(DEEMED TO BE UNIVERSITY)

CIVIL ENGINEERING

M.Tech Geotechnical Engineering

2020 & 2021 Admitted Students

CURRICULUM & SYLLABUS

Vision of University

To be a globally renowned university.

Mission of University

To impart quality higher education and to undertake research and extension with emphasis on application and innovation that cater to the emerging societal needs through all-round development of students of all sections enabling them to be globally competitive and socially responsible citizens with intrinsic values.

Vision of Department

To impart knowledge and excellence in Civil Engineering with global perspectives to the student community and to make them ethically strong engineers to build our nation.

Mission of Department

M1: To provide holistic development of student

M2: To meet the ever-changing needs of civil engineering industry

M3: To be involved in forward looking research

M4: To be involved in consultancy useful to society

PROGRAM EDUCATIONAL OBJECTIVES (PEOs):

- **PEO1:** Demonstrate knowledge in broad areas of Geotechnical Engineering
- **PEO2:** Demonstrate a depth of knowledge in a chosen/focus area of Geotechnical Engineering
- **PEO3:** Demonstrate knowledge of contemporary issues in their chosen/ focused area
- **PEO4:** Demonstrate the ability to complete a technical project independently

PROGRAMME OUTCOMES (POs):

On completing the M. Tech. (**Geo-Technical Engineering**) – Civil Engineering Programme successfully the students will exhibit the following capabilities:

PO1: Knowledge of a broad range of Geotechnical methodologies and underlying civil engineering, commonly used in the development and analysis of geo spatial systems.

PO2: Knowledge of fundamental design issues relevant to Geotechnical methodologies and an understanding of how to formulate and analyses design solutions in various engineering contexts.

PO3: In-depth knowledge of one or more of the following (depending of selection of option modules and project area): specific engineering systems, design methods, modeling techniques.

PO4: Knowledge of basic research and development principles and practices relevant to mainstream engineering industry.

PO5: Knowledge of key professional, safety and ethical issues arising in modern engineering industry.

PO6: Knowledge of time management and work planning issues related to the organization implementation and successful completion, including reporting, of an individual, master's level, Engineering based projects.

MAPPING OF PEO's WITH MISSION STATEMENTS

S.No	Description of PEOs	Key Components of Mission			
		M 1	M 2	M 3	M 4
		To provide holistic development of student	To meet the ever changing needs of civil engineering industry	To be involved in forward looking research	To be involved in consultancy useful to society
PEO 1	Demonstrate knowledge in broad areas of Geotechnical Engineering	√	√	√	√
PEO 2	Demonstrate a depth of knowledge in a chosen/focus area of Geotechical Engineering	√	√	√	√
PEO 3	Demonstrate knowledge of contemporary issues in their chosen/ focused area	√	√	√	√
PEO 4	Demonstrate the ability to complete a technical project independently	√	√	√	√

MAPPING OF POs/PSOs with PEOs:

S. No.	Key Components of POs andPSOs	PEO			
		PEO 1	PEO 2	PEO 3	PEO 4
1	**PO1:** Knowledge of a broad range of Geotechnical methodologies and underlying civil engineering, commonly used in the development and analysis of geo spatial systems.	√		√	
2	**PO2:** Knowledge of fundamental design issues relevant to Geotechnical methodologies and an understanding of how to formulate and analyses design solutions in various engineering contexts.	√			
3	**PO3:** In-depth knowledge of one or more of the following (depending of selection of option modules and project area): specific engineering systems, design methods, modeling techniques.	√	√		
4	**PO4:** Knowledge of basic research and development principles and practices relevant to mainstream engineering industry.	√			
5	**PO5:** Knowledge of key professional, safety and ethical issues arising in modern engineering industry.	√	√		
6	**PO6:** Knowledge of time management and work planning issues related to the organization implementation and successful completion, including reporting, of an individual, master's level, Engineering based projects.	√		√	√

ACADEMIC REGULATIONS

This document supplements the KLEF rules and regulations to aid all students. It is required that every individual must abide by these regulations.

Note: The regulations stated in this document are subject to change or can be relaxed / modified without prior notice at the discretion of the Hon'ble Vice Chancellor.

Terminology

Academic Council: The Academic Council is the highest academic body of the University and is responsible for the maintenance of standards of instruction, education and examination within the University. Academic Council is an authority as per UGC regulations and it has the right to take decisions on all academic matters including academic research.

Academic Year: It is the period necessary to complete an actual course of study within a year. It comprises of two consecutive semesters i.e., Even and Odd semester.

Y20 Audited Course: It is a course of study which has zero credits and has a "Satisfactory" or an "Unsatisfactory" grade.

Backlog Course: A course is considered to be a backlog course if the student has obtained a failure grade (F).

Basic Sciences: The courses of foundational nature in the areas of Mathematics, Physics, Chemistry, Biology etc., are offered in this category.

Betterment: Betterment is a way that contributes towards improving the students' grade in any course(s). It can be done by either (a) re-appearing or (b) re-registering for the course.

Board of Studies: Board of Studies (BOS) is an authority as defined in UGC regulations, constituted by Vice Chancellor for each of the department separately. They are responsible for curriculum design and update in respect of all the programs offered by a department.

Branch of Study: It is a branch of knowledge, an area of study or a specific program (like Civil Engineering, Mechanical Engineering, Electrical and Electronics Engineering etc.)

Certificate course: It is a course that makes a student gain hands-on expertise and skills required for holistic development. It is a mandatory, non-credited course for the award of degree.

Change of Branch: Change of branch means transfer from one's branch of study to other.

Compulsory course: Course required to be undertaken for the award of the degree as per the program.

Course: A course is a subject offered by the University for learning in a particular semester.

Course Handout: Course Handout is a document, which gives complete plan of the course. It contains the details of the course viz. Course title, Course code, Pre-requisite, Credit structure, team of instructors, Course objectives, Course rationale, Course Outcomes and the relevant syllabus, textbook(s) and reference books, Course delivery plan and session plan, evaluation method, chamber consultation hour, course notices and other course related aspects. In essence, course handout is an agreement between students (learners) and the instructor.

Course Outcomes: The essential skills that need to be acquired by every student through a course.

Credit: A credit is a unit that gives weight to the value, level or time requirements of an academic course. The number of 'Contact Hours' in a week of a particular course determines its credit value. One credit is equivalent to one lecture hour per week or two hours per week of tutorials/ self- learning/ practical/ field work during a semester.

Credit point: It is the product of grade point and number of credits for a course.

Credit Transfer: The procedure of granting credit(s) to a student for course(s) undertaken at another institution.

Cumulative Grade Point Average (CGPA): It is a measure of cumulative performance of a student over all the completed semesters. The CGPA is the ratio of total credit points secured by a student in various courses in all semesters and the sum of the total credits of all courses in all the semesters. It is expressed up to two decimal places.

Curriculum: Curriculum incorporates the planned interaction of students with instructional content, materials, resources, and processes for evaluating the attainment of Program Educational Objectives.

Degree: A student who fulfills all the Program requirements is eligible to receive a degree.

Degree with Specialization: A student who fulfills all the Program requirements of her/his discipline and successfully completes a specified set of Professional elective courses in a specialized area is eligible to receive a degree with specialization.

Department: An academic entity that conducts relevant curricular and co-curricular activities, involving both teaching and non-teaching staff and other resources.

Y20 Detention in a course: Student who does not obtain minimum prescribed marks in continuous in-semester evaluation and /or minimum prescribed attendance in a course shall be detained in that particular course.

Dropping from the Semester: A student who doesn't want to register for the semester should do so in writing in a prescribed format before commencement of the semester.

Elective Course: A course that can be chosen from a set of courses. An elective can be Professional Elective, Open Elective, Management Elective and Humanities Elective.

Engineering Sciences: The courses belonging to basic evolutionary aspects of engineering from Mechanical Sciences, Electrical Sciences and Computing like Engineering Mechanics, Data structures, Network Theory, Signal Analysis etc...

Evaluation: Evaluation is the process of judging the academic work done by the student in her/his courses. It is done through a combination of continuous in-semester assessment and semester end examinations.

Grade: It is an index of the performance of the students in a said course. Grades are denoted by alphabets.

Grade Point: It is a numerical weight allotted to each letter grade on a 10 - point scale.

