

SYLLABUS M.TECH. (CIVIL ENGINEERING)
(SOIL MECHANICS)
AUTONOMOUS REGULATIONS 2017
(Effective for the batches admitted in 2017-18 onwards)



DEPARTMENT OF CIVIL ENGINEERING
ANIL NEERUKONDA INSTITUTE OF TECHNOLOGY & SCIENCES (A)
(Affiliated to AU, Approved by AICTE & Accredited by NBA)
SANGIVALASA, Bheemunipatnam Mandal, Visakhapatnam District-531162



ANIL NEERUKONDA INSTITUTE OF TECHNOLOGY & SCIENCES (AUTONOMOUS)

DEPARTMENT OF CIVIL ENGINEERING

M.TECH. 2 YEAR DEGREE COURSE STRUCTURE

(Effective for the M.Tech. students admitted into first year from the academic year 2017-18)

M.TECH. I Year - I Semester

Code	Subject	Periods				Sessional Marks	End Exam Marks	Total Marks	Credits
		L	T	P	Total				
PCIVGTE111	Advanced Soil Mechanics	4	0	-	4	40	60	100	4
PCIVGTE112	Advanced Foundation Engineering	4	0	-	4	40	60	100	4
PCIVGTE113	Geosynthetics and Reinforced Soil Structures	4	0	-	4	40	60	100	4
PCIVGTE114	Earth and Earth Retaining Structures	4	0	-	4	40	60	100	4
PCIVGTE115	Geotechnics of Problematic Soils	4	0	-	4	40	60	100	4
PCIVGTE116	Elective – I	4	0	-	4	40	60	100	4
	(a) Marine Sub-Structures								
	(b) Soil Science								
	(c) Reliability Analysis								
PCIVGTE117	Seminar	-	3	-	-	50	50	100	2
PCIVGTE118	Advanced Geotechnical Engineering Lab – I	-	-	3	3	50	50	100	2
PCIVGTE119	MOOC*	-	-	-	-	-	-	-	2
Total		24	3	3	30	340	460	800	30

M.TECH. I Year – II Semester

Code	Subject	Periods				Sessional Marks	End Exam Marks	Total Marks	Credits
		L	T	P	Total				
PCIVGTE121	Ground Improvement Techniques	4	-	-	4	40	60	100	4
PCIVGTE122	Geoenvironmental Engineering	4	-	-	4	40	60	100	4
PCIVGTE123	Finite Element Methods for Geotechnical Engineering	2	-	3	5	40	60	100	4
PCIVGTE124	Dynamics of Soils and Foundations	4	-	-	4	40	60	100	4
PCIVGTE125	Rock Mechanics	4	-	-	4	40	60	100	4
PCIVGTE126	Elective – II	4	-	-	4	40	60	100	4
	(a) Forensic Geotechnical Engineering								
	(b) Geotechnics of Underground Structures								
	(c) Pavement Analysis and Design								
PCIVGTE127	Design Project	-	3	-	-	50	50	100	2
PCIVGTE128	Advanced Geotechnical Engineering Lab – II	-	-	3	3	50	50	100	2
PCIVGTE129	MOOC*	-	-	-	-	-	-	-	2
Total		22	3	6	31	340	460	800	30



ANIL NEERUKONDA INSTITUTE OF TECHNOLOGY & SCIENCES (AUTONOMOUS)
DEPARTMENT OF CIVIL ENGINEERING

M.TECH. 2 YEAR DEGREE COURSE STRUCTURE

(Effective for the M.Tech. students admitted into first year from the academic year 2016-17)

M.TECH. II Year – I Semester

<i>Code</i>	<i>Subject</i>	<i>Periods / Week</i>	<i>Sessional Marks</i>	<i>End Exam Marks</i>	<i>Total Marks</i>	<i>Credits</i>
PCIVGTE211	Dissertation (Preliminary)	12	100	-	100	6
Total		12	100	-	100	6

