	--	03	30	10	60	--	--	100	03
PE	CE2234	Program elective II	03	--	--	03	30	10	60	--	--	100	03
RM	SH2201	Research Methodology	02	--	--	02	30	20	--	--	--	50	02
PC	CE2235	Geotechnical Engineering Lab II	--	--	06	06	--	--	--	50	50	100	03
ISS	CE2236	Seminar II	--	--	01	01	--	--	--	50	--	50	02
OJT/FP		OJT/FP	--	--	--	--	--	--	--	50	--	50	04
		Total	14	--	07	21	150	60	240	150	50	650	23

List of Programme Electives	
CE2234: Programme Elective – II	
A	Environmental Geo-technology
B	Dynamics of Soil and Foundations
C	Foundation on weak soil

Note:

i) The contact hours for the students (with concerned supervisor) for Seminar – II, shall be one hour per week per student,subject to maximum of four hours per week.

ii) The hours shown in the teaching scheme for Seminar II are the contact hours for the students with concerned supervisor. Each student is expected to devote at least four hours per week for Seminar II.

iii) Individual students are required to choose a topic of their interest for Seminar II. They shall acquire state-of-the art knowledge in that area and shall define the grey area related to topic (gap analysis) so as to carry dissertation in that area.The students are required to reviewliterature on the topic and deliver seminar.

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Exit option:

- The exit option at the end of one year of the Master's degree program willcommence from AY 2024-25.
- Students who have joined a two-year Master's degree program may opt for exit at the end of the first year and he/ she shall be eligible for M. Voc. Degree (Level 6.5)
- The M. Voc. Degree may be awarded to a student provided they have earned all 43 credits of first year (first and second semester) including 04 credits of On-job training / Internship/ Field work. The On-job training / Internship/ Field work shall be completed during summer break, after completion of the second semester of the first year in the respective Major Subject.
- Even if, a student exits after third semester, the M. Voc. Degree may be awarded to him/ her provided he/ she have earned all 43 credits of first year (first and second semester) including 04 credits of On-job training / Internship/ Field work. The On-job training / Internship/ Field work shall be completed during summer break, after completion of the second semester of the first year in the respective Major Subject.
- The student must submit the report of On-job training / Internship/ Field work, in the format prescribed by the institute, as partial fulfilment of award of M. Voc. degree.
- Re-entry to complete the PG degree, after taking the exit option, will be permissible up to 05 years from the date of admission to the PG programme. Such students, shall have to surrender the M. Voc. Degree, at the time of re-entry. There shall be a gap of at least six months between exit after first year and re-entry to PG degree at third semester

M. Tech. Geotechnical Engineering) Semester III

Category	Course Code	Name of the course	Teaching Scheme				Examination Scheme						Credits
							Theory			Practical		Total	
			Theory	Tut	Pract	Total	MSE	TA	ESE	ICA	ESE		
PE	CE2331	Program Elective III	03	--	--	03	30	10	60	--	--	100	03
OE	SH2301	Open Elective	03	--	--	03	30	10	60	--	--	100	03
RP/DI	CE2332	Dissertation Stage – I	--	--	04	04	--	--	--	150	--	150	13
	CE2332	Total	06	--	04	10	60	20	120	150	--	350	19

Note: The hours shown in the teaching scheme for Dissertation Stage I are the contact hours for the students with concerned supervisor. The student is expected to devote at least twenty-six hours per week for Dissertation Stage I.

List of Programme Electives			List of Open Electives	
CE2331: Programme Elective – III			**SH2301: Open Elective**	
A	Artificial Intelligence and Machine Learning		A	Industrial Safety
B	Advanced Soil Mechanics		B	Operations Research
C	Engineering Rock Mechanics		C	Project Management
D	Finite Element Method in Geomechanics		D	Data Structures and Algorithms
-	-		E	Nano Technology

M. Tech. Geotechnical Engineering Semester IV

Category	Course Code	Name of the course	Teaching Scheme				Examination Scheme						Credits
							Theory			Practical		Total	
			Theory	Tut	Pract	Total	MSE	TA	ESE	ICA	ESE		
RP/DI	CE2401	Dissertation Stage – II	--	--	04	04	--	--	--	100	200	300	18
		Total	--	--	04	04	--	--	--	100	200	300	18

Note:

i) Dissertation Stage – I is pre-requisite for Dissertation Stage – II

ii) The hours shown in the teaching scheme for Dissertation Stage II are the contact hours for the students with concerned supervisor. The student is expected to devote at least thirty-six hours per week for Dissertation Stage II.

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Comparison of existing and new programme structure:

i) On the basis of Marks and Credit:

Semester	Marks		Credits	
	Existing	**New**	**Existing**	**New**
I	610	550	17	20
II	600	650	19	23
III	300	350	16	19
IV	400	300	16	18
Total	**1910**	**1850**	**68**	**80**

ii) On the basis of semester wise number of courses:

	Number of courses									
	Semester I		Semester II		Semester III		Semester IV		Total	
	Existing	New	Existing	New	Existing	New	Existing	New	Existing	New
Theory	05	04	05	05	02	02	---	---	12	11
Practical	01	01	01	01	---	---	---	---	02	02
Seminar	01	01	01	01	---	---	---	---	02	02
Internship	---	---	---	01	---	---	---	---	---	01
Dissertation	---	---	---	---	01	01	01	01	02	02

iii) On the basis of course category:

Course category	Number of courses		Credits	
	Existing	**New**	**Existing**	**New**
PC	08	08	24	27
PE	03	03	09	09
OE	02	01	03	03
RM	01	01	02	02
OJT / FP	---	01	---	04
ISS	02	02	04	04
RP / DI	02	02	26	31
Total	**18**	**18**	**68**	**80**

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PROGRAM EDUCATIONAL OBJECTIVES (PEOs)

1. To make students learn the principles of soil and rock mechanics. Understand different problems associated with geotechnical engineering. Explain how to select design soil/rock parameters for design purpose based on the subsurface exploration. Develop Analysis and Design procedure for various geotechnical structures.
2. Students should gain competency in the design of shallow/deep foundations, earth retaining structures, embankment and earthen dams, underground structures. Can assess stability of slopes and apply preventive measures for stability.

Program Outcomes:

PO1: Students will be able to perform geotechnical investigations by conducting various laboratory and in-situ tests on soil to find out design parameters and predict soil behaviour and prepare reports.

PO2: Students will be able to suggest suitable Ground Improvement Technics to suit different site conditions

PO3: Students will be able to carry out analysis and design of shallow foundations, deep foundations, earth retaining structures, earthen dams, and pavements for given site conditions.

PO4: Student will be able to compute factor of safety to assess stability of slopes and apply preventive measures for stability

PO5: Student will be able to develop numerical models / experimental setup to estimate response of various geotechnical structures under different loadings.

Equivalence Scheme

Programme Name:-M. Tech. Geotechnical Engineering

Sr.	Course code with Name of course(old)		Credit	Course code with Name of course (new)		Credit
1	CEP151	Advanced Soil Mechanics	03	CE2331	Programm Elective III (A) Advanced Soil Mechanics	03
2	CEP152	Advanced Foundation Engineering	03	CE2232	Advanced Foundation Engineering	03
3	CEP153	Ground Improvement Technology	03	CE2132	Ground Improvement Technology	03
4	CEP154 (A)	Earth dam analysis & Design	03	CE2134	Program Elective – I (A) Earth dam analysis & Design	
5	CEP154 (B)	Computational Geomechanics	03	CE2134 (B)	Computational Geomechanics	03
6	CEP154 (C)	Design of Underground structures	03	CE2134 (C)	Design of Underground structures	03
7	CEP155	Geotechnical Engineering Laboratory-I	03	CE2135	Geotechnical Engineering Laboratory-I	03
8	CEP156	Seminar I	02	CE2136	Seminar I	02
9	CEP251	Dynamics of Soil and Foundations	03	CE2234 (B)	Program Elective – II (B) Dynamics of Soil and Foundations	03
10	CEP252	Geotechnical Investigations and Construction Practices	03	CE2133	Geotechnical Investigations & Construction practices	03
11	CEP253	Pavement Analysis and Design	03	CE2233	Highway Soil Mechanics	03