Honors Degree: A student who fulfills all the Program requirements of her/his discipline and successfully completes a specified set of additional courses within the same program is eligible to receive an Honors degree.

Humanities Elective: A course offered in the area of Liberal Arts.

Industrial Training: Training program undergone by the student as per the academic requirement in any company/firm. It is a credited course.

Industrial Visit: Visit to accompany/firm as per the academic requirement.

Y20: Summative assessments used to evaluate student learning, acquired skills, and academic attainment during a course.

Y20 Make-up Test: An additional test scheduled on a date other than the originally scheduled date. (Describe elaborately)

Y20: An additional test scheduled on a date other than the originally scheduled date.

Management elective: A course that develops managerial skills and inculcates entrepreneurial skills.

Mini project: Mini Project is a credit-based course that a student has to undergo during his/her academic term, which involves the student to explore in a discipline belonging to their research interest within their program area.

Minor Degree: A student who fulfills all the Program requirements of her/his discipline and successfully completes a specified set of courses from another discipline is eligible to receive a minor degree in that discipline.

Multi- Section Course: Course taught for more than one section.

Open Elective: This is a course of interdisciplinary nature. It is offered across the University for all programs.

Over loading: Registering for more number of credits than normally prescribed by the Program in a semester.

Practice School: It is a part of the total program and takes one full semester in a professional location, where the students and the faculty get involved in finding solutions to real-world problems. A student can choose Project/Practice School during his/her 7th or 8th semester of his/her Academic Year to meet the final requirements for a degree.

Pre-requisite: A course, the knowledge of which is required for registration into higher level course.

Professional Core: The courses that are essential constituents of each engineering discipline are categorized as Professional Core courses for that discipline.

Professional Elective: A course that is discipline centric. An appropriate choice of minimum number of such electives as specified in the program will lead to a degree with specialization.

Program: A set of courses offered by the Department. A student can opt and complete the stipulated minimum credits to qualify for the award of a degree in that Program.

Program Educational Objectives: The broad career, professional, personal goals that every student will achieve through a strategic and sequential action plan.

Project: Course that a student has to undergo during his/her final year which involves the student to undertake a research or design, which is carefully planned to achieve a particular aim. It is a credit based course.

Project based laboratory: Project Based Laboratory is a student-centric learning methodology that involve students in design, problem-solving, decision making, and investigative activities;

gives students the opportunity to work in teams, over extended periods of time; and culminate in realistic products or presentations

Re-Appearing: A student can reappear only in the semester end examination for the Theory component of a course, subject to the regulations contained herein.

Registration: Process of enrolling into a set of courses in a semester/ term of the Program.

Re-Registering: A student desiring to repeat a course is permitted to do so, subject to the regulations contained herein.

Semester: It is a period of study consisting of 15 to 18 weeks of academic work equivalent to normally 90 working days including examination and preparation holidays. The odd Semester starts normally in July and even semester in December.

Semester End Examinations: It is an examination conducted at the end of a course of study.

Single Section Course: Course taught for a single section.

Social Service: An activity designed to promote social awareness and generate well-being; to improve the life and living conditions of the society.

Student Outcomes: The essential skill sets that need to be acquired by every student during her/his program of study. These skill sets are in the areas of employability, entrepreneurial, social and behavioural.

Substitution of Elective course: Replacing an elective course with another elective course as opted by the student.

Summer term: The term during which courses are offered from May to July. Summer term is not a student right and will be offered at the discretion of the University.

Term Paper: A 'term paper' is a research report written by students that evolves their course-based knowledge, accounting for a grade. Term paper is a written original research work discussing a topic in detail. It is a credit-based course.

Under-loading: Registering for lesser number of credits than normally prescribed by the Program in a semester.

Withdraw from a Course: Withdrawing from a Course means that a student can drop from a course within the first two weeks of the odd or even Semester (deadlines are different for summer sessions). However s/he can choose a substitute course in place of it by exercising the option within 5 working days from the date of withdrawal.

Curriculum Structure

SEMESTER-1								
S.No	**Course Code**	**Course Title**	**L**	**T**	**P**	**S**	**Cr**	**CH**
1	20CE5161	Advanced Soil Mechanics	3	0	2	0	4	5
2	20CE5162	Sub Surface Investigations	3	0	2	0	4	5
3	20CE5163	Geo Environmental Engineering	3	0	2	0	4	5
4	20CE5164	Ground Improvement Techniques	3	0	2	0	4	5
5	20CE51M1	Soil structure interaction (PE 1)	3	0	0	0	3	0
	20CE51M2	Finite Element Methods (PE 1)						
6	20CE51N1	Stability Analysis of Slopes (PE 2)	3	0	0	0	3	0
	20CE51N2	Design of Highways and Airfiled Pavements (PE 2)						
7	20IE5149	Seminar	0	0	4	0	2	4
		Total	**18**	**0**	**12**	**0**	**24**	**24**

SEMESTER-2								
S.No	**Course Code**	**Course Title**	**L**	**T**	**P**	**S**	**Cr**	**CH**
1	20CE5265	Soil Dynamics and Geotechnical Earthquake Engineering	3	0	2	0	4	5
2	20CE5266	Geo Synthetics and Design of Retaining Walls	3	0	2	0	4	5
3	20CE5267	Design of Earth and Earth Retaining Structures	3	0	2	0	4	5
4	20CE5268	Advanced Foundation Engineering	3	0	2	0	4	5
5	20CE52O1	Solid Waste Management and Landfills (PE 3)	3	0	0	0	3	3
	20CE52O2	Offshore Geotechnical engineering (PE3)						
6	20CE52P1	RS and GIS Applications in Civil Engineering (PE 4)	3	0	0	0	3	3
	20CE52P2	Constitutive Modeling in Geo-techniques (PE 4)						
7	20IE5250	Term Paper	0	0	4	0	2	4
		Total	**18**	**0**	**12**	**0**	**24**	**30**

SEMESTER-3								
S.No	**Course Code**	**Course Title**	**L**	**T**	**P**	**S**	**Cr**	**CH**
1	20IE6050	Project	0	0	36	0	18	36
SEMESTER-4								
S.No	**Course Code**	**Course Title**	**L**	**T**	**P**	**S**	**Cr**	**CH**
1	20IE6050	Project	0	0	36	0	18	36
		GRAND TOTAL	**36**	**0**	**96**	**0**	**84**	**126**

Course Wise CO – PO Mapping

Course Code	Course Title	Description of the Course Outcome	1	2	3	4	5	6
20CE5161	Advanced Soil Mechanics	Analyze effective stress for different field conditions.	2	2	1			1
		Calculate settlement of soils using one dimensional and three-dimensional consolidation theories.			2			
		Estimates shear strength of saturated and partially saturated soils.	2	2	2			
		Develop stress path diagrams for different load conditions.	2	2	2		1	
		Analyze soil properties by conducting various laboratory/ field tests.			3			
20CE5162	Sub-Surface Investigations	Analyze effective stress for different field conditions.	2	2	2			
		Calculate settlement of soils using one dimensional and three dimensional consolidation theories.	2	2	2			1
		Estimate shear strength of saturated and partially saturated soils.	2	2	2			
		Develop stress path diagrams for different load conditions.	2	2	2			
		Analyze the various sub-surface investigations by conducting various field or laboratory tests.	3	3		3	3	
20CE5163	Geo-Environmental Engineering	Consider possible susceptibility of soil properties to environmental effects.	2	2	2	2		
		Identify contaminant transport mechanisms in soils	2	2	2		1	1