M.TECH. II Year – II Semester

<i>Code</i>	<i>Subject</i>	<i>Periods / Week</i>	<i>Sessional Marks</i>	<i>End Exam Marks</i>	<i>Total Marks</i>	<i>Credits</i>
PCIVGTE221	Dissertation (Final)	12	-	100	100	14
Total		12	-	100	100	14

** Massive Open Online Course: Method of evaluation will be decided by a Departmental Committee constituted for this purpose and students are graded accordingly*

ADVANCED SOIL MECHANICS

PCIVGTE 111

Instruction: 4 Lecture / week

End Exam: 3 hours

Credits: 3

Sessional marks: 40

End Exam Marks: 60

Course Objective:

The course contents enable the students to know the engineering properties of soils and determine the shear strength of cohesive and granular soils.

Course outcomes:

By the end of the course the students will be able to

1. Know the engineering properties of soils.
2. Understand the shrinkage and consolidation behaviour of soils.
3. Determine the shear strength of cohesive and granular soils.
4. Understand the deformation characteristics of soils.

Mapping of course outcomes with program outcomes:

		PO												PSO		
		1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO	1	3	3	2	3	1	2	2	1	1	2	2	2	3	2	2
	2	3	3	3	2	1	2	2	1	1	2	2	3	3	2	2
	3	3	3	3	2	2	3	3	1	1	2	2	3	3	2	2
	4	3	3	3	2	1	3	3	1	1	2	2	3	3	2	2

SYLLABUS

UNIT – I

Engineering properties of soils: Engineering properties of granular soils, influence of clay phase, Atterberg limits, Activity, influence of exchangeable cations and pH, effects of organic matter.

Principle of effective stress: force distribution in a particulate system, inter particle forces, inter granular pressure. Shrinkage: Factors affecting shrinkage, Formation of cracks, Measurement of shrinkage

UNIT – II

Consolidation: Review of theory of one dimensional consolidation, laboratory consolidation tests, Estimation of total compression, Time and load deformation curves, load increment ratio, Soil structure in consolidation and compression – Sand drains – effect smear zone.

UNIT – III

Yield and failure: Concept of Yield and failure in soils, Yield criteria, Failure theories, Laboratory triaxial test for strength measurements.

Granular soil strength: Introduction, Friction Properties, Apparent friction Parameters, Sliding and interlocking friction, Laboratory measurement of Granular soil strength, measurement of friction angle, stress and strain, intrinsic friction angle, Volumetric strain.

UNIT – IV

Cohesive soil strength: Analytical and physical strength parameters, Porewater pressure, Components of Pore water pressure for fully saturated soil, Pore pressures in partially saturated clay, Pore water measurements, Pore pressure coefficients, Laboratory determination – Stress Path – Undrained shear strength of anisotropic clay.

UNIT – V

Mechanism for development of Shear strength: strength and soil structure, Yield and failure.

Critical state: Effect of intermediate principle stress, anisotropy, Resistance to cyclic loading and liquefaction, Strength of mixed soils, Deformation characteristics, Elastic and plastic Deformation.

TEXT BOOKS

1. Mitchell (2005), J. K. Fundamentals of Soil Behaviour, John Wiley.
2. Yong, R. N. and Warkentin (1975), B. P. Soil Properties and Behaviour, Elsevier.

REFERENCES

1. B M Das (2008), Advanced Soil Mechanics, Taylor and Francis
2. R.O. Davis and A.P.S. Selvadurai (1996), Elasticity and Geomechanics, Cambridge University Press, New York.
3. R F Scott (1963), Principles of Soil Mechanics, Addison & Wesley.
4. Wood, D.M (1991) Soil Behaviour and Critical State Soil Mechanics. cambridge university press
5. Lambe, T. W. and Whitman, R. V (2011) Soil Mechanics SI version , John Wiley & Sons.