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12	CEP254(A)	Program Elective II (A) Geotechnical Earthquake Engineering	03	-	-	-
13	CEP254 (B)	Program Elective II (B) Environmental Geotechnology	03	CE2234	Program Elective II (A) Environmental Geo-technology	03
14	CEP254 (C)	Program Elective II (C) Foundation on weak soil	03		Program Elective II (C) Foundation on weak soil	
15	CEP255	Geotechnical Engineering Laboratory-II	03	CE2235	Geotechnical Engineering Laboratory-II	03
16	CEP256	Seminar - II	02	CE2236	Seminar - II	02
17	CEP351 (A)	Program Elective III (A) Finite Element Methods in Geomecanics	03	CE2331 (C)	Program Elective III (A) Finite Element Methods in Geomecanics	03
18	CEP352 (B)	Program Elective III (B) Engineering Rock Mechanics	03	CE2332 (B)	Program Elective III (B) Engineering Rock Mechanics	03
19	CEP352 (C)	Program Elective III (C) Earth Retaining Structures	03	CE2232	Earth Retaining Structures	03
20	CEP352	Dissertation Stage I	10	CE2332	Dissertation Stage I	10
21	CEP451	Dissertation Stage II	16	CE2431	Dissertation Stage II	16
22	-	-	-	CE2131	Analysis of Slopes	3
23	SHP321	**Open Elective** (B). Industrial Safety (C) Operations Research (H) Project Management (I) Data Structure & Algorithms	3	SH2301	**Open Elective** (A) Industrial Safety A) Operation Research B) Project Management C) Data Structure & Algorithms	3
24	SHP321	**Open Elective** (A) Business Analytics (D) Cost Management	3	----	No Equivalence	---

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		of Engineering Projects (E) Composite Materials (F) Waste to Energy (G) Finance Management				
25	----	No Equivalence	---	CE2302	On Job training/Internship/Field Work	
26	SHP121	Audit courses	--	----	No Equivalence	---

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Course Code	CE2131							Course category		PC
Course Name	ANALYSIS OF SLOPES									
Teaching Scheme				Examination Scheme						Credits
Th	Tu	Pr	Total	Theory				Practical		Total	
				MSE	TA	ESE	ESE Duration	ICA	ESE		
04	-	-	04	30	10	60	2 hrs 30 min	-	-	100	04

Course Objectives:

To make the students aware and understand:

1. Flow nets for various hydraulic structures and field situations and determine seepage discharge
2. Stability of sloes for various field situations.
3. Strengthening of slopes by various methods to prevent the instability of slopes, earthen dams and embankments

Course Contents:

Seepage analysis:

Two dimensional flow – Laplace equation and it's solution, graphical method, determination of phreatic line, flow nets in homogeneous and zoned earth dams under steady seepage and draw-down conditions, seepage control in earth dams, Flow net for anisotropic soil media, Construction of flow net for hydraulic structures on non-homogeneous soil, Directional variation of permeability in anisotropic medium, Anisotropy governing differential equations for flow through porous media in Cartesian co-ordinate & polar co-ordinate systems for Laplace Equations, computation of seepage force

Slope Stability analysis:

Types and causes of slope failures, mechanics of slope failure, failure modes Infinite and finite slopes with or without water pressures; concept of factor of safety, pore pressure coefficients, Mass analysis, Wedge methods, friction circle method ; Method of slices, Bishop's method, Janbu's method, Morgenstern and Price, Spencer's method, Stability analysis in the presence of seepage:, Influence of seepage on slope stability, stability analysis of dam body during steady seepage

Slope strengthening measures:

Stabilization of slopes by drainage methods, Surface and subsurface drainage, Use of synthetic filters, retaining walls, stabilization and strengthening of slopes, shotcreting, rock bolting and rock anchoring, maintenance of slopes

Reference Books and Websites:

1. K. R. Arora, Irrigation Engineering, Irrigation Engineering, Standard Publishers Distributers
2. R. K. Sharma and T. K. Sharma, Irrigation Engineering, S. Chnad & co., New Delhi, 2007
3. Bharat Singh and R. S. Varshney, Engineering for Embankment Dams, Oxford &IBH
4. Chowdhary R. and Chowdhary I. , "Geotechnical Slope Analysis", CRC Press
5. Harr M.E., Ground Water and Seepage, McGraw Hill. 1962

Course Outcomes:

On completion of the course, students will be able to:

CE2131.1 Draw flow nets in homogeneous and zoned earth dams under steady seepage and draw-down conditions and determine seepage discharge.
CE2131.2 Construct flow nets for anisotropic soil media, and for hydraulic structures on non-homogeneous soil
CE2131.3 Determine stability of slopes by various methods
CE2131.4 Determine stability of slopes in presence of seepage
CE2131.5 Describe various methods for strengthening of slopes to prevent the instability of slopes, earthen dams and embankments

CO – PO Mapping:

Course Outcomes	Program Outcomes				
	PO1	PO2	PO3	PO4	PO5
CE2131.1	--	-	3	2	-
CE2131.2	--	-	3	2	-
CE2131.3	-	-	3	3	-
CE2131.4	-	-	3	3	-
CE2131.5	-	3	1	1	2

0 - Not correlated 1 - Weakly Correlated 2 - Moderately Correlated 3 - Strongly Correlated

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Course Code	CE2132							Course category			PC
Course Name	GROUND IMPROVEMENT TECHNOLOGY										
Teaching Scheme				Examination Scheme							Credits
Th	Tu	Pr	Total	Theory				Practical		Total	
				MSE	TA	ESE	ESE Duration	ICA	ESE		
04	-	-	04	30	10	60	2 hrs 30 min	-	-	100	04

Course Objectives:

To make the students aware and understand:

1. Different issues related to problematic soils and their associated solutions
2. Various methods of ground improvement, their principles and field applications.
3. Design techniques for ground improvement methods for different projects.

Course Contents:

Introduction: Major soil deposits in India, Necessity of Ground Improvement, Various mechanisms of Ground Improvement, Classification, Applications, Economic consideration, and suitability

Mechanical modification: Dynamic compaction, impact loading, compaction by blasting, vibro-compaction; pre-compression, Hydraulic modification: dewatering systems, preloading and vertical drains, electro-kinetic dewatering

Stone columns: Introduction, layout, function and application, advantages, vibrofloatation and rammed technique of stone column installation, Analysis of stone column treated soft soil, unit cell concept, load transfer mechanism, load carrying capacity and settlement analysis, different methods to improve the effectiveness of stone column, strengthening by micro piles

Chemical modification; Modification by admixtures, Methods of stabilization, mechanical stabilization, stabilization of soil using cement, lime, bitumen, chemical and fly ash stabilization, and stabilisation using industrial wastes,

Grouting – Applications, Types of grouts and their suitability, Desirable characteristics of grouts, Groutability, Grouting methods – Permeation grouting, soil facture grouting, Compaction grouting, Jet grouting, their applications, Grouting Technology- single stage grouting, Descending and Ascending stage grouting, Sleeved Pipe Grouting, Grout plant and equipment, Grouting procedure- Pre-grouting site investigation, Grout hole pattern, Grouting arrangement, Grout injection measurements and monitoring

Stabilisation/improvement of ground using Geotextiles, Geogrid, Geomembrane, geocells, genets, and soil nails.

Application of soil reinforcement: Shallow foundations on reinforced earth, design of reinforced earth retaining walls, reinforced earth embankments structures, wall with reinforced backfill, analysis and design of shallow foundations on reinforced earth, road designs with Geosynthetics

Reference Books and Websites:

1. S K Gulhati& M Datta, Geotechnical Engineering, Tata McGraw Hill Publishing Company Ltd. 2005
2. P Purushothams Raj, Ground Improvement Techniques, University Science Press, 2011
3. Foundation Engineering Handbook, HSAI – YANG FANG, CHAPMAN & HILL, New York, 1991
4. Hausmann, M.R., Engineering Principles of Ground Modification, McGraw-Hill International Editions, 1990.
5. Koerner, R. M., Designing with Geosynthetics, Prentice Hall Inc. 1998.