		Estimate environmental influences on engineering properties of soil to be used in design.	2	3	2	2		2
		Apply environmental changes to soil stabilization and landfill engineering	2	2	2			2
		Analyze Geoenvironmental engineering characteristics by conducting various laboratory tests.	3	3	3	3		
20CE5164	Ground Improvement Techniques	Identify difficult ground conditions in engineering practice.	2	2	2			1
		Identify different ground improvement techniques.	2	2	2	1		
		Select Site specific method of improvement and its design	2	2	2		2	
		Promote wider use of techno – economical construction techniques such as Reinforced soil structures, Gabion walls, Crib walls and fabric form work.	2	2	2			3
		Analyze different ground improvement techniques by conducting various laboratory/ field tests or software tools			3	3		
20CE5265	Soil Dynamics & Geotechnical Earthquake Engineering	Understand the principles of soil dynamics, wave propagation and apply the base isolation techniques to design foundations	2	2	2			
		Understand the fundamentals of earthquake engineering, ground motion, evaluate the ground motion parameters and generate the artificial ground motion for any specific site	2	2	2		1	
		Understand the principles of seismic hazard principles and various	2	2	2		2	

		methods of measuring the dynamic soil properties						
		Analyze the ground response analyses and evaluate the liquefaction potential for a given site	2	2	2			
		Generate the site-specific strong ground motion and perform the site specific ground response analysis and evaluate the liquefaction potential for a give site.	3			3	3	
20CE5266	Geosynthetics & Design of Retaining walls	Analyze the Geosynthetics and Different Types of Soil Retaining Structures Construction Aspects of Geosynthetic Reinforced Soil Retaining Walls Design Codes for Reinforced Soil Retaining Walls	3					3
		Analyze the Reinforced Soil Retaining Walls – simple geometry Design of reinforced soil retaining walls	3			1		3
		Analyze the Stability analysis of reinforced soil slopes.	3				2	3
		Apply and Analyze application of geosynthetics.	3					3
		Analyze the various geosynthetics characteristics by using laboratory testing.	2	2	2			3
20CE5267	Design of Earth & Earth Retaining Structures	Analyze Earth pressure theories for different field conditions.	2	2	2			
		Designing the earth retaining structures at different conditions.	2	2	2			1
		Designing the sheet piles and cofferdam.	2	2	2			
		Analyze and design the stability of slopes .	2	2	2			

		Analyze the various earth retaining characteristics by conducting filed/lab/ software tools or spread sheets.	3			3	3	
20CE5268	Advanced Foundation Engineering	Select different types of foundations based on site conditions.	2	2	2	2		
		Analyze the foundation in swelling soils	2	2	2	2		
		Analyze the spread footings and factors affecting it.	2	2	2	2	1	
		Analyze the rectangular, trapezoidal, and strap footings	2	2	2	2		
		Analyze Mat foundations and machine foundations			3	3		
20CE51M1	Soil structure interaction	Analyze the basic soil models.	2	2	2			
		Analyzing beam and winkler foundations	2	2	2			
		Estimate shear Beams on Elastic continuum	2	2	2			
		Analyzing path Pile on Winkler foundation.	2	2	2			
20CE51M2	Finite Element Methods	Derive stress deformation relationships for 1-D,2-D and 3-D Problems for use in FEM	2	2	2		2	
		Derive element stiffness matrices of elements by various approaches	2	2	2			
		Formulate stiffness matrices for two dimensional and axisymmetric problems	2	2	2			
		Derive FEM formulations for Settlement Analysis ,Seepage Analysis and Consolidation Analysis	2	2	2			
		Understand about the stability of slopes	2	2	2			

20CE51N1	Stability Analysis of Slopes	Analyzing the different types of soil and slopes conditions.	2	2	2			
		Analyzing the stability of slopes by using the contaminated soil filling.	2	2	2			3
		Analyzing the slopes using different geo synthetics materials by filling soil.	2	2	2			
20CE51N2	Design of Highways and Airfield pavements	Understand different types of pavements	2	2	2			
		Design flexible pavements as per codal provisions	2	2	2			
		Design rigid pavements as per codal provisions	2	2	2			
		Design joints, pavement overlay and analyze pavement condition in all weather conditions	2	2	2			
20CE52O1	Solid Waste Management and Landfills	Understand the types, classification and properties of solid waste and options available for disposal and classification and disposal of Hazardous waste	2	2	2			
		Understand engineered systems for solid waste management and conversion and recovery of materials and energy, Applying Modeling Technique using to solid waste Management	2	2	2			
		Understand Familiarize with landfills , site selection design and operation, collection of gas and lechate , treatment of lechate and CPCB and MOEF guidelines. Applying the design criteria to construction of landfills	2	2	2			
		Understand Familiarize with clay and geo synthetic lining systems types and function	2	2	2			
20CE52O2	Offshore	Analyze index and engineering properties of marine clays.	2	2	2	2		

	Geotechnical engineering	Adopt suitable investigation method and sampling techniques for these marine deposits	2	2	2			
		Analyze loads on offshore structures and select appropriate foundation for these structures.	2	2	2	2		
		Implement required ground improvement technique for these structures	2	2	2			2
20CE51P1	RS & GIS Applications in Civil Engineering	Understanding and Applying the Basics of Remote Sensing	2	2	2			
		Understanding and analysing the Basic elements of image interpretation	2	2	2			
		Understanding and analysing about the GIS	2	2	2			
		Understanding and analysing about Land use /Land cover studies	2	2	2		1	
20CE52P2	Constitutive Modeling in Geo-techniques	Analysing the soil fundamental and modelling.	2	2	2			
		Determining the soil plasticity characteristics	2	2	2			
		Analyzing the soil Elastic and plastic characterizes	2	2	2			3
		Analyzing the clay model: critical state line, shear strength, stress-dilatancy, index properties, and prediction of conventional soil tests. Applications	2	2	2			
20 IE 5148	Seminar						2	2
20 IE 5250	Term Paper						2	2
20 IE 6050	Dissertation						2	2

ADVANCED SOIL MECHANICS

Course Code: 20CE5161 **L-T-P-S-S: 3-0-2-0**

Prerequisites: - Nil **Credits: 4**

Mapping of Course Outcome with POs:

CO	Description	PO	BTL
CO 1	Calculate settlement of soils using one dimensional and three-dimensional consolidation theories.	PO3	3
CO 2	Estimates shear strength of saturated and partially saturated soils.	PO3, PO4	3
CO 3	Develop stress path diagrams for different load conditions.	PO3	3
CO 4	Analyze soil properties by conducting various laboratory/ field tests.	PO3	3
CO 5	Analyze soil properties by conducting various laboratory/ field tests.	PO5	3

SYLLABUS:

Origin, nature, and distribution of soils. Description of individual particle, Clay mineralogy, clay-water-electrolytes. Soil fabric and structure.

Effective stress principle: Steady state flow in soils. Effect of flow on effective stress. Determination of coefficient of permeability. Consolidation. one, two, three and redial consolidation. Various consolidation tests and determination of parameters. Stress-path.

Triaxial and direct shear tests. Shear behaviour of soils under static and dynamic loads. Factors affecting shear behaviour. Determination of parameters. Shear behavior of fine-grained soils. Pore pressure parameters. UU, CU, CD tests. Total and effective stress-strength parameters. Total and effective stress-paths.

Water content contours.

Factors affecting strength: stress history, rate of testing, structure, and temperature. Anisotropy of strength, thixotropy, creep. Determination of in-situ undrained strength. Stress-strain characteristics of soils. Determination modulus values. Critical state model, Engineering Behaviour of soils of India: Black cotton soils, alluvial silts and sands, laterites, collapsible and sensitive soil.

TEXTBOOKS

1. Clay Minerology by R. E. Grim.
2. Critical State Soil Mechanics by Atkinson and Bransby.
3. Soil Mechanics by T. W. Lambe and R. V. Whitman

REFERENCE BOOKS

1. Clay colloid Chemistry by H. Van Olphen.
2. Advanced Soil mechanics by Braja M. Das.
3. Soil behaviour and Critical State Soil Mechanics by D.M Wood

Experiments : (Include laboratory/field/Demonstration/Design activities):

1. Index and Engineering Properties Of soils
2. Determination of Swell Parameters – Differential Free Swell, Swell Pressure Tests.
3. Determination of Shear Parameters – Tri-axial Test, Direct Shear Test, Vane Shear test, Unconfined Compression Test.
4. Determination of Relative Density of granular soils.