ADVANCED FOUNDATION ENGINEERING

PCIVGTE 112

Instruction: 4 Lecture / week

End Exam: 3 hours

Credits: 3

Sessional marks: 40

End Exam Marks: 60

Course Objective:

The course contents enable the students to learn the basic aspects of geotechnical engineering, analysis and structural design of foundations and retaining structures.

Course outcomes:

By the end of the course the students will be able to

1. Understand the basic concepts of foundation design.
2. Analyze the settlement of footings.
3. Understand the design and construction procedure of deep foundations
4. Design the foundations for transmission line towers.

Mapping of course outcomes with program outcomes:

		PO											PSO			
		1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO	1	3	3	2	3	1	2	2	1	1	2	2	2	3	2	2
	2	3	3	3	2	1	2	2	1	1	2	2	3	3	2	2
	3	3	3	3	2	2	3	3	1	1	2	2	3	3	2	2
	4	3	3	3	2	1	3	3	1	1	2	2	3	3	2	2

SYLLABUS

UNIT – I

Foundation Design-general Principles: Types of Foundations, Basic requirement of a foundation, computation of loads, Design steps.

Shallow Foundations-I: Introduction, location and depth of foundation, Bearing Capacity of footings, Local and Punching shear failure, Skempton's Bearing capacity factor, footings on layered soils, Bearing capacity from penetration tests, Bearing capacity from Plate load test, factor of safety, soil pressure for structural design in normal and swelling soils.

UNIT – II

Shallow Foundations-II: Settlement of footings: Settlement from penetration tests, Stress path method for Settlement calculation, Settlement of footings on slope, Allowable Bearing Pressure, Allowable Bearing pressure of Raft foundation, Floating Raft, Uplift capacity of footings, Modulus of sub grade reaction. Beams on elastic foundation, design of circular and annular rafts.

UNIT – III

Pile Foundations: Introduction, Classification of piles, Bearing capacity of piles, Pile load test, Negative skin friction, Vertical pile subjected to lateral load, lateral load capacity of single pile, Batter piles under lateral loads, uplift capacity of piles, pile groups, Bearing capacity of a pile group, settlement of pile group, Negative skin friction in a pile group, uplift capacity of a pile group, Lateral pile load test, ultimate lateral load resistance of pile group,

Hrennikoff's method, proportioning and design of pile foundations, bored piles – secant piles, tangent piles, intermittent piles, V – piles, Static installation, Box Jacking, piled raft.

UNIT – IV

Bridge substructures: Introduction, Elements of bridge substructures, determination of maximum flood discharge, determination of maximum depth of scour, depth of foundation, allowable bearing pressure, lateral stability of well foundation. Well foundations, Types of well foundations, sinking stresses in wells, tilts and shifts, sinking of wells, Design aspects of components of well foundations, Lateral stability of Well foundation.

UNIT – V

Foundations of Transmission Line Towers: Introduction, Necessary information, Forces on tower foundations, General design criteria, Choice and type of foundation, Design procedure.

TEXT BOOKS

1. W.C. Teng (1962) Foundation Design, John Wiley, New York.
2. Swami Saran (2006) Analysis and Design of Substructures, Oxford & IBH Publishing Co.

REFERENCES

1. J.E. Bowles (1997) Foundation Analysis and Design, Mc Graw Hill Publishing Co.
2. P.C. Vargheese (2005) Foundation Engineering, Prentice Hall of India
3. Gopal Ranjan and A.S.R. Rao(2007)Basic and Applied Soil Mechanics, New Age International
4. Poulos, H. G. & Davis, E. H. (1980) Pile Foundation Analysis and Design john wiley & sons inc
5. Tomlinson(2003) M. J. - Foundation Design and Construction - Prentice Hall
6. Salgado, R. (2008) The Engineering of Foundations McGraw-Hill, Boston

GEOSYNTHETICS AND REINFORCED SOIL STRUCTURES

PCIVGTE 113

Instruction: 4 Lecture / week

End Exam: 3 hours

Credits: 3

Sessional marks: 40

End Exam Marks: 60

Course Objective:

The course content enables students to learn the use of Geosynthetics in Civil Engineering, modern concepts of Soil Reinforcement, design principles and ease of their applicability to construction practices.