Course Outcomes:

On completion of the course, students will be able to:

CE2132.1 Explain the various mechanisms, classification, applications, and design methodology of Ground Improvement techniques

CE2132.2. Explain various methods of ground improvement, their principles, and applications in the field suitable for sandy soils

CE2132.3 Explain various methods of ground improvement, their principles, and applications in the field for clayey soil

CE2132.4 Explain various types of grouts and methods of grouting, their principles and applications.

CE2132.5: Carry out analysis and design reinforced earth retaining walls, and shallow foundations on reinforced earth

CO – PO Mapping:

Course Outcomes	Program Outcomes				
	PO1	PO2	PO3	PO4	PO5
CE2132.1	-	3	-	-	-
CE2132.2	-	3	-	-	-
CE2132.3	-	3	-		-
CE2132.4	-	3	-	-	-
CE2132.5	-	3	3	-	

0 - Not correlated 1 - Weakly Correlated 2 - Moderately Correlated 3 - Strongly Correlated

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Course Code	CE2133							Course category		PC
Course Name	GEOTECHNICAL INVESTIGATIONS & CONSTRUCTION PRACTICES									
Teaching Scheme				Examination Scheme						Credits
Th	Tu	Pr	Total	Theory				Practical		Total	
				MSE	TA	ESE	ESE Duration	ICA	ESE		
04	-	-	04	30	10	60	2 hrs 30 min	-	-	100	04

Course Objectives:

To make the students aware and understand:

1. Various methods of subsurface investigation and their suitability and preparation of reports
2. IS code provisions for subsurface investigations for civil engineering project
3. Construction methods, procedures and practices for stabilised rods, embankments, foundations and underground structures.

Course Contents:

GEOTECHNICAL INVESTIGATIONS

Introduction: Planning of sub-surface programs, Stages in sub-surface exploration, Reconnaissance, Lateral extent and depth of exploration, Methods of exploration – trial pits, open excavation, boring Types of boring and drilling: Auger, wash, rotary, percussion, core etc., Methods for stabilization of borehole, Types of soil samples, Sample disturbance, storage, labelling and transportation of samples, Types of soil samplers: Split spoon sampler, Scraper bucket sampler, Shelby tube and thin wall samplers, piston sampler, Denion sampler, hand carved samples etc. Field Tests: Standard Penetration Test, Cone Penetration Test, Vane Shear Test, Plate Load Test, Pressure Meter Test, Geophysical methods, Seismic methods, Electrical resistivity methods. Determination of ground water table, Soil investigation report: Bore log, soil profile and contents of report, Field records Site investigation in the view of ground improvement

GEOTECHNICAL CONSTRUCTIONS:

Embankment construction: Earth moving equipment, Compaction equipment, types of rollers and their suitability, Methods of quality control, Compaction specifications, Construction of Rock fill dams

Deep Foundation Construction: Piling- Pile driving methods, Pile driving equipment, Construction of Driven Precast concrete piles, Driven cast in situ concrete piles, Bored cast-in- situ concrete piles, under reamed piles, Auger cast-in-situ piles, Micro-piles, Barrettes, Patented methods of pile construction

Caissons & Wells: Construction of open caisson, Pneumatic Caisson, Construction of well foundation- Sinking of Wells, Measures for rectification of tilt and shift

Excavation, and Underground construction: Underground construction Methodology, Vertical & Horizontal Construction, Management of ground water, Excavate-support Sequence, Temporary & permanent Soil Support, Spoil removal, stabilisation of nearby foundations Soil Support Methods, Dewatering Methods

Tunnel: Cut and Cover tunnels, Bored tunnels: Shield Tunnels, Types of Shield tunnel machines, Tunnel lining and supports in Bored Tunneling, Jacked Tunnels: Box Jacking, Micro tunnels, Horizontal Directional Drilling, Tunnel Boring machines (TBM) – Types of TBMs, Components of full face TBM, Choice between Full face and Partial face machines, Mucking

Construction of stabilised Roads- Construction of cement stabilised roads- different methods, Construction of Lime stabilised roads and bituminous stabilised roads, Field control of stabilization

Reference Books and Websites:

1. Geotechnical Engineering: S. K. Gulhati& M. Datta, Tata McGraw-Hill, New Delhi (2005)
2. Soil Mechanics and Foundation Engineering: K.R. Arora, Standard Publisher and Distributor
3. Basic and Applied soil mechanics: Gopal Ranjan & A.S. Rao, New Edge Int. ltd., (2004)
4. Soil Mechanics in Theory and Practice: Alam Singh, Asia Publisher and Distributor, (1975)
5. Advanced Foundation Engineering: Murthy VNS, CBS publishing, (2007).

Course Outcomes:

On completion of the course, students will be able to:

CE2133.1: Explain various methods of subsurface investigation and their suitability.
CE2133.2: Explain various field tests for subsurface investigation, their suitability and prepare soil exploration report.
CE2133.3: Explain construction procedures for embankment, pile foundations, underground constructions and stabilized roads
CE2133.4: Explain construction procedures for caissons and well foundations
CE2133.5: Explain various types of TBMs and methods of tunnelling

CO – PO Mapping:

Course Outcomes	Program Outcomes				
	PO1	PO2	PO3	PO4	PO5
CE2133.1	3	-	-	-	-
CE2133.2	3	-	-	-	-
CE2133.3	-	-	2	-	2
CE2133.4		-	2	-	2
CE2133.5	-	-	2	-	2

0 - Not correlated 1 - Weakly Correlated 2 - Moderately Correlated 3 - Strongly Correlated

Member Secretary BoS Chairperson Dean (Academics) Principal

Course Code	CE2134 (A)							Course category			PE
Course Name	EARTH DAM ANALYSIS & DESIGN										
Teaching Scheme				Examination Scheme							Credits
Th	Tu	Pr	Total	Theory				Practical		Total	
				MSE	TA	ESE	ESE Duration	ICA	ESE		
03	-	-	03	30	10	60	2 hrs 30 min	-	-	100	03

Course Objectives:

To make the students aware and understand:

1. design criteria, typical cross sections of earthen dams, design requirements of various components as per IS Code a to suit different field situations
2. Preliminary design of earthen dams for the given data
3. seepage analysis of earthen dams
4. stability analysis of earthen dams

Course Contents:

Preliminary section:

Requirements of good dam, Types of earthen dams and their suitability, Components of earthen dam and their functions, Causes of failure, Design criteria, Typical cross sections as per and design requirements of various components as per IS Code, General guidelines for embankment section as per IS codes, Typical cross sections of earthen dams to suit different field conditions, suitability of different soils as per IS code

Seepage analysis:

Phreatic line, flow nets in homogeneous and zoned earth dams under steady seepage and draw-down conditions, seepage control in earth dams, determination of pore water pressures, pore water pressure distribution diagram, determination of seepage discharge

Design of filters and upstream impermeable blanket

Design criteria

Stability analysis:

Stability analysis of homogeneous and zoned earth dam during steady seepage, Stability analysis considering earthquake forces, Design considerations for earth dam in Seismic region

Stability of foundation

Reference Books and websites:

1. Bharat Singh and R. S. Varshney, Engineering for Embankment Dams, Oxford &IBH.
2. K. R. Arora, Irrigation Engineering, Standard Publishers Distributers.
3. R. K. Sharma and T. K. Sharma, Irrigation Engineering, S. Chnad & co., New Delhi, 2007
4. Mitchell, J.K and Soga, K., Fundamentals of Soil Behavior, John Wiley and Sons Inc., 2005

Course Outcomes:

On completion of the course, students will be able to:

CE2134(A).1 Explain the design criteria and design requirements of various components of earth dams as per revenant IS codes and draw typical cross sections of earthen dams to suit different field conditions.

CE2134(A).2 Carry out preliminary design of earthen dam for the given data

CE2134(A).3 Design the various components of earthen dam as per IS Codes of practice

CE2134(A).4 carry out seepage analysis for earthen dam.

CE2134(A).5 Check the stability of earthen dams under different conditions.