SUB-SURFACE INVESTIGATIONS

Course Code: 20CE5162 **L-T-P-S: 3-0-2-0**
Prerequisites: - NIL **Credits: 4**

Mapping of Course Outcome with POs:

CO	Description	PO	BTL
CO 1	Analyze effective stress for different field conditions.	PO1, PO2, PO3	2
CO 2	Calculate settlement of soils using one dimensional and three dimensional consolidation theories.	PO1, PO2, PO3	2
CO 3	Estimate shear strength of saturated and partially saturated soils.	PO1, PO2, PO3	3
CO 4	Develop stress path diagrams for different load conditions.	PO1, PO2, PO3	3
CO 5	Analyze the various sub-surface investigations by conducting various field or laboratory tests.	PO1, PO2, PO3, PO4	3

Syllabus: (Include Laboratory/Field/Demonstration/Design activities)
Introduction: Necessity and Importance of soil exploration, Method of sub surface exploration Test pits, Trenches, Caissons, Tunnels, and drifts, wash boring, Percussion drilling , Rotary drilling, Factors affecting the selection of a suitable method of boring. Extent of boring, Factors controlling spacing and depth of bore holes, Spacing and depth of various Civil engineering structures.

Indirect method of exploration, Seismic method, Electrical resistivity, Resistivity sounding and profiling, Qualitative and quantitative interpretation of test results, Comparison of resistivity and seismic surveys, Shortcomings. Stabilization of bore holes, Different method of stabilization of the bore holes, their relative merits, and demerits. Ground water Observation: Different method of ground water observation: Time lag in observation, sampling of ground water.

Sampling: Source of disturbance and their influence. Type of sampler, Principle of design of sampler, Representative and undisturbed sampling in various types of soils. Surface sampling, Amount of sampling, Boring and sampling record, Preservation, and shipment of sample preparation of bore log.
Penetration tests, Standard penetration tests, Dynamic cone penetration tests with and without bentonite slurry, Static cone penetration tests, factor affecting the penetration tests. Various corrections in the test results. Interpretation of test result for design and determination of modulus of deformation. Small size penetrometers. Correlation among various test results.

TEXTBOOKS:

1. M. Hvorsler, Subsurface exploration and sampling of soil for Civil Engg. Purpose.
2. B. M Das, Principles of Foundation Engineering, Thomson Brooks/Cole
3. N.P. Kurian, Design of Foundation Systems : Principles & Practices, Narosa, New Delhi 1992

REFERENCE BOOKS:

1. G.Ranjan and A S R Rao, Basic and Applied Soil Mechanics, New Age international Publishers.
2. H. F. Winterkorn and H Y Fang, Foundation Engineering Handbook, Galgotia Book source
3. Simon and Cayton, Site Investigation.

GEO ENVIRONMENTAL ENGINEERING

Course Code: 20CE5163 **L-T-P-S: 3-0-2-0**
Prerequisites: - NIL **Credits: 4**

Mapping of Course Outcome with POs

CO	Description	PO	BTL
CO 1	Consider possible susceptibility of soil properties to environmental effects.	PO1, PO2	4
CO 2	Identify contaminant transport mechanisms in soils	PO1, PO2	4
CO 3	Estimate environmental influences on engineering properties of soil to be used in design.	PO1, PO2, PO4, PO5	4
CO 4	Apply environmental changes to soil stabilization and landfill engineering	PO1, PO2, PO3, PO4	4
CO 5	Analyze Geoenvironmental engineering characteristics by conducting various laboratory tests.	PO5	3

SYLLABUS:
Syllabus: (Include Laboratory/Field/Demonstration/Design activities)

Soil as a multiphase system: Soil-environment interaction; Properties of water in relation to the porous media; Water cycle with special reference to soil medium.

Soil mineralogy: significance of mineralogy in determining soil behaviour; Mineralogical characterization.

Mechanisms of soil-water interaction: Diffuse double layer models; Force of attraction and repulsion; Soil-water-contaminant interaction; Theories of ion exchange; Influence of organic and inorganic chemical interaction.

Concepts of waste containment: Sources, production and classification of wastes, Environmental laws and regulations, physio-chemical properties of soil, ground water flow and contaminant transport, desirable properties of soil; contaminant transport and retention; contaminated site remediation.

Soil characterization techniques: volumetric water content; gas permeation in soil; electrical and thermal properties; pore-size distribution; contaminant analysis. contaminated site characterization, estimation of landfill quantities, landfill site location, design of various landfill components such as liners, covers, leachate collection and removal, gas generation and management, ground water monitoring, end uses of landfill sites, slurry walls and barrier systems, design and construction, stability, compatibility and performance, remediation technologies, stabilization of contaminated soils and risk assessment approaches.

TEXTBOOKS:

1. Mitchell J.K and Soga K., Fundamentals of Soil Behavior, John Wiley and Sons Inc.
2. Fang H-Y., Introduction to Environmental Geotechnology, CRC Press
3. Daniel D.E, Geotechnical Practice for Waste Disposal, Chapman and Hall
4. Rowe R.K., Quigley R.M. and Booker J.R., Clayey Barrier Systems for Waste Disposal Facilities, CRC Press.

REFERENCE BOOKS:

1. Rowe R.K, Geotechnical and Geoenvironmental Engineering Handbook, Kluwer Academic Publishers
2. Reddi L.N. and Inyang H.F, Geoenvironmental Engineering - Principles and Applications, Marcel Dekker Inc.
3. Sharma H.D. and Lewis S.P, Waste Containment Systems, Waste Stabilization and Landfills: Design and Evaluation, John Wiley & Sons Inc.

GROUND IMPROVEMENT TECHNIQUES

Course Code: 20CE5164 **L-T-P-S : 3-0-2-0**
Prerequisites: - NIL **Credits: 4**

Mapping of Course Outcome with POs

CO	Description	PO	BTL
CO 1	Identify difficult ground conditions in engineering practice.	PO1, PO2, PO3	4
CO 2	Identify different ground improvement techniques.	PO1, PO2, PO3, PO5	4
CO 3	Select Site specific method of improvement and its design	PO1, PO2, PO3, PO4	4
CO 4	Promote wider use of techno – economical construction techniques such as Reinforced soil structures, Gabion walls, Crib walls and fabric form work.	PO1, PO2, PO3, PO4	4
CO 5	Analyze different ground improvement techniques by conducting various laboratory/ field tests or software tools	PO5, PO6	3

SYLLABUS:

Compaction: Theory of compaction, Shallow Surface Compaction - Equipment, Placement water content, factors affecting shallow compaction;

Deep compaction: Methods - Vibroflotation, Terra probe method, Pounding, Blasting, Compaction piles; Compaction Control.

Stabilization: Introduction, objectives, Methods of stabilization – Mechanical, Cement, Lime, Bituminous, Calcium chloride; construction methods, factors affecting stabilization of soils; Deep Mixing methods – Soil lime Columns and Cement Lime Columns, applications

Soil Replacement techniques: Stone columns - Rammed, vibratory Dewatering: Definition, necessity, Methods of dewatering – Interceptor ditch, Single, Multistage and Vacuum well points, Horizontal wells, Electro-osmosis. Permanent drainage by Foundation drains and Blanket drains.

Grouting: Definition, Objectives of grouting, Grouts and their properties, Categories of Grouting

Grouting methods: Ascending, Descending and Stage Grouting in Soils, Hydro fracture, Grouting Equipment

TEXTBOOKS

1. Engineering Principles of Ground Modification by Monfred R Hausmann, Mc Graw Hill Publishing Co.
2. Venkatappa Rao, G. and Ramana G.V.(2000) State of the Art : Lime soil stabilization , IRC, Spl Publication No. 1, Indian Road Congress, New Delhi
3. Jones, C.J.F.P.Earth Reinforcement and Soil structures 2. Koerner, R.M. (2005) Designing with Geotextiles 3. P. Purushotham Raj, ground Improvement Techniques, Lakshmi Publications (P) Ltd. 4. NPTEL Lecture Notes and Online Lectures
4. P. Purushothama Raj, Ground Improvement Techniques, Tata McGraw-Hill, New Delhi, 1995.
5. Dr. B.C.Chattopadhyay and J.Maity, Ground Control and Improvement Techniques, PEEDOT, Howrah, 2011.