Course Outcomes:

At the end of the course the student will be able to;

1. Explain the significance of Geosynthetics, Properties of Geotextiles and its application.
2. Design with Geotextiles.
3. Learn the Concept of Reinforced Earth.
4. Design the Reinforced Earth Retaining Walls, Reinforced Pavements, and Landfills.

Mapping of course outcomes with program outcomes:

		PO												PSO		
		1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO	1	3	2	2	1	3	2	3	1	2	2	2	2	2	2	2
	2	2	3	3	3	2	2	2	1	2	1	2	2	3	2	2
	3	3	2	3	2	1	2	2	1	1	1	2	1	2	2	2
	4	3	3	3	2	2	2	3	2	2	2	2	2	3	2	2

SYLLABUS

UNIT – I

Geosynthetics-Types, Functions, Applications, Raw materials, Manufacturing methods.

UNIT – II

Properties of Geotextiles- Physical Properties, Mechanical Properties, Hydraulic Properties, Survivability and Durability.

Tests on Geotextiles- Mass per unit area, Nominal Thickness, Apparent Opening Size, Characteristic Opening Size, Tensile Strength-Strip Tensile Strength, Wide Width Tensile Strength, Grab Tensile Strength, Seam strength, Static Puncture test- CBR push through test, Rod Puncture Test, Dynamic Puncture Test- Cone Drop test, Permittivity, Transmittivity.

UNIT – III

Designing with Geotextiles-Design Methods, Designing for separation, Designing for Highway Reinforcement, Designing for Filtration, Designing for drainage, Designing for Multiple functions, Construction Methods and Techniques using Geotextiles.

Designing with geogrid, Geonets, Geomembranes.

UNIT – IV

Reinforced Earth: Concept, Effects of Reinforcement on soils – Equal Confining and Pseudo Cohesion Concepts, Materials, Friction Coefficient – Definition, Laboratory determination, Factors affecting friction coefficient; Telescope and Hitex Methods of construction, Application of Reinforced Earth – Binquet & Lee’s Approach for analysis of foundations with reinforcement layers.

UNIT – V

Reinforced Earth Retaining Walls: Introduction, Stability Mechanisms, Design of Reinforced Earth Retaining Wall, Advantages over conventional Retaining Walls

Reinforced Pavements: Benefits of placing reinforcement in flexible pavement layers, design of reinforced pavements by Giroud and Noiray approach and modified CBR Method.

Landfills: Geosynthetic applications for land fill liners, covers and other components

TEXT BOOKS

1. Venkatappa Rao G & Suryanarayana Raju GVS (1990), “Engineering with Geosynthetics”, Tata McGraw Hill Publishing Co. Ltd.
2. Robert M Koerner (1991), “Designing with Geosynthetics”, Prentice Hall; 2nd Edition.

REFERENCES

1. Siva Kumar Babu G.L. (2006), “An Introduction to Soil Reinforcement and Geosynthetics”, Universities Press, India.
2. Robert M. Koerner (1985), “Construction and Geotechnical Methods in Foundation Engineering”, McGraw Hill, New York.
3. Hausmann, M. R. (1989), “Engineering Principles of Ground Modifications”, McGraw Hill Pub Co.
4. BS 8006:1995, “Code of practice for strengthened/reinforced soils and other fills”.
5. FHWA-NH1-00-043, “Mechanically stabilized earth walls and reinforced soil slopes design and construction guidelines”.

EARTH AND EARTH RETAINING STRUCTURES

PCIVGTE 114

Instruction: 4 Lecture / week

End Exam: 3 hours

Credits: 3

Sessional marks: 40

End Exam Marks: 60

Course Objective:

The course contents enable the students to understand the earth pressure concepts and design principles of retaining structures.