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CO – PO Mapping:

Course Outcomes	Program Outcomes				
	PO1	PO2	PO3	PO4	PO5
CE2134(A).1	1	-	3	-	1
CE2134(A).2	1	-	3	-	1
CE2134(A).3	1	-	3	-	1
CE2134(A).4	1	-	3	-	1
CE2134(A).5	1	-	3	3	-

0 - Not correlated 1 - Weakly Correlated 2 - Moderately Correlated 3 - Strongly Correlated

Member Secretary BoS Chairperson Dean (Academics) Principal

Course Code	CE2134 (B)	Course category	PE
Course Name	COMPUTATIONAL GEOMECHANICS		

Teaching Scheme				Examination Scheme							Credits
Th	Tu	Pr	Total	Theory				Practical		Total	
				MSE	TA	ESE	ESE Duration	ICA	ESE		
03	-	-	03	30	10	60	2 hrs 30 min	-	-	100	03

Course Objectives:

To make the students aware and understand:

1. Different numerical and statistical tools for analysing various geotechnical engineering problems and their suitability for different field situations
2. Probabilistic approach for selection of design parameters and compute their impact on risk assessment

Course Contents:

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

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

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

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

Correlation and Regression Analysis: Correlation - Scatter diagram, Karl Pearson coefficient of correlation, Limits of correlation coefficient; Regression –Lines of regression, Regression curves, Regression coefficient, Differences between correlation and regression analysis.

One-dimensional Consolidation - Theory of consolidation, Analytical procedures, Finite difference solution procedure for multilayered systems, Finite element formulation.

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

Reference Books and Websites:

1. S. Chandrakant., Desai and John T. Christian, "Numerical Methods in Geotechnical Engineering", Mc. Graw Hill Book Company, 1977.
2. M.K. Jain, S.R.K. Iyengar and R.K. Jain, "Numerical Methods for Scientific and Engineering computations", Third edition, New Age International (P) Ltd. Publishers, New Delhi.
3. D.J. Naylor and G.N. Pande, "Finite Elements in Geotechnical Engineering", Pineridge Press Ltd., UK
4. Sam Helwany, "Applied soil mechanics", John Wiley & sons, Inc

Course Outcomes:

On completion of the course, students will be able to:

CE2134(B).1	Explain various methods for solution of Linear and Non-linear Equations for analysing various geotechnical engineering problems.
CE2134(B).2	Explain finite difference and Finite Element
CE2134(B).3	Describe Correlation and Regression Analysis
CE2134(B).4	Analyse one-dimensional consolidation problem by Finite difference solution and Finite element formulation
CE2134(B).5	Analyse flow through porous media by Numerical methods,

CO – PO Mapping:

Course Outcomes	Program Outcomes				
	PO1	PO2	PO3	PO4	PO5
CE2134(B).1	-	-	3	-	2
CE2134(B).2	-	-	3	--	2
CE2134(B).3	-	-	3	-	2
CE2134(B).4	-	-	3	-	2
CE2134(B).5	-	-	3	-	2

0 - Not correlated 1 - Weakly Correlated 2 - Moderately Correlated 3 - Strongly Correlated

Member Secretary BoS Chairperson Dean (Academics) Principal

Course Code	CE2134 (C)							Course category			PE
Course Name	DESIGN OF UNDERGROUND STRUCTURES										
Teaching Scheme				Examination Scheme							Credits
Th	Tu	Pr	Total	Theory				Practical		Total	
				MSE	TA	ESE	ESE Duration	ICA	ESE		
03	-	-	03	30	10	60	2 hrs 30 min	-	-	100	03

Course Objectives:

To make the students aware and understand:

1. Planning and exploration for various underground construction projects, their principles and its application in underground excavation design
2. Concepts of elastic & plastic analysis, and rock mass classification systems in the design of underground support system
3. Field tests generally conducted during and after construction of under structures

Course Contents:

Introduction, planning and exploration for various underground construction projects, stereographic projection method, principle and its application in underground excavation design.

Elastic stress distribution around tunnels, stress distribution for different shapes and under different in-situ stress conditions, Greenspan method, design principles, multiple openings, openings in laminated rocks, elasto-plastic analysis of tunnels, Daemen's theory.

Application of rock mass classification systems, ground conditions in tunnelling, analysis of underground openings in squeezing and swelling ground, empirical methods, estimation of elastic modulus and modulus of deformation of rocks; uniaxial jacking / plate jacking tests, radial jacking and Goodman jacking tests, long term behaviour of tunnels and caverns, New Austrian Tunnelling Method (NATM), Norwegian Tunnelling Method (NTM), Construction dewatering.

Rock mass-tunnel support interaction analysis, ground response and support reaction curves, Ladanyi' selasto-plastic analysis of tunnels, design of various support systems including concrete and shotcrete linings, steel sets, rock bolting and rock anchoring, combined support systems, estimation of load carrying capacity of rock bolts.

In-situ stress, flat jack, hydraulic fracturing and over coring techniques and USBM type drill hole deformation gauge, single and multi-point bore hole extensometers, load cells, pressure cells, etc. Instrumentation and monitoring of underground excavations, during and after construction, various case studies

Member Secretary BoS Chairperson Dean (Academics) Principal

Reference Books and Websites:

1. Hoek, E and and Brown, E. T.," Underground Excavations in Rocks", Institute of Mining Engineering.
2. Obert, L. and Duvall, W.I., "Rock Mechanics and Design of Structures in Rocks", John
3. Singh, B. and Goel, R. K., "Rock Mass Classification- A Practical Engineering Approach", Elsevier.
4. Singh, B. and Goel, R. K., "Tunnelling in Weak Rocks", Elsevier

Course Outcomes:

On completion of the course, students will be able to:

CE2134(C).1 Describe planning and exploration for various underground construction projects, their principles and its application in underground excavation design.

CE2134(C).2 Describe elastic stress distribution around tunnels for different shapes and under different in-situ stress conditions.

CE2134(C).3 Discuss elastic and plastic analysis and rock mass classification systems in the design of underground support system

CE2134(C).4. Describe rock mass-tunnel support interaction analysis, ground response and support reaction curves, elasto-plastic analysis of tunnels, and design of various support systems

CEP154(C).5. Describe Instrumentation and monitoring of underground excavations conducted during and after construction

CO – PO Mapping:

Course Outcomes	Program Outcomes				
	PO1	PO2	PO3	PO4	PO5
CE2134(C).1	-	-	3	-	2
CE2134(C).2	-	-	3	--	2
CE2134(C).3	-	-	3	-	2
CE2134(C).4	-	-	3	-	2
CE2134(C).5	-	-	3	-	2

0 - Not correlated 1 - Weakly Correlated 2 - Moderately Correlated 3 - Strongly Correlated

Member Secretary BoS Chairperson Dean (Academics) Principal

Course Code	CE2135							Course category			PC
Course Name	GEOTECHNICAL ENGINEERING LAB I										
Teaching Scheme				Examination Scheme							Credits
Th	Tu	Pr	Total	Theory				Practical		Total	
				MSE	TA	ESE	ESE Duration	ICA	ESE		
-	-	06	06	-	-	-	-	50	50	100	03

Course Objectives:

To make the students competent:

1. For conducting various laboratory tests as per relevant IS Codes to determine the various properties of soil
2. Classify given soil as per IS classification system
3. Use Geo5 software for solving problems in Geotechnical Engineering

Course Contents:

Representative list of Practicals:

A. List of Laboratory Practicals:

1. Determination of In-situ density and Specific gravity of soil
2. Classification of soil as per Indian Standard Classification System by conducting Grain Size Distribution Analysis and Atterberg Limits (Liquid Limit, Plastic limit)
3. Vibration test for relative density of sand
4. Standard and modified proctor compaction test
5. Falling head permeability test and Constant head permeability test
6. Unconfined compression test
7. Direct shear test
8. Laboratory vane shear test
9. Swelling Pressure Test

Part B: Designs

Design of earthen dam and its Seepage analysis and slope stability analysis, Design of filters

Course Outcomes:

At the end of this course, students will demonstrate the ability to:

CE2135.1 Perform various laboratory tests as per relevant IS Codes to determine the various physical, Index and engineering properties of soil.
CE2135.2: Classify soil as per IS classification system
CE2135.3: Design earth dam and carry out its seepage and slope stability analysis

CO – PO Mapping:

Course Outcomes	Program Outcomes				
	PO1	PO2	PO3	PO4	PO5
CE2135.1	3	1	1	1	1
CE2135.2	3	1	1	1	1
CE2135.3	-	-	3	2	2

0 - Not correlated 1 - Weakly Correlated 2 - Moderately Correlated 3 - Strongly Correlated

Member Secretary BoS Chairperson Dean (Academics) Principal

Course Code	CE2136							Course category			ISS
Course Name	SEMINAR I										
Teaching Scheme				Examination Scheme							Credits
Th	Tu	Pr	Total	Theory				Practical		Total	
				MSE	TA	ESE	ESE Duration	ICA	ESE		
-	-	01	01	-	-	-	-	50	-	50	02

Course Objectives:

To make the students competent:

1. To select a topic for seminar based on latest technological advancements and carry out literature review
2. Write seminar report
3. Prepare and present Power Point Presentation for Seminar

Course Contents:

Student has to select a topic for Seminar based on literature review on advanced topics / recent developments in the field of Geotechnical Engineering and submit the report and deliver the seminar based on it. It is to be evaluated internally by panel of examiners headed by HOD (if possible) wherein guide should be one of the members of the panel

Course Outcomes:

At the end of this course, students will demonstrate the ability to:

CE2136.1 Select a topic for seminar based on latest technological advancements and collect related literature

CE2136.2: Prepare seminar report and power point presentation based on information collected related to the selected topic

CE2136.3: Deliver seminar

CO – PO Mapping:

Course Outcomes	Program Outcomes				
	PO1	PO2	PO3	PO4	PO5
CE2135.1	1	1	1	1	1
CE2135.2	1	1	1	1	1
CE2135.3	1	1	1	1	1

0 - Not correlated 1 - Weakly Correlated 2 - Moderately Correlated 3 - Strongly Correlated

Member Secretary BoS Chairperson Dean (Academics) Principal

Course Code	CE2231							Course category			PC
Course Name	ADVANCED FOUNDATION ENGINEERING										
Teaching Scheme				Examination Scheme							Credits
Th	Tu	Pr	Total	Theory				Practical		Total	
				MSE	TA	ESE	ESE Duration	ICA	ESE		
03	-	-	03	30	10	60	2 hrs 30 min	-	-	100	03

Course Objectives:

To make the students aware and understand:

1. Design procedure for various types of shallow as per relevant IS codes and based on various criteria and different field situations
2. Various types of deep foundations as per relevant IS codes and based on various criteria and different field situations
3. Determination of Foundation settlements

Course Contents:

Shallow foundations

Requirements for satisfactory performance of foundations, Types of shear failures of shallow foundations, Terzaghi's, Meyerhoff, Hansens, Vesic bearing capacity theories, IS Code method for analysis of shallow foundation, , Effect of water table on bearing capacity, layered soils, eccentric and inclined loads, Bearing capacity on slopes, Annular Footings, Rigid and flexible foundations, Design of Individual, Combined and Raft Foundations for axial and bending loads (Uniaxial and biaxial)

Foundation settlements

Settlements of footings and rafts, - Elastic and consolidation settlement, proportioning of foundations using field test data, IS codes.

Pile foundations

Introduction, classification, Load transfer mechanism, Static and dynamic formulas for pile capacity in various soil types, settlements of pile foundations, pile group capacity and settlement, negative skin friction of piles, laterally loaded piles, pile load tests, lateral and uplift capacity of piles, Analysis and design of pile and pile cap

Drilled Piers and Caissons: Introduction, types, Design considerations, bearing capacity equations, Settlements, Types of caissons, stability analysis, advantages and disadvantages of caissons

Well foundation

Different shapes of well, grip length, forces acting on well foundation, Trezaghi's analysis, components of well, sinking of wells, measurement and rectification of tilts and shifts, IS and IRC codal provisions,

Foundations on problematic soils:

Foundations for collapsible and expansive soil

Reference Books and Websites:

1. Das B.M., Shallow Foundations: Bearing capacity and settlement, CRC Press, 1999
2. V.N.S. Murthy, Advanced Foundation Engineering, CBS Publishers & Distributors.
3. Kaniraj S. R., Design Aids in Soil Mechanics and Foundation Engineering, TATA McGRAW-HILL Publishing Company Limited, New Delhi
4. N.P. Kurien, Design of Foundation Sytems, Principles & Practices, Narosa
5. L.C. Reese, Single piles and pile groups under lateral loading, Taylor & Francis
6. P. C. Varghese, Foundation Design, PHI Learning Pvt. Ltd Bowles. J.E., Foundation Analysis and Design, Tata McGraw-Hill International Edition, 5th Edn, 1997
7. Poulos, H. G. and Davis, F. H., "Pile Foundation Analysis and Design", Wiley and Sons 1980, John Wiley & Sons, 1979

Course Outcomes:

On completion of the course, students will be able to:

CE2231.1. Analyse and design various types of shallow foundations by Terzaghi's, Meyerhoff, Hansens, Vesic bearing capacity theories and IS Code taking in to account effect of water table, layering soils, eccentricity and inclination of loads, and ground slopes

CE2231.2 Analyse and design various types of shallow foundations by various methods taking in to account effect of water table, layering of soils, eccentricity and inclination of loads, and ground slopes.

CE2231.3. Determine foundation settlements based on soil properties and foundation details

CEP251.4. Analyse and design pile foundations, pile groups and determine their settlements,

CEP251.5 Carry out analysis and design of deep foundations such as cessions and well foundation.

CO – PO Mapping:

Course Outcomes	Program Outcomes				
	PO1	PO2	PO3	PO4	PO5
CE2231.1	-	-	3	-	2
CE2231.2	-	-	3	-	2
CE2231.3	-	-	3	-	2
CE2231.4	-	-	3	-	2
CE2231.5	-	-	3	-	2

0 - Not correlated 1 - Weakly Correlated 2 - Moderately Correlated 3 - Strongly Correlated

Member Secretary BoS Chairperson Dean (Academics) Principal

Course Code	CE2232							Course category			PC
Course Name	EARTH RETAINING STRUCTURES										
Teaching Scheme				Examination Scheme							Credits
Th	Tu	Pr	Total	Theory				Practical		Total	
				MSE	TA	ESE	ESE Duration	ICA	ESE		
03	-	-	03	30	10	60	2 hrs 30 min	-	-	100	03

Course Objectives:

To make the students aware and understand:

1. Determination of earth Pressure on retaining structures by various theories
2. Stability analysis of different types of earth retaining structures
3. Design of different types of earth retaining structure

Course Contents:

Earth Pressure

Rankin and Coulomb theories, active, passive and pressure at rest; earth pressure due to uniform surcharge, earth pressure of stratified backfills, saturated and partially saturated backfill.

Retaining walls

Types of retaining walls, Proportioning of retaining walls, mechanically stabilized retaining walls (MSE) /reinforced earth retaining walls, stability analysis of retaining walls,.

Design of Retaining Walls

Design of Gravity, cantilever, and MSE walls

Sheet Pile wall

Free earth system, fixed earth system for analysis.

Bulkheads

Bulkheads with free and fixed earth supports, equivalent beam method, Anchorage of bulkheads and resistance of anchor walls, spacing between bulkheads and anchor walls, resistance of anchor plates.