REFERENCE BOOKS

1. Engineering Principles of Ground Modification by Monfred R Hausmann, Mc Graw Hill Publishing Co.

Soil Dynamics and Geotechnical Earthquake Engineering

Course Code: 20CE5265 **L-T-P-S : 3-0-2-0**

Prerequisites: - NIL Credits: 3

Mapping of Course Outcomes with POs:

CO	Description	PO	BTL
CO 1	Understand the principles of soil dynamics, wave propagation and apply the base isolation techniques to design foundations	PO1, PO2	3
CO 2	Understand the fundamentals of earthquake engineering, ground motion, evaluate the ground motion parameters and generate the artificial ground motion for any specific site	PO1, PO2, PO5	3
CO 3	Understand the principles of seismic hazard principles and various methods of measuring the dynamic soil properties	PO1, PO2, PO4	2
CO 4	Analyze the ground response analyses and evaluate the liquefaction potential for a given site	PO1, PO2, PO3, PO4, PO5	4
CO 5	Generate the site-specific strong ground motion and perform the site specific ground response analysis and evaluate the liquefaction potential for a give site.	PO1, PO2, PO5, PO6	4

Syllabus:

Engineering problems involving soil dynamics; Role of inertia; Theory of Vibrations: Single and two-degree freedom systems, vibration measuring instruments, Vibration absorption and isolation techniques.

Wave propagation: elastic continuum medium and semi-infinite elastic continuum medium. Measurement of small strain and large strain dynamic soil properties: Field and Laboratory tests. Selection of design values.

Design criteria for machine foundations, elastic homogeneous half space solutions, lumped parameter solutions. Codal provisions; Design of Pile-supported machine foundations.

Strong Ground Motion: Measurement, characterization, and estimation; Amplification theory and ground response analysis. Liquefaction of soils: evaluation using simple methods and mitigation measures. Seismic slope stability analysis, Seismic bearing capacity and earth pressures. Codal provisions.

Liquefaction of Foundation soils: Definitions, mechanism of liquefaction, field conditions for soil liquefaction, Standard curves & correlations for liquefaction, Evaluation of zone of liquefaction in field, Evaluation of liquefaction potential using SPT, factors affecting liquefaction& anti liquefaction measures

TEXTBOOKS:

1. Soil Dynamics & Machine Foundations by Shamsher Prakash 2. Soil Dynamics & Machine Foundations by Swami Saran
2. Das B.M., “Fundamentals of Soil Dynamics”, Elsevier (1983).
3. Geotechnical Earthquake Engineering by Kramer, S.L Pearson Education, New Delhi.
   2. Soil Dynamics & Machine Foundation by S Saran, Galgotia Pub. Pvt. Ltd. New Delhi.
4. S. Saran, Soil Dynamics and Machine Foundations, Galgotia Publications Private Ltd.1999

REFERENCE BOOKS:

1. Foundation for Bases & Machines by D. Barkan 2. Machine Foundations by A. Major
2. Geotechnical Earthquake Engineering Handbook by W Day Robert, McGraw-Hill, New York.

Geo Synthetics and Design of Retaining Walls

Course Code: 20CE5266 **L-T-P-S: 3-0-2-0**

Prerequisites: - NIL Credits: 3

Mapping of Course Outcomes with POs:

CO	Description	PO	BTL
CO 1	Analyze the Geosynthetics and Different Types of Soil Retaining Structures Construction Aspects of Geosynthetic Reinforced Soil Retaining Walls Design Codes for Reinforced Soil Retaining Walls	PO1, PO2, PO3, PO4	4
CO 2	Analyze the Reinforced Soil Retaining Walls – simple geometry Design of reinforced soil retaining walls	PO1, PO2, PO3	4
CO 3	Analyze the Stability analysis of reinforced soil slopes.	PO1, PO2, PO3, PO6	4
CO 4	Apply and Analyze application of geosynthetics.	PO1, PO2, PO3, PO4	4
CO 5	Analyze the various geosynthetics characteristics by using laboratory testing.	PO1, PO2, PO3, PO5	4

Syllabus:

Introduction to Geosynthetics: Types of geosynthetics and their applications Manufacture of Geosynthetics, Strength of reinforced soils Testing of Geosynthetics, Different Types of Soil Retaining Structures Construction Aspects of Geosynthetic Reinforced Soil

Retaining Walls Design Codes for Reinforced Soil Retaining Walls, External Stability Analysis of Reinforced Soil Retaining Walls Seismic Loads and Internal Stability Analysis of Reinforced Soil Walls Testing Requirements for Reinforced Soil Retaining Walls. Design of Reinforced Soil Retaining Walls – simple geometry

Design of reinforced soil retaining walls – sloped backfill soil Design of reinforced soil retaining walls supporting a bridge abutment Stability analysis of soil slopes – infinite and finite slopes Stability analysis of reinforced soil slopes resting on soft foundation soils Stability analysis of reinforced soil slopes resting on strong foundation soil.

Stability analysis of reinforced soil slopes – bilinear wedge analysis Design of Embankments supported on Load Transfer Platforms, Reinforced soil for supporting shallow foundations, Accelerated consolidation of soft clays using geosynthetics Geosynthetic encased stone columns for load support. Drainage application of geosynthetics

Filtration Applications of Geosynthetics: Erosion control using geosynthetics Natural geosynthetics and their applications, Geosynthetics for construction of municipal and hazardous waste landfills.

Textbooks:

J.L.Sherard, R.J.Woodward, S.F.Gizienski, and W.A. Clevenger, Earth, and Earth –Rock Dams Engineering Problems of Design and Construction, John Wiley and Sons, New York, 1963.

Reference Books:

1. C. Justin and Hinds, Engineering for Dams Vol. 2 & 3.4.
2. S. Leliavsky, ‘Design of Dams for Percolation and Erosion’, Chapman and Hall.

DESIGN OF EARTH & EARTH RETAINING STRUCTURES

Course Code: 20CE5267 **L-T-P-S : 3-0-2**

Prerequisites: - NIL **Credits: 4**

Mapping of Course Outcomes with POs:

CO	Description	PO	BTL
CO 1	Analyze Earth pressure theories for different field conditions.	PO1, PO2, PO3, PO4	4
CO 2	Designing the earth retaining structures at different conditions.	PO1, PO2, PO3, PO5	4
CO 3	Designing the sheet piles and cofferdam.	PO1, PO2, PO3, PO4	4
CO 4	Analyze and design the stability of slopes .	PO1, PO2, PO3, PO6	4
CO 5	Analyze the various earth retaining characteristics by conducting filed/lab/ software tools or spread sheets.	PO1, PO2, PO3, PO5	4

Syllabus:

Earth pressure, introduction, earth pressure as a stability problem, concept of strain dependence of developed stresses, active, at rest and passive conditions, plastic equilibrium, various theories related with E.P. Distillation, Rankine, Coulomb and Hansen theoretical derivation and graphical construction with different geometric and boundary conditions.

Retaining wall - types, material, method of construction, nature of forces acting. Comparison of different earth pressure theories and application in retaining wall. Stability analysis and design aspects, application of theory of elasticity in analysis of earth pressure distribution.

Sheet pile and cofferdam. Type, material, method of construction, distribution of earth pressure and related approximation. Distinction between Sheet Pile and Retaining wall, analysis, and design.

Earth - structure - Definition, Features of an earth dam, stability analysis of slope, total - vs. - effective stress analysis, limit equilibrium method of slices based on circular failure surfaces, introduction to analysis based on general failure surfaces, introduction to analysis based on general failure surfaces. Stability of earth dams during different stages – during and at end of construction, steady seepage, sudden draw down, estimation of pore water pressure - use of stability charts.

TEXTBOOKS:

1. J.L. Sherard, R.J. Woodward, S.F. Gizienski, and W.A. Clevenger, Earth, and Earth – Rock Dams Engineering Problems of Design and Construction, John Wiley and Sons, New York, 1963.
2. R F Craig, Soil Mechanics, Chapman, and Hall(ELBS)
3. Slope Stability by R.N Chowdhury

REFERENCE BOOKS:

1. C. Justin and Hinds, Engineering for Dams Vol. 2 & 3.4. S. Leliavsky, 'Design of Dams for Percolation and Erosion', Chapman and Hall.
2. Soil Mechanics by T. William Lambe and Robert V. Whitman

ADVANCED FOUNDATION ENGINEERING

Course Code: 20CE5268 **L-T-P-S: 3-0-2-0**

Prerequisites: - NIL **Credits: 4**

Mapping of Course Outcomes with POs:

CO	Description	PO	BTL
CO 1	Analyze the foundation in swelling soils	PO1, PO3, PO4	4
CO 2	Analyze the spread footings and factors affecting it.	PO1, PO3, PO4	3
CO 3	Analyze the rectangular, trapezoidal, and strap footings	PO1, PO3, PO4	4
CO 4	Analyze Mat foundations and machine foundations	PO1, PO3, PO4	4
CO 5	Determination of Soil properties by using laboratory experiments	PO1, PO3, PO4	3

SYLLABUS:

Foundation on collapsible and expansive soils: Collapse potential and settlement, Computation of collapse settlement, Treatment methods for collapsible soils, General characteristics of swelling soils, Clay mineralogy and mechanism of swelling, Evaluation of the swelling potential of expansive soils by single Index Method, Classification of swelling soils by Indirect Measurement, Swelling pressure by direct measurement, Design of foundation in swelling soils, drilled pier foundations Factors to consider in foundation design: Footing Depth and spacing, Displaced soil effects, Net versus gross soil pressure design soil pressures, erosion problems for structures adjacent to flowing water, Corrosion protection, Water table fluctuation, Foundations in Sand deposits, Foundations on Loess and other collapsible soils, Frost depth and foundations on permafrost, Environmental considerations problems.