Course outcomes:

By the end of the course the students will be able to

1. Understand the basic concepts of earth pressure theories.
2. Learn the design procedure of sheet pile walls
3. Know the types of bracing systems and cellular cofferdams.
4. Understand the construction techniques and design criteria of earth and rock fill dams.

Mapping of course outcomes with program outcomes:

		PO												PSO		
		1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO	1	3	2	2	2	1	2	2	1	1	2	2	3	3	3	2
	2	3	3	3	2	1	2	2	1	1	3	3	3	3	2	2
	3	3	3	2	2	2	2	2	1	1	2	2	3	3	3	2
	4	3	3	3	2	2	2	2	1	1	3	3	3	3	2	2

SYLLABUS

UNIT – I

Earth Pressure: Basic concepts, Rankine and Coulomb earth pressure theories, Determination of active and passive pressures: Culmann's Graphical method, logarithmic spiral methods, friction circle method. Consideration of surcharge, seepage, earth quack, wave effect, stratification, type of backfill, wall friction and adhesion.

UNIT – II

Rigid Retaining Walls: Uses, types, stability and design principles of retaining walls, backfill drainage, settlement and tilting.

Sheet Pile Walls: Types, Design of cantilever sheet pile walls in granular and Cohesive soils; Design of anchored sheet pile walls by free and fixed earth support methods, Rowe's theory of moment Reduction, Design of anchors, Diaphragm Walls – construction, trench cutter.

UNIT – III

Braced excavations: Types of sheeting and Bracing systems, lateral earth pressure on sheeting in sand and clay, Design components of braced cuts. Cellular cofferdams: Types – Diaphragm and Circular type, Design by TVA method. Stability of cellular cofferdams, cellular cofferdams in rocks and soils.

UNIT – IV

Earth and Rock fill dams: Earth dams : Selection of Site, types of earthen dams, design criteria, stability analysis: upstream and down stream for steady seepage, rapid draw down, end of construction; Seepage, Uplift Control, filters and drains.

UNIT – V

Construction techniques, Slope protection, Failure of earth dams: Hydraulic, Seepage and Structural; Instrumentation and performance observations in earth dams. Rock Fill Dams: Types, Design parameters, Advantages over other types of dams

TEXT BOOKS

1. Arora K.R. (2001), Soil Mechanics and Foundation Engineering, Standard Publishers, Delhi – 110 006.
2. Bharat Singh and Sharma, H. D.(1999) Earth and Rockfill Dams.

REFERENCES

1. Terzaghi. K. and Peck R. B. (1968) Soil mechanics in engineering and practice 2 nd edition, John Wiley.
2. Bowles. J. W. (1955) analysis and design of foundations, McGraw Hill, 4 th edition.
3. Rowe, R.K. (2001) Geotechnical and Geoenvironmental Engineering Handbook, Kluwer Academic Publishers.
4. Terzaghi, K.(1965) Theoretical Soil Mechanics, John Wiley.
5. Narsinga Rao B.N.D (2015), Soil Mechanics and Foundation Engineering, Wiley Publishers.
6. Taylor, D.W.(1948) Fundamentals of Soil Mechanics, John Wiley.
7. B. M. Das (2003) Principles of Foundation Engineering, Thomson, Indian Edition.
8. P. Raj (1995) Geotechnical Engineering, Tata McGraw Hill
9. Hans Friedrich Winterkorn, Hsai-Yang Fang (1975) Foundation Engineering Handbook, Van Nostrand Reinhold.

GEOTECHNICS OF PROBLEMATIC SOILS

PCIVGTE 115

Instruction: 4 Lecture / week

End Exam: 3 hours

Credits: 3

Sessional marks: 40

End Exam Marks: 60

Course Objectives:

To identify and classify various problematic soils and adopt foundation techniques for different problematic soils

Course Outcomes:

At the end of this course, the students will be able to:

1. Learn about the behaviour of expansive soil under various moisture conditions.
2. Identify expansive soils based upon various swell properties.
3. Understand about properties of soft clays and organic soils.