Braced excavations

Earth pressure against bracings in cuts, Heave of the bottom of cut in soft clays

Reference Books and websites:

1. Das, Braja M., "Principles of Foundation Engineering", PWS Publishing. 1998
2. Bowles. J.E., Foundation Analysis and Design, Tata McGraw-Hill International Edition, 5th Edn, 1997
3. Kaniraj S. R., Design Aids in Soil Mechanics and Foundation Engineering, TATA McGRAW-HILL Publishing Company Limited, New Delhi

Course Outcomes:

On completion of the course, students will be able to:

CE2232.1 Determine the earth pressure on retaining structures for different field situations.
CE2232.2 Carry out stability analysis of retaining walls for given data
CE2232.3. Design of different types of earth retaining walls for given data
CE2232.4. Carry out analysis of sheet pile wall
CE2232.5. Carry out analysis of bulkheads and braced excavations

CO – PO Mapping:

Course Outcomes	Program Outcomes				
	PO1	PO2	PO3	PO4	PO5
CE2232.1	-	-	3	-	2
CE2232.2	-	-	3	-	2
CE2232.3	-	-	3	-	2
CE2232.4	-	-	3	-	2
CE2232.5	-	-	3	-	2

0 - Not correlated 1 - Weakly Correlated 2 - Moderately Correlated 3 - Strongly Correlated

Member Secretary BoS Chairperson Dean (Academics) Principal

Course Code	CE2233							Course category		PC
Course Name	HIGHWAY SOIL MECHANICS									
Teaching Scheme				Examination Scheme						Credits
Th	Tu	Pr	Total	Theory				Practical		Total	
				MSE	TA	ESE	ESE Duration	ICA	ESE		
03	-	-	03	30	10	60	2 hrs 30 min	-	-	100	03

Course Objectives:

To make the students aware and understand:

1. Different types of pavements, their components and characteristics
2. Subsoil drainage and compaction of pavements
3. Design parameters and Material Characteristics for pavement analysis and design
4. Analysis and Design of flexible pavements by various methods
5. Analysis of Rigid pavements by various methods

Course Contents:

Highway Compaction:

Mechanics of compaction, Field-compaction equipment; their suitability and choice, Compaction quality control and measurement

Subsoil drainage in Highway:

Design of filters, perforated pipe drainage, Methods of sub soil drainage for roads, permeable blankets, longitudinal and transverse under drains, horizontal drains, stabilizing trenches, Sub soil drainage in highways, and runways

Types of Pavements:

Types of pavements – Rigid, semi-rigid and rigid, Structural action of flexible and rigid pavements, Characteristics of highway and airfield pavements

Highway Design parameters:

Standard Axial load and wheel assemblies for road vehicles under carriage system for aircraft, Tire and contact pressure, contact area imprints, Computations of ESWL for flexible and rigid pavements. Load repetitions and distributions of traffic for highway and airfield pavement, airport traffic areas.

Highway Material Characteristics:

AASHO sub-grade soil classification. Group index, CBR, North Dakota cone bearing value, plate load test for “K”, Marshal’s method of bituminous mix design, Modulus of rupture and elasticity, poison’s ratio &coefficient of thermal expansion of concrete, Layer equivalency concepts

Analysis of Pavements:

Stress, Strain deformation analysis for single, two, three and multi-layered flexible pavement systems. Stress and deflections for rigid pavements due to load and temperature, influence Charts, ultimate load analysis, joints in pavements.

Design of Flexible Pavement:

Selection of pavement design input parameters – traffic loading and volume, failure criteria, Different methods -North Dakota cone, Group index, CBR, IRC-37, Brumister, Triaxial (Kansas), AASHO method of design, comparison of different pavement design approaches

Reference Books and websites:

1. K. Khanna, and Justo, C.E.G., Highway Engineering;, Khanna Publication, Roorkee,
2. Sharma and Sharma, Principles and Practice of Highway Engg., Asia Publishing House, 1980
3. Yoder &Witzace, Principles of Pavement Design,; Prentice Hall,2000
4. H. H. Yang, Pavement Analysis and Design, , Pearson Prentice Hall, 2004
5. Croney & Croney, Design and Performance of Road Pavements, , McGraw Hill, 2002
6. Yoder and Witzech, Pavement Design, McGraw-Hill, 1982

Course Outcomes:

On completion of the course, students will be able to:

CE2233.1 Diffentiate between different types of pavement and explain their components and functions
CE2233.2 Describe Subsoil drainage and compaction of pavements
CE2233.3 Apply Design parameters and Material Characteristics for pavement analysis and design
CE2233.4 Carry out analysis and Design of flexible pavements by various methods
CE2233.5 Carry out analysis of rigid pavements

CO – PO Mapping:

Course Outcomes	Program Outcomes				
	PO1	PO2	PO3	PO4	PO5
CE2233.1	-	-	3	-	1
CE2233.2	-	-	3	-	1
CE2233.3	-	-	3	-	1
CE2233.4	-	-	3	-	1
CE2233.5	-	-	3	-	1

0 - Not correlated 1 - Weakly Correlated 2 - Moderately Correlated 3 - Strongly Correlated

Member Secretary BoS Chairperson Dean (Academics) Principal

Course Code	CE2234(A)							Course category		PE
Course Name	ENVIRONMENTAL GEOTECHNOLOGY									
Teaching Scheme				Examination Scheme						Credits
Th	Tu	Pr	Total	Theory				Practical		Total	
				MSE	TA	ESE	ESE Duration	ICA	ESE		
03	-	-	03	30	10	60	2 hrs 30 min	-	-	100	03

Course Objectives:

To make the students aware and understand:

1. Various sources and effects of subsurface contamination, characteristics of waste, and Soil-waste interaction
2. Planning, designing and construction of landfills for MSW, and pond-ash
3. Remediation and control of toxic and hazardous waste sites
4. Geotechnical re-use of waste materials

Course Contents:

Contamination:

Surface & subsurface contamination, Sources and effects of subsurface contamination, Physical, Chemical and biological characteristics of solid waste, Identification, Characterization and regulatory requirements for disposal of hazardous, non-hazardous and domestic waste, Soil-waste interaction, Effect of pollutants on soil properties

Contaminants of solid waste in landfills:

Characteristics of solid wastes, Disposal of solid waste, Waste containment, Solid waste Landfills and its components, Shape and size of landfills, Types of landfills, Site selection Impervious barriers for liners and Covers, Liner systems and cover systems, , Landfill construction and operation, Leachate generation, Closure and post- closure care, Sustainable waste management, Ground water contamination associated with leachate transfer

Containment systems using Geomembrane:

Advantages of using composite barrier for Liners and Covers, Single composite liner system for MSW landfill, Double composite liner system for HW landfill, Stability of landfills

Contaminants of slurry wastes:

Slurry transported waste, Slurry Ponds and their operation, Embankment construction methods for ponds, Design aspects, Environmental impact and control,

Vertical barriers for containment:

Contaminated sites, Types of vertical barriers, - Soil- bentonite slurry trench walls, and Cement-Bentonite slurry trench walls -construction and design aspects

Geotechnical reuse of Waste material:

Waste reduction, Use of waste in Geotechnical construction, Waste characteristics for soil replacement, Transportation consideration, engineering properties of waste, Waste material in embankment and fills, Reclamation of contaminated site, various methods

Reference Books and websites:

1. S K Gulhati & M Datta, Geotechnical Engineering, Tata McGraw Hill Publishing Company Ltd. 2005
2. Fang, H-Y., Introduction to Environmental Geotechnology, CRC Press, 1997
3. Daniel, D.E, Geotechnical Practice for Waste Disposal, Chapman and Hall, 1993.
4. Rowe, R.K., Quigley, R.M. and Booker, J.R., Clay Barrier Systems for Waste Disposal Facilities, E & FN Spon, 1995.
5. Rowe, R.K, Geotechnical and Geoenvironmental Engineering Handbook, Kluwer Academic Publishers, 2001.
6. Reddi, L.N. and Inyang, H.F, Geoenvironmental Engineering - Principles and Applications, Marcel

Course Outcomes:

On completion of the course, students will be able to:

CE2234(A).1 describe sources and effects of subsurface contamination, characteristics of waste, and Soil-waste interaction.