Spread footing design: Footing Classification and purpose, Allowable soil pressures in spread footing design, Assumptions used in footing design, reinforced concrete design – USD, Rectangular footings, eccentrically loaded spread footings.

Spread footing and beams on elastic foundations: Rectangular combined footings, design of trapezoid shaped footings, design of strap (or cantilever) footings, footings for industrial equipment, Modulus of sub grade reaction, Classical solution of Beam on Elastic foundation.

Mat foundations: Types of Mat foundations, Bearing capacity of Mat foundations, Mat settlements, Modulus of subgrade reaction for mats, Design of Mat foundation, Finite difference Method for Mats, Finite element method for Mat foundations, The finite grid method, Mat superstructure interaction, Circular mats or plates.

Machine foundations: Design criteria for satisfactory action of a machine foundation, Theory of linear weightless spring, Methods of analysis of a block foundation, Soil spring constants, Determination of soil spring constants, Degrees of freedom of block foundation, vertical vibrations of a block foundations, Rocking vibrations of a block foundations

TEXTBOOKS

1. Foundation Analysis & Design, J.E. Bowles, McGraw Hill Education India Private Limited, New Delhi
2. Geotechnical Engineering" by C. Venkatramaiah, New Age International Limited, New
   Delhi.
3. B. M Das, Principles of Foundation Engineering, Thomson Brooks/Cole
4. Geotechnical Engineering by Debashis Moitra, Universities Press, Hyderabad.

REFERENCE BOOKS

1. Basic and applied soil mechanics by Gopal Ranjan and ASR Rao, Wiley Eastern Limited.
2. Theory & Practice of Foundation Design. By N.N. Som, S.C. Das, PHI Learning Private Limited, Delhi.

Experiments:

(Include Laboratory/Field/Demonstration/Design activities):

- Determination of bearing capacity of shallow foundations by using spreadsheets.
- Design of Raft foundation.
- Determination of various settlements.
- Standard penetration test
- Plate load test
- Cyclic Plate load test

SOIL STRUCTURE INTERACTION

Course Code: 20CE51M1 **L-T-P-S: 3-0-0-0**

Prerequisites: - NIL **Credits: 3**

Mapping of Course Outcomes with POs:

CO	Description	PO	BTL
CO 1	Analyze the basic soil models.	PO1, PO3	4
CO 2	Analyzing beam and winkler foundations	PO1, PO3	4
CO 3	Estimate shear Beams on Elastic continuum	PO1, PO3	3
CO 4	Analyzing path Pile on Winkler foundation.	PO1, PO3	4

Syllabus:

Basic Soil Models: Single parameter model - Winkler; Two parameter models - Bilonenko- Borodick, Pasternak; Elastic Continuum - plane strain, plane stress, Boussinesq's problem, line load strip load; Special models starting with elastic continuum - Vlazov, Reissner; Three parameter model - Kerr model; Evaluation of model parameters for different conditions.

Beam on Winkler foundation: solutions for infinite and semi-infinite beams; Finite beams: method of initial parameters, method of superposition.

Beams on Elastic continuum: Use of finite difference method, rigid and flexible beams, lift-off, nonhomogeneous soil, non-linear soil, plastic yielding of soil. Raft of Mat foundations: thin rectangular plates, approximate theory of plates, circular plates.

Pile on Winkler foundation: Vertically loaded pile - rigid pile, evaluation of spring stiffness, non-homogeneous soil, compressible pile; Laterally loaded pile - rigid pile, Elastic pile, standard solutions for different end conditions; Pile on elastic continuum - vertically loaded piles - rigid pile.

TEXTBOOKS:

1. Tsudik, E. (2012). Analysis of Structures on Elastic Foundations. J. Ross Publishing
2. Wolf, J. P. (1985). Dynamic soil-structure interaction. Prentice Hall int.
3. Wolf, J. P., & Song, C. (1996). Finite-element modelling of unbounded media. Chichester: Wiley.

REFERENCE BOOKS:

1. Kramer, S. L. (1996). Geotechnical earthquake engineering (Vol. 80). Upper Saddle River, NJ: Prentice Hall.
2. Kellezi, L. (1998). Dynamic Soil-Structure-Interaction
3. Jones, G. (1997). Analysis of beams on elastic foundations: using finite difference theory. Thomas Telford.

FINITE ELEMENT METHODS

Course Code: 20CE51M2 **L-T-P-S : 3-0-0-0**

Prerequisites: - NIL **Credits: 3**

Mapping of Course Outcomes with POs:

CO	Description	PO	BTL
CO 1	Derive stress deformation relationships for 1-D,2-D and 3-D Problems for use in FEM	PO5	3
CO 2	Derive element stiffness matrices of elements by various approaches	PO1, PO5	3
CO 3	Formulate stiffness matrices for two dimensional and axisymmetric problems	PO1, PO5	3
CO 4	Derive FEM formulations for Settlement Analysis ,Seepage Analysis and Consolidation Analysis	PO1, PO5	3

Syllabus:

Stress-deformation analysis: One dimensional, two dimensional and three-dimensional formulations.

Discretization of a Continuum, Elements, Strains, Stresses, Constitutive, Relations, Hooke's Law, Formulation of Stiffness Matrix, Boundary Conditions, Solution Algorithms.

Principles of discretization, element stiffness and mass formulation based on direct, variational, and weighted residual techniques and displacements approach, Shape functions and numerical integrations, convergence.

Displacement formulation for rectangular, triangular, and iso-parametric elements for two dimensional and axisymmetric stress analysis.

Settlement Analysis: 2-D elastic solutions for homogeneous, isotropic medium, Steady Seepage Analysis: Finite element solutions of Laplace's equation, Consolidation Analysis: Terzaghi consolidation problem, Choice of Soil Properties for Finite Element Analysis.

TEXTBOOKS:

1. Zienkiewicz O.C. and Taylor R.L., Finite element methods (Vol I & Vol II), McGraw Hill
2. Bathe K.J., Finite element procedures, PHI Ltd.

REFERENCE BOOKS

1. David M Potts. And Lidija, Zdravkovic, Finite Element Analysis in Geotechnical Engineering, Vol 1 & 2.Thomas Telford, London.
2. J.N.Reddy, Elementary Finite Element Method, Tata Mc Graw Hill, New Delhi.

(DEEMED TO BE UNIVERSITY)

STABILITY ANALYSIS OF SLOPES

Course Code: 20CE51N1 **L-T-P-S : 3-0-0-0**

Prerequisites: - NIL **Credits: 3**

Mapping of Course Outcomes with POs:

CO	Description	PO	BTL
CO 1	Understand about the stability of slopes	PO1, PO3, PO5	2
CO 2	Analyzing the different types of soil and slopes conditions.	PO1, PO3, PO5	4
CO 3	Analyzing the stability of slopes by using the contaminated soil filling.	PO1, PO3, PO5	4
CO 4	Analyzing the slopes using different geo synthetics materials by filling soil.	PO1, PO3, PO5	4

Syllabus:

Introduction Stability of Slopes, Aims of Slope Analysis, Natural Slopes and their stability, Slopes, Geomorphology and Slopes, Types of Slope movement and Landslides.