Mapping of course outcomes with program outcomes:

		PO												PSO		
		1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO	1	2	2	1	2	1	1	2	1	1	-	-	1	2	2	1
	2	2	2	2	2	1	2	2	1	-	1	1	1	2	3	2
	3	2	1	1	2	1	2	2	1	-	1	-	1	2	1	2

SYLLABUS

Unit – I

Introduction: Type of Damages and Heave, seasonal moisture variation, active zone, mechanism of swelling. Factors influencing heave, estimation of heave.

Unit – II

Identification and classification of expansive soil: swell potential, differential swell pressure. Free swell ratio, swelling pressure, Determination of swelling pressure, early methods-free swell ratio method, effective plasticity index.

Unit – III

Foundation techniques in expansive soils: foundation isolation, rigid foundations-underreamed pile foundation, Reinforced Slab-on-Grade Foundations.

Unit - IV

Control of soil moisture fluctuations, surface grading, subsurface drains, moisture barriers. Altering soil properties-controlled soil excavation and backfill, prewetting. Lime stabilization.

Unit – V

Soft clays: Geology of soft marine clays, mineralogy, physical properties, shear strength and compressibility, foundation types.

Organic and peaty soils, **Collapsible soils:** Geotechnical properties, foundation types.

TEXT BOOKS

1. Dr.B.N.D.Narasingarao,2015”Soil Mechanics and Foundation Engineering”,chapter-24,Foundations on Expansive Soils,P.P 1039-1080,Wiley India Pvt Ltd.

REFERENCES

1. S. A. Ola “Tropical soils in engineering practice”, Balkema publications.
2. O. G. and metcaff, J. B., Butterworth,1972,”Soil stabilization principles and practice

Elective - I
MARINE SUBSTRUCTURES

PCIVGTE 116 (a)

Instruction: 4 Lecture / week

End Exam: 3 hours

Credits: 3

Sessional marks: 40

End Exam Marks: 60

Course Objectives:

The course enables to understand various marine sub-structures, their working and preliminarily design of the sub-structures

Course Outcomes:

At the end of the course the student will be able to

1. Understand the definition and purpose of marine or sub-structures.
2. Gain knowledge about the load calculations on sub-structures.
3. Apply the concepts of the preliminary design concepts of marine sub-structures.

Mapping of course outcomes with program outcomes:

		PO												PSO		
		1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO	1	2	2	2	2	1	2	2	1	1	-	-	2	2	2	2
	2	2	2	2	2	2	2	2	1	-	1	1	2	2	2	2
	3	2	2	2	2	1	2	2	1	-	1	-	2	2	2	2

SYLLABUS

UNIT – I

Introduction: Offshore definition, Purpose of Offshore Structures, Classification and Examples, Various types of Offshore Structures – Jacket Platforms, Semi submersibles, Tension Leg Platforms, Gravity Platforms Guyed Towers, Articulated Towers.

Load Calculations: Environmental loads on offshore structures due to a)Wind b) Wave c) Current d) Ice e) Earth quake, Functional loads, Buoyant Forces, Installation forces, Soil structure interaction. Wave force calculation on a Jacket platform and Semi submersible.

UNIT – II

Introduction, Coastal Protection works – Seawall – Groins – Structural aspects – Sand dunes – Vegetation – Beach nourishment.

Break waters – Types – Selection of site and type – Effects on the beach – Design principles of Rubble mound, vertical wall and composite Breakwaters – Stability of Rubble Structures.

UNIT – III

Wharves and Jetties – Types – Materials of Construction – Design Principles – Deck for fenders – Types – Design.

Dolphins – Mooring Accessories.

UNIT – IV

Submarine Pipelines – Route selection and Diameter / wall thickness calculations; Pipeline stability, free span calculations; Concrete coated pipelines and pipe-in-pipe insulated pipelines; Design using DNV 81 code.

UNIT – V

Preliminary design aspects of offshore structures. Construction, Towing and installation procedure of Jacket platforms and Gravity platforms.