CE2234(A).2 Discuss components of landfill and their functions, Planning, designing and construction of landfills for MSW

CE2234(A).3 Explain containment systems using Geomembrane: for MSW landfill, and HW landfill, Stability of landfills

CE223A(A).4 Explain contaminants of slurry wastes by slurry Ponds and their operation, and design aspects

CE2234(A).5 Describe Geotechnical reuse of Waste material in Geotechnical construction, embankment and fills, and reclamation of contaminated site by various methods

CO – PO Mapping:

Course Outcomes	Program Outcomes				
	PO1	PO2	PO3	PO4	PO5
CE2234(A).1	1	1	1	-	-
CE2234(A).2	1	1	1	-	-
CE2234(A).3	1	1	1	-	-
CE2234(A).4	1	1	1	-	-
CE2234(A).5	1	1	1	-	-

0- Not correlated 1 - Weakly Correlated 2- Moderately Correlated 3- Strongly Correlated

Member Secretary BoS Chairperson Dean (Academics) Principal

Course Code	CE2234(B)							Course category			PE
Course Name	DYNAMICS OF SOIL AND FOUNDATIONS										
Teaching Scheme				Examination Scheme							Credits
Th	Tu	Pr	Total	Theory				Practical		Total	
				MSE	TA	ESE	ESE Duration	ICA	ESE		
03	-	-	03	30	10	60	2 hrs 30 min	-	-	100	03

Course Objectives:

To make the students aware and understand:

1. Principles of soil dynamics, theory of vibration, propagation of body waves and surface waves through soil
2. Different laboratory and field tests to determine dynamic soil properties required for design purpose
3. Liquefaction mechanism and evaluation of liquefaction potential of soil.
4. General requirements of machine foundation, and criteria for its design
5. Procedure of analysis & Design of different types of Machine foundation

Course Contents:

Introduction to dynamic loading:

Earthquake loading, machine vibrations, blast loading, background and lessons learnt from damages in past earthquakes due to soil and ground failure, effect of soil properties on seismic response of structures, seismic waves and their characteristics

Soil Dynamics and its applications

Fundamentals of vibrations:

Single, two and multiple degree of freedom systems, vibration isolation, vibration absorbers, vibration measuring instruments

Wave propagation:

Elastic continuum medium, semi-infinite elastic continuum medium, soil behaviour under dynamic loading

Dynamic elastic constants of soil:

Static and dynamic characteristics of soils, stress-strain behaviour of cyclically loaded soils, effect of strain level on the dynamic soil properties, measurement of seismic response of soil at low and high strain, using laboratory tests, cyclic triaxial, cyclic direct simple shear, resonant column, shaking table, centrifuge and using field tests - block vibration test, cross bore hole, their suitability and limitations, Interpretation of results, IS Codes

Liquefaction of soils:

Liquefaction mechanism, factors affecting liquefaction, liquefaction of cohesionless soils and sensitive clays, liquefaction susceptibility, evaluation of liquefaction potentialstudies by dynamic tri-axial testing, oscillatory shear box, shake table and blast tests.

MACHINE FOUNDATION

Introduction:

Types of machines**,** Types of machine foundations, Modes of vibrations, General requirements of machine foundation, General criteria for design, Permissible amplitude

Analysis & Design of Machine foundation:

Elastic homogeneous half space and lumped parameter solutions, analysis and design of foundations for reciprocating and impact type machines, turbines, effect of machine foundation on adjoining structures.

Vibration isolation& control:

Force isolation & motion isolation, Methods of isolation in machine foundations Isolating materials and their properties

Bearing capacity of foundations:

Introduction to bearing capacity of dynamically loaded foundations

Reference Books and websites:

1. Das, B.M., “Fundamentals of Soil Dynamics”, Elsevier, 1983
2. Prakash, S., Soil Dynamics, McGraw Hill, 1981
3. Prakash, S. and Puri, V.K., Foundation for machines: Analysis and Design, John Wiley & Sons, 1998
4. Steven Kramer, “Geotechnical Earthquake Engineering”, Pearson, 2008.
5. Kameswara Rao, N.S.V., Vibration analysis and foundation dynamics, Wheeler Publication Ltd., 1998
6. Richart, F.E. Hall J.R and Woods R.D., Vibrations of Soils and Foundations, Prentice hall Inc., 1970.
7. Bowles. J.E., Foundation Analysis and Design, Tata McGraw-Hill International Edition, 5th Edn, 1997.
8. Sharma, H.D. and Lewis, S.P, Waste Containment Systems, Waste Stabilization and

Course Outcomes:

On completion of the course, students will be able to:

CE2234(B).1 Explain basics of soil dynamics, theory of vibration, propagation of body waves and surface waves through soil.

CE2234(B).2 Discuss different laboratory and field tests to determine dynamic soil properties required for design purpose.

CE2234(B).3 Describe liquefaction mechanism and evaluation of liquefaction potential studies by various tests.

CE2234(B).4 Explain general requirements of machine foundation, and criteria for its design.

CE2234(B).5 Analysis & Design of different types of Machine foundation required in the field

CO – PO Mapping:

Course Outcomes	Program Outcomes				
	PO1	PO2	PO3	PO4	PO5
CE2234(B).1	-	-	3	-	2
CE2234(B).2	-	-	3	-	2
CE2234(B).3	-	-	3	-	2
CE2234(B).4	-	-	3	-	2
CE2234(B).5	-	-	3	-	2

0 - Not correlated 1 - Weakly Correlated 2 - Moderately Correlated 3 - Strongly Correlated

Member Secretary BoS Chairperson Dean (Academics) Principal

Course Code	CE2234(C)							Course category			PE
Course Name	FOUNDATIONS ON WEAK SOIL										
Teaching Scheme				Examination Scheme							Credits
Th	Tu	Pr	Total	Theory				Practical		Total	
				MSE	TA	ESE	ESE Duration	ICA	ESE		
03	-	-	03	30	10	60	2 hrs 30 min	-	-	100	03

Course Objectives:

To make the students aware and understand:

1. Engineering properties of weak rocks, different rock mass classification systems, Failure criteria for weak rocks and modes of failure of foundations on rocks/ rock masses
2. Bearing capacity and Pressure-settlement characteristics of foundations on rocks and rock masses.
3. Design procedure for different types of foundations placed over rock mass

Course Contents:

Engineering properties of weak rocks, different rock mass classification systems, relative merits, and demerits

Failure criteria for weak rocks, bi-linear Mohr-Coulomb failure criterion, Hoek and Brown criterion and modified Hoek and Brown failure criterion etc

Effect of structural planes on rock foundations, possible modes of failure of foundations on rocks/ rock masses, determination of in-situ shear strength of rocks and rock masses

Requirements for satisfactory performance of foundations, bearing capacity of foundations on rocks and rock masses, allowable bearing pressure of rock foundations using a nonlinear failure criterion, monotonic and cyclic plate load tests

Pressure-settlement characteristics, effect of layering, anisotropy, heterogeneity and inelasticity

Shallow foundations, shallow foundations on sloping ground, raft foundations, stilt foundations, foundations for suspension bridges, transmission line towers, framed buildings etc, treatment of foundations - open joints, solution cavities, weak seams

Piles in weak rocks, bearing capacity and settlement of piles, piles in stratified rock masses, field load tests on piles in weak rocks, behaviour of bored / driven piles in soft / weathered

Reference Books and websites:

1. Hudson J.A. and J.P. Harrison. Engineering Rock Mechanics: an Introduction to the Principles, 1997. Elsevier, Oxford
2. Ramamurthy, T., "Engineering in Rocks", PHI Learning Pvt. Ltd
3. Wyllie Duncan C.," Foundations on Rock: Engineering Practice", E&FNSpon, Taylor and Francis.
4. Singh, B. and Goel, R.K., " Rock Mass Classification- A Practical Engineering Approach", Elsevier.
5. Hoek, E., "Practical Rock Engineering", Rock science.

Course Outcomes:

On completion of the course, students will be able to:

CE2234(C).1: Discuss Engineering properties of weak rocks, and different rock mass classification systems, Failure criteria for weak rocks and modes of failure of foundations on rocks/ rock masses.

CE2234(C).2: Discuss failure criteria for weak rocks and modes of failure of foundations on rocks/ rock masses.