Methods of Analysis :- Fellinius method, Bishop's method and Morgestern- Price methods, approach, Statistical and Probabilistic analysis Seepage force, hydrostatic force, , Seismic and Blast vibration effect on slope. Embankment and Earth -rock dams Behaviour of rock slope in presence of structural discontinuities, We fragmented rock, Rock Mass rating. Case studies of Slope failure.

Geo-engineering Parameters influencing Stability of Internal dump, External dump and rock high wall. Stability Analysis of Internal Dump, External Dump and Rock High wall.

Slope Protection Geo-textiles and Geo-membranes, Geo-grids, Coffer dams Braced coffer dams - walls and supports, bottom heave and piping, Cellular Sheet Piles:- Cantilever sheet pile walls, Bulkhead anchor Failures in Anchored Bulkheads

TEXT BOOKS

1. Rock Slope Engineering by E. Hoek and Bray
2. Slope Stability by R.N Chowdhury
3. Soil Mechanics by T. William Lambe and Robert V. Whitman

REFERENCE BOOKS

1. A handbook on Dragline Dump profiles in Surface Coal mines of India by I Roy & S. Sengupta

(DEEMED TO BE UNIVERSITY)

DESIGN OF HIGHYWAYS & AIRFILED PAVEMENTS

Course Code: 20CE51N2 **L-T-P-S : 3-0-0-0**

Prerequisites: - NIL **Credits: 3**

Mapping of Course Outcomes with POs:

CO	Description	PO	BTL
CO 1	Understand different types of pavements	PO4	2
CO 2	Design flexible pavements as per codal provisions	PO5	3
CO 3	Design rigid pavements as per codal provisions	PO2	3
CO 4	Design joints, pavement overlay and analyze pavement condition in all weather conditions	PO1	2

Syllabus:

Pavement Types: Stress distribution in pavements, Theoretical subgrade conditions and traffic loadings, Basic difference between flexible and rigid pavements, design factors, wheel load, equivalent single wheel load , repetition of loads, elastic modulii, climatic variations, differences between highway and airfield pavements.

Design of flexible pavements: Group index method, CBR method, IRC 37-2002 recommendations, Mc Load method, Burmister's layer theory, FAA method of design.

Design of rigid pavements: Radius of relative stiffness, critical load positions, Westergaard's stress equation, Bradley's stress coefficients, design charts. Temperature stresses in concrete pavements: Westergaard's concept, wrapping stress, frictional stress, combination of stresses.

Design of joints in concrete pavements: Expansion joints, construction joints, design of dowel bars, tie bars, IRC 58-2002 recommendation.

Evaluation of pavement condition: pavement instrumentation, types of pavement distress, roughness and skid resistance, Environmental influence and effects, pavement maintenance and overlays.

Textbooks:

1. Pavement Analysis and Design by Yang H Huang, Pearson Prentice Hall, 2004 Principles of Pavement Design, by H.J. Yoder, John wiley and sons

Reference Books:

1. Khanna O.P, Justo C.G., Highway Engineering, Nem Chand Publisher 2. IRC codes of practice for design of Flexible and rigid pavements

(DEEMED TO BE UNIVERSITY)

SOLID WASTE MANAGEMENT & LANDFILLS

Course Code: 20CE52O1 **L-T-P-S : 3-0-0-0**

Prerequisites: - NIL **Credits: 3**

Mapping of Course Outcomes with POs:

CO	Description	PO	BTL
CO 1	Understand the types, classification and properties of solid waste and options available for disposal and classification and disposal of Hazardous waste	PO1, PO6	2
CO 2	Understand engineered systems for solid waste management and conversion and recovery of materials and energy, Applying Modeling Technique using to solid waste Management	PO1, PO6	3
CO 3	Understand Familiarize with landfills , site selection design and operation, collection of gas and lechate , treatment of lechate and CPCB and MOEF guidelines. Applying the design criteria to construction of landfills	PO1, PO6	3
CO 4	Understand Familiarize with clay and geo synthetic lining systems types and function	PO1, PO6	2

Syllabus:

Municipal Solid Wastes: Types of solid wastes, Sources of Municipal and Hazardous wastes, Properties of solid wastes-Physical and Chemical composition.

Solid Waste Management: An Overview, Introduction Reduction, Reuse and Recovery, Waste Disposal Options, Current Scenario and Challenges

Engineered Systems For Solid Waste Management: Functional Elements, Solid waste generation, On-site handling, Storage and Processing, Collection of solid wastes, Transfer and Transport, Processing of Solid wastes, Ultimate disposal.

Conversion of Solid wastes and Recovery: Mechanical processing and Material recovery systems. Biological Conversion-Composting, Anaerobic Digestion. Thermal Conversion-Combustion, Incineration, Gasification, Pyrolysis, Refuse Derived Fuel, Energy recovery systems.

Landfills for Municipal Solid Wastes: Land Filling of Municipal Solid Wastes, Site selection, Planning, Design and Operation. Landfill Gas- composition, Collection. Lechate-environmental effects, Lechate collection systems, Treatment of lechate, MoEF rules, CPCB guidelines for hazardous waste land filling. Lechate Control By Clay Liners: Clay Liners-Types-Compacted clay liners and their design-Construction of clay liners.

Geosynthetic Lining Systems: Geosynthetics Types and Functions-Geosynthetic clay liners-Properties, Hydraulic conductivity, Installation.

Textbooks:

1. Howard S. Peavy, Donald R. Rowe and George Tchobanoglous (1985), Environmental Engineering, Mc Graw-Hill International Editions, NewYork.
2. Venkatappa Rao. G and Sasidhar. R.S.(2009), Solid waste management and Engineered Landfills, Sai Master Geoenvironmental Services Pvt.Ltd, Hyderabad

Reference Books:

1. P.Aarne Vesilind, Willium Worrell and Debra Reinhart,(2004), Solid waste Engineering Cengage Learning India Private Limited, New Delhi.
2. J.Glynn Henry, Gary W.Heinke,(2004) Environmental Science and Engineering,Low Price Edition, Pearson Education Inc, Singapore.
3. MoEF(2000) Municipal Waste Management and Handling Rules, Govt. of India.
4. CPCB(2001) Criteria for Hazardous waste Landfill(HASWAMS/17/2000-01)
5. M.N.Rao and Razia Sultana, Solid and hazardous waste management BS Publications, Hyderabad.

OFFSHORE GEOTECHNICAL ENGINEERING

Course Code: 20CE52O2 **L-T-P-S : 3-0-0-0**

Prerequisites: - NIL **Credits: 3**

Mapping of Course Outcomes with POs:

CO	Description	PO	BTL
CO 1	Analyze index and engineering properties of marine clays.	PO1, PO3	2
CO 2	Adopt suitable investigation method and sampling techniques for these marine deposits	PO1, PO3	2
CO 3	Analyze loads on offshore structures and select appropriate foundation for these structures.	PO1, PO3	4
CO 4	Implement required ground improvement technique for these structures	PO1, PO3	2

Syllabus:

Submarine soils: Origin, nature, and distribution. Terrigenic and pelagic soils. Submarine soils of India.

Engineering behaviour of submarine soils: under-consolidated soils, calcareous soils, cemented soils, corals.

Offshore site investigations: sampling and sampling disturbance, in-situ testing, wireline technology. Offshore pile foundations for jacket type structures. Foundations of gravity structures. Foundations for jack up rigs. Anchors and breakout forces; anchor systems for floating structures. Stability of submarine slopes. Installation and stability of submarine pipelines.

TEXTBOOKS:

1. Ben C. Gerick, “Construction of Marine and Offshore Structures”, CRC Press, 1999.
2. B. Gou, S. Song, J. Chacko, and A. Ghalambor, “Offshore Pipelines”, GPP Publishers, 2006.