TEXT BOOKS

1. Mark Randolph and Susan Gourvenec, (2011), “Offshore Geotechnical Engineering”, CRC Press.

SOIL SCIENCE

PCIVGTE 116 (b)

Instruction: 4 Lecture / week

End Exam: 3 hours

Credits: 3

Sessional marks: 40

End Exam Marks: 60

Course Objectives:

The course enables to understand the formation of soils, their mineralogy and various mechanisms involved in soil water interaction.

Course Outcomes:

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

1. Understand the Formation, Nature and Mineralogy soils
2. Gain knowledge about the Soil Fabric Structure and its characterisation
3. Apply concepts of water movement in Saturated and Unsaturated soils to measure unsaturated hydraulic conductivity.

Mapping of course outcomes with program outcomes:

		PO												PSO		
		1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO	1	2	2	3	2	1	2	2	1	1	-	-	2	3	2	2
	2	2	2	2	2	2	2	2	1	-	1	1	2	2	2	2
	3	2	2	1	2	1	1	2	1	-	1	-	2	2	1	2

SYLLABUS

UNIT – I

Soil Formation: Introduction: Weathering: Origin of clay minerals and clay genesis – soil profiles and their development. Sediment erosion – transport and deposition.

Nature of Soil: Particle size composition – Measurement of Pore size distribution – Principles of sedimentation analysis – Interpretation of accumulation Curves.

UNIT – II

Soil Mineralogy: Silicate Crystals - Surfaces – Gravel, Sand and Silt particles – Biogenic and Geochemical processes – Non-clay Mineral Characteristics.

Structural units of layer silicates – classification of clay minerals – Intersheet and InterLayer bonding – The 1:1 Minerals – Smectite Minerals – Mica like clay minerals – other clay minerals.

UNIT – III

Soil Fabric and Structure: Introduction – Structure and Fabric – Granular Soil packing – clay soil Fabric – Fabric classification – Particle arrangement in fabric units – First and Second order fabric characterization – Pore spaces and fabric – Techniques for direct fabric viewing – Quantification of fabric – Fabric characteristics from sedimentation.

UNIT – IV

Mechanism of Soil Water interactions – structures properties of adsorbed water – clay water electrolyte system. Ion distribution in clay water system - elements of double layer theory –

Influence of system variables on double layer theory – Limitations of Gouy-Chopman diffused double layer model – Energy and force of repulsions – long range attraction – Cation exchange.

UNIT – V

Soil water – flow through soils – introduction – capillarity - saturated flow: darcy's equations, determination of permeability in the field, Kozeny-Carmen Relationship – layered soils – factors effecting saturated flow – seepage force – Quicksand condition – Two dimensional flow - flownets and their characteristics – phreatic line for earthdams - uplift pressure – exit gradient – piping – filter criteria

Unsaturated flow: unsaturated flow equations for no volume change; for volume change cases
Measurement of unsaturated hydraulic conductivity.

TEXT BOOKS

1. James K Mitchell, (1976), “Fundamentals of Soil Behaviour”, John Wiley & Sons Inc.
2. Yong, R.N. and Warkentin B.P., (1975), “Soil Properties & Behaviour”, Elsevier Scientific Publishing Company.

RELIABILITY ANALYSIS

PCIVGTE 116 (c)

Instruction: 4 Lecture / week

End Exam: 3 hours

Credits: 3

Sessional marks: 40

End Exam Marks: 60

Course Objectives:

The course enables to enlighten the concepts of reliability based design in geotechnical engineering.

Course Outcomes:

At the end of the course the student will be able to

1. Basic understanding of the principles of reliability
2. Gain knowledge in Basic statistics like Data reduction techniques, Histograms, etc.
3. Design geotechnical structures on the principle of reliability based design with enhanced and optimal partial factors of safety.

Mapping of course outcomes with program outcomes:

		PO												PSO		
		1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO	1	2	2	1	2	1	1	2	1	1	-	-	1	2	2	1
	2	2	2	2	2	1	2	2	1	-	1	1	1	2	3	2
	3	2	1	1	2	1	2	2	1	-	1	-	1	2	1	2

SYLLABUS

UNIT – I

Concepts of Structural Safety: General, Design methods.

Basic Statistics: Introduction, Data reduction, Histograms, Sample correlation.

UNIT – II

Probability Theory: Introduction, Random events, Random variables, Functions of random variables, Moments and expectation, Common probability distribution, Extremal distribution.

UNIT – III

Resistance Distributions and Parameters: Introduction, Statistics of properties of concrete, Statistics of properties of steel, Statistics of strength of bricks and mortar, Dimensional variations, Characterization of variables, Allowable stresses based on specified reliability.

Probabilistic Analysis of Loads: Gravity loads, Wind load.

UNIT – IV

Basic Structural Reliability: Introduction, Computation of structural reliability. Monte Carlo Study of Structural Safety: General, Monte Carlo method, Applications.

Level 2 Reliability Methods: Introduction, Basic variables and failure surface, First-order second-moment methods (FOSM).

UNIT – V

Reliability Based Design: Introduction, Determination of partial safety factors, Safety checking formats, Development of reliability based design criteria, Optimal safety factors, Summary of results of study for Indian standard – RCC design. Reliability of Structural Systems: Preliminary concepts as applied to simple structures.

TEXTBOOKS

1. Ranganatham. R. (2006), “Structural Reliability Analysis and Design”, Jaico Publishing House.
2. Melchers, R.E. (2nd Edition, 1999), “Structural Reliability”, Wiley – Blackwell Publisher.

SEMINAR

PCIVGTE 117

Instruction: 3 Tutorial / week

End Exam: -

Credits: 3

Sessional marks: 50

End Exam Marks: 50

Course Objectives:

The objective of this course is

1. To develop an overview of geotechnical engineering and its importance.
2. To promote teamwork and lifelong learning among the students.

Course Outcomes:

At the end of the course the students will be able to

1. Improve the communication skills and cultivate lifelong learning.
2. Broaden their knowledge about Geotechnical Engineering and its significance
3. Update their knowledge on the latest developments in geotechnical engineering.
4. Understand the environmental, safety, economical and sustainability aspects of any geotechnical engineering structure.

Mapping of course outcomes with program outcomes:

		PO												PSO		
		1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO	1	-	-	-	-	-	-	-	-	-	3	-	2	-	-	-
	2	2	2	2	2	2	2	2	-	-	-	-	-	2	2	2
	3		2	2	2	2	2	2	-	-	-	-	-	2	2	2
	4	-	-	2	-	-	2	2	-	-	-	-	-	2	-	2

SYLLABUS

Each student has to select a topic and collect about 10 papers with at least 5 journal papers and prepare a report and give a seminar at the end the semester.

ADVANCED GEOTECHNICAL ENGINEERING LAB - I

PCIVGTE 118

Instruction: 3 Practical / week

End Exam: 3 hours

Credits: 3

Sessional marks: 50

End Exam Marks: 50

Course Objectives:

To enable a student to understand the various index and engineering properties of soil by experimentation

Course Outcomes:

By the end of the course, student will be able to:

1. Determine index and engineering properties of different soils and understand their behaviour.
2. Gain basic knowledge towards geophysical testing techniques.

Mapping of course outcomes with program outcomes:

		PO												PSO		
		1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO	1	2	2	2	3	2	1	1	1	3	3	1	2	3	2	2
	2	2	1	2	2	1	2	1	1	2	2	2	2	2	2	2

SYLLABUS

Soil Laboratory

1. Sieve Analysis
2. Liquid Limit
3. Plastic Limit
4. Permeability
5. Differential Free Swell
6. Hydrometer Analysis
7. Shrinkage Limit
8. Compaction Test
9. Swell Pressure Test
10. Consolidation Test
11. Triaxial