CE2234(C).3: Discuss bearing capacity of foundations on rocks and rock masses, and allowable bearing pressure of rock foundations using a nonlinear failure criterion,

CE2234(C).4: Discuss shallow foundations on sloping ground, raft foundations, stilt foundations, foundations for suspension bridges, transmission line towers, framed and apply design procedure for different types of foundations placed over rock mass

CE2234(C).5. Determine bearing capacity and settlement of piles in weak rocks and stratified rock masses

CO – PO Mapping:

Course Outcomes	Program Outcomes				
	PO1	PO2	PO3	PO4	PO5
CE2234(C).1	1	-	-	-	1
CE2234(C).2	1	-	-	-	1
CE2234(C).3	1	-	-	-	1
CE2234(C).4	1	-	-	-	1
CE2234(C).5	1	-	-	-	1

0 - Not correlated 1 - Weakly Correlated 2 - Moderately Correlated 3 - Strongly Correlated

Member Secretary BoS Chairperson Dean (Academics) Principal

Course Code	SH2201							Course category			RM
Course Name	RESEARCH METHODOLOGY										
Teaching Scheme				Examination Scheme							Credits
Th	Tu	Pr	Total	Theory				Practical		Total	
				MSE	TA	ESE	ESE Duration	ICA	ESE		
02	-	-	02	30	20	-	--	-	-	50	02

Course Objectives:

To make the students aware and understand:

1. Research problem formulation and methods
2. Data collection methods and analyze research related information
3. Research reports, and thesis writing
4. Research Ethics and Intellectual Property Right
5. Research paper writing and publishing

Course Contents:

Introduction to Research: Definition of research, Characteristics of research, Types of research- Descriptive *vs.* Analytical, Applied *vs.* Fundamental, Quantitative *vs.* Qualitative, Conceptual *vs.* Empirical, Steps of research methodology

Research Problem Formulation and Methods:

Literature review, sources of literature, various referencing procedures, maintain literature data using Endnote2, Identifying the research areas from the literature review and research database, Problem Formulation, Identifying variables to be studied, determining the scope, objectives, limitations and or assumptions of the identified research problem, Justify basis for assumption, Formulate time plan for achieving targeted problem solution. Important steps in research methods: Observation and Facts, Laws and Theories, Development of Models. Developing a research plan: Exploration, Description, Diagnosis and Experimentation

Data collection:

Sampling methods, methods of data collection, Basic Concepts concerning testing of hypotheses, procedures of hypothesis testing, generalization and interpretation Applied statistics: Regression analysis, Parameter estimation, Multivariate statistics, Principal component analysis Software tools for modeling, Simulation and analysis.

Research reports and Thesis writing

Introduction: Structure and components of scientific reports, types of report, Thesis writing: different steps and software tools in the design and preparation of thesis, layout, structure and language of typical reports, Illustrations and tables, bibliography, referencing and footnotes, Oral presentation: planning, software tools, creating and making effective presentation, use of visual aids, importance of effective communication.

Research Ethics, IPR and Publishing:

Ethics: Ethical issues.

IPR: intellectual property rights and patent law, techniques of writing a Patent, filing procedure, technology transfer, copy right, royalty, trade related aspects of intellectual property rights,

Publishing: design of research paper, citation and acknowledgement, plagiarism tools, reproducibility and accountability.

Reference Books and websites:

1. Ranjit Kumar, "Research Methodology: A Step by Step Guide for Beginners", SAGE Publications Ltd., 2011
2. C.R. Kothari ,"Research Methodology: Methods and Trends", New Age International,2004
3. Wayne Goddard, Stuart Melville, "Research Methodology: An Introduction" JUTA and Company Ltd, 2004.
4. S.D. Sharma , "Operational Research", Kedar Nath Ram Nath & Co.,1972
5. B.L. Wadehra, "Law Relating to Patents, Trademarks, Copyright Designs and Geographical Indications", Universal Law Publishing, 2014.

Course Outcomes:

On completion of the course, students will be able to:

SH2221.1 Differentiate between various methods / types of research.
SH2221.2 Formulate research problem
SH2221.3 Collect and analyze research related information
SH2221.4 Describe ethics and IPR and its significance.
SH2221.5 Describe thesis report and research paper writing and publishing

CO – PO Mapping:

Course Outcomes	Program Outcomes				
	PO1	PO2	PO3	PO4	PO5
SH2221.1	-	-	-	-	3
SH2221.2	-	-	-	-	3
SH2221.3	-	-	-	-	3
SH2221.4	-	-	-	-	3
SH2221.5	-	-	-	-	3

0- Not correlated 1 - Weakly Correlated 2- Moderately Correlated 3- Strongly Correlated

Member Secretary BoS Chairperson Dean (Academics) Principal

Course Code	CE2135							Course category			PC
Course Name	GEOTECHNICAL ENGINEERING LAB II										
Teaching Scheme				Examination Scheme							Credits
Th	Tu	Pr	Total	Theory				Practical		Total	
				MSE	TA	ESE	ESE Duration	ICA	ESE		
-	-	06	06	-	-	-	-	50	50	100	03

Course Objectives:

To make the students competent:

1. for conducting laboratory tests to determine properties of stabilised / reinforced soil
2. design earth dam as per provisions of IS Code and carry out its seepage slope stability analysis
3. Use Geo5 software for Slope stability analysis of earthen dam for different conditions

Course Contents:

Representative list of Practicals:

Part A-List of Practical's:

1. Field Vane shear test.
2. Standard penetration test.
3. Dynamic cone penetration test.
4. Static cone penetration test.
5. Plate load test.
6. Geophysical exploration tests.
7. C.B.R. Test
8. Triaxial Test
9. Consolidation Test

PART B- Use of Geo5 Software for:

1. Determination of Earth pressure.
2. Determination of stability of slopes by various methods.
3. Determination of stability of retaining wall.
4. Design of shallow footing.
5. Design of pile foundation.
6. Determination of settlement of footing.

A Report based on above experiments, Design and field visit reports shall be submitted by each student.

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Course Outcomes:

At the end of this course, students will demonstrate the ability to:

CE2135.1 Perform various field tests as per relevant IS Codes to determine the various in-situ properties of soil.

CE2135.2: Perform advanced lab tests as per relevant IS Codes to determine the various engineering properties of soil

CE2135.3: Use GEO5 software for solving geotechnical problems

CO – PO Mapping:

Course Outcomes	Program Outcomes				
	PO1	PO2	PO3	PO4	PO5
CE2235.1	3	1	1	1	1
CE2235.2	3	1	1	1	1
CE2235.3	-	-	3	2	2

0 - Not correlated 1 - Weakly Correlated 2 - Moderately Correlated 3 - Strongly Correlated

Member Secretary BoS Chairperson Dean (Academics) Principal

Course Code	CE2236							Course category			ISS
Course Name	SEMINAR II										
Teaching Scheme				Examination Scheme							Credits
Th	Tu	Pr	Total	Theory				Practical		Total	
				MSE	TA	ESE	ESE Duration	ICA	ESE		
-	-	01	01	-	-	-	-	50	-	50	02

Course Objectives:

To make the students competent:

1. To select a topic for seminar based on latest technological advancements and carry out literature review, with a focus on selecting a topic for dissertation
2. Write seminar report and prepare and present Power Point Presentation for Seminar
3. Deliver seminar

Course Contents:

Student has to select a topic for Seminar based on literature review on advanced topics / recent developments in the field of Geotechnical Engineering and submit the report and deliver the seminar based on it. The topic for seminar should be related to the literature survey based on Dissertation topic. It is to be evaluated internally by panel of examiners headed by HOD (if possible) wherein guide should be one of the members of the panel

Course Outcomes:

At the end of this course, students will demonstrate the ability to:

CE2136.1 Select a topic for seminar based on latest technological advancements and collect related literature related to dissertation topic

CE2136.2: Prepare seminar report and power point presentation based on information collected related to the selected topic

CE2136.3: Deliver seminar

CO – PO Mapping:

Course Outcomes	Program Outcomes				
	PO1	PO2	PO3	PO4	PO5
CE2136.1	1	1	1	1	1
CE2136.2	1	1	1	1	1
CE2136.3	1	1	1	1	1

0 - Not correlated 1 - Weakly Correlated 2 - Moderately Correlated 3 - Strongly Correlated

Member Secretary BoS Chairperson Dean (Academics) Principal

Course Code						CATEGORY				OJT/FP
Course Name	ON JOB TRAINING / FIELD PRACTICE									
Teaching Scheme				Examination Scheme						Credits
Th	Tu	Pr	Total	Theory				Practical		Total	
				MSE	TA	ESE	ESE Duration	ICA	ESE		
-	-	-	-	-	-	-	-	50	-	50	04

Students must complete On-the-job training/ Internship/ Field work for a duration of minimum four weeks during summer break, after completion of second semester of first year in the respective major subject. The company/ organization for On-job training/ Internship/ Field work must be approved by the DFB.

The student must submit the report of On-job training / Internship / Field Work , in the format prescribed by the Institute.

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