REFERENCE BOOKS:

1. S. K. Chakrabarti, “Handbook of Offshore Engineering”, Elsevier, 2005.
2. M. J. Tomlinson, “Pile Design and Construction”, E and F Spon, 1994

(DEEMED TO BE UNIVERSITY)

RS & GIS APPLICATIONS IN CIVIL ENGINEERING

Course Code: 20CE52P1 **L-T-P-S : 3-0-0-0**

Prerequisites: - NIL **Credits: 3**

Mapping of Course Outcomes with POs:

CO	Description	PO	BTL
CO 1	Understanding and Applying the Basics of Remote Sensing	PO1, PO2, PO3	2
CO 2	Understanding and analysing the Basic elements of image interpretation	PO1, PO2, PO3	2
CO 3	Understanding and analysing about the GIS	PO1, PO2, PO3	2
CO 4	Understanding and analysing about Land use /Land cover studies	PO1, PO2, PO3	2

Syllabus:

Definitions and introduction to remote sensing, components of remote sensing system. Spectral windows and spectral signatures and their significance in remote sensing. Radiometric quantities used in the collection of spectral signatures. Remote sensing satellite orbits, image acquisition process, repeativity, row/path and ground swath and coverage. Various remote sensing platforms.

Passive and active remote sensors: Radar, Lidar, and SAR. Spectral and spatial resolution of various remote sensors with special relevance to Indian Remote Sensing satellites. Different types of remotely sensed data products.

Characteristics of photographic images, colour, tone and texture, photo-interpretation keys, techniques of photointerpretation. Digital image classification techniques and extraction of thematic information.

Global Positioning System (GPS): Introduction & components of GPS, Space segment, control segment and user segment, Elements of Satellite based surveys –Map datums, GPS receivers, GPS observation methods and their advantages over conventional methods.

Geographic Information System (GIS) – Definition of GIS, Geographical concepts and terminology, Components of GIS, Data acquisition, Raster and vector formats, scanners, and digitizers. Advantages of GPS and GIS in the storage thematic information extracted from remotely sensed images.

Role of remote sensing and GIS in terrain investigation and advantages over conventional mapping techniques. Extraction of topographic information from remotely sensed data and generation of digital terrain model from stereo pairs of images. Resource mapping for engineering project: selection of sites for construction materials, water resources, soil, buildings, railways, and highways etc. using remotely sensed data.

Geological mapping for the geotechnical investigation of soil strata. Monitoring of areas prone to landslides using remote sensing, digital model and GIS. Application of visible, infra-red and microwave remote sensing for the identification of soil types, grain size and moisture studies.

TEXTBOOKS

1. Lillesand T.M. and Kiefer R. W., *Remote Sensing and image interpretation,* John Wiley and Sons. New York.
2. J. B. Campbell, *Introduction to remote sensing* , Taylor & Francis, London.

REFERENCE BOOKS

1. J. R.Jensen, *Introductory Digital Image Processing*, Prentice Hall International Ltd., London.
2. Kennie, T. J. M. and Matthews M. C., *Remote Sensing in Civil Engineering*, Surrey University Press, Glasgow

(DEEMED TO BE UNIVERSITY)

CONSTITUTIVE MODELLING IN GEOTECHNICS

Course Code: 20CE52P2 **L-T-P-S : 3-0-0-0**

Prerequisites: - NIL **Credits: 3**

Mapping of Course Outcomes with POs:

CO	Description	PO	BTL
CO 1	Analysing the soil fundamental and modelling.	PO3, PO5	4
CO 2	Determining the soil plasticity characteristics	PO3, PO5	2
CO 3	Analyzing the soil Elastic and plastic characterizes	PO3, PO5	4
CO 4	Analyzing the clay model: critical state line, shear strength, stress-dilatancy, index properties, and prediction of conventional soil tests. Applications	PO3, PO5	4

Syllabus:

Introduction: fundamental relations, models, and soil mechanics. Elasticity: Isotropic, anisotropic, soil elasticity. Plasticity and yielding of clays, yielding of sands, slip line fields.

Introduction to upper and lower bounds, selected boundary value problems. Elastic-plastic model for soils: elastic volumetric strains, plastic volumetric strains, plastic hardening, plastic shear strains, plastic potentials, flow rule.

Cam clay model: critical state line, shear strength, stress-dilatancy, index properties, prediction of conventional soil tests. Applications

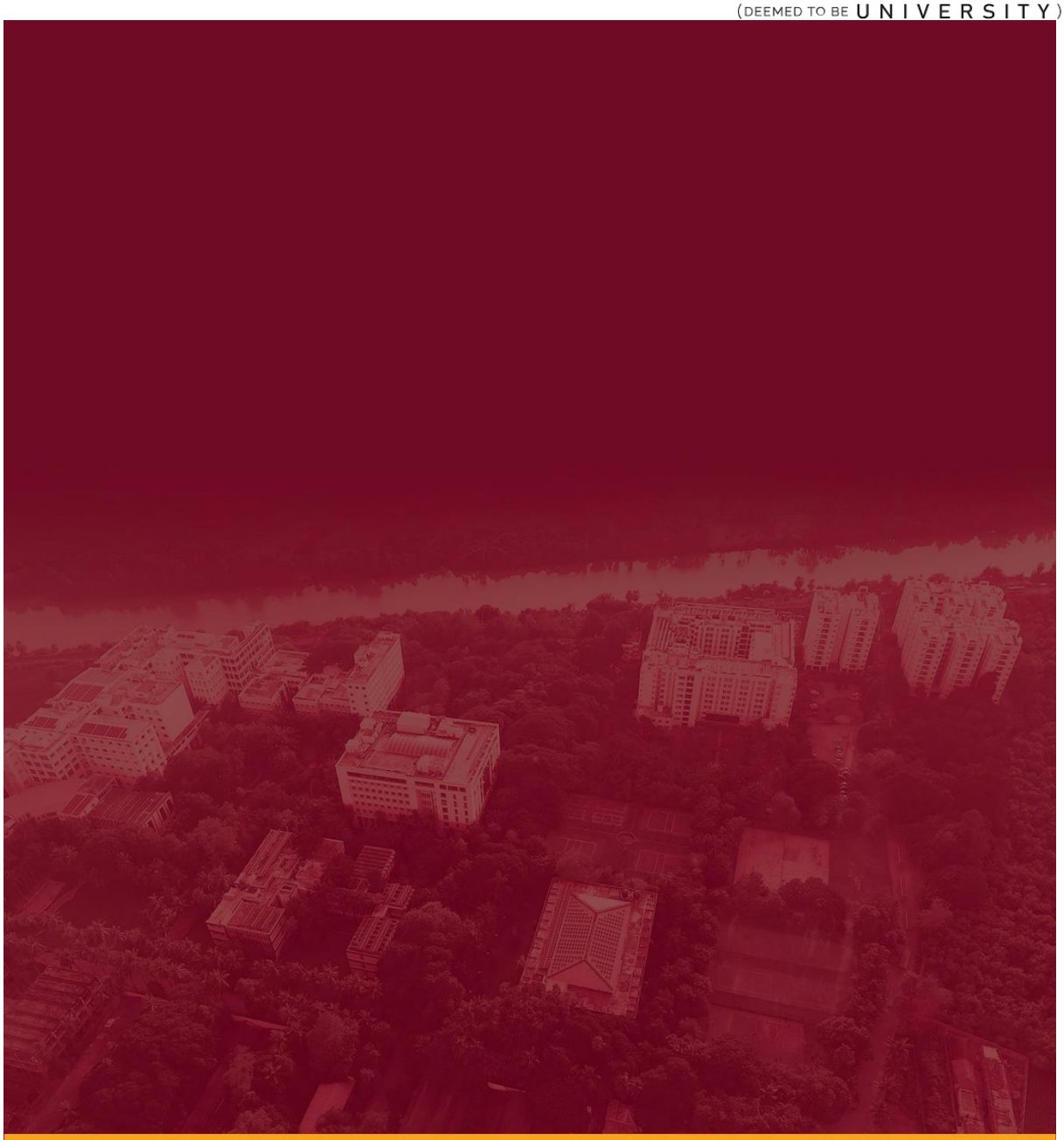
TEXTBOOKS:

1. Advanced Geotechnical Engineering: Soil-Structure Interaction using Computer and Material Models by Chandrakant S. Desai, Musharraf Zaman
2. Disturbed Soil Properties" by A N Schofield
3. Soil Behaviour and Critical State Soil Mechanics by D M Wood
4. INTELLIGENT MODELS in geotechnical engineering by Samui Pijush

REFERENCE BOOKS:

1. "Geotechnical Modelling" by David Muir-Wood
2. "Physical Modelling in Geotechnics" by David White and Christophe Gaudin
3. "Constitutive Modeling of Geomaterials: Principles and Applic

(DEEMED TO BE UNIVERSITY)



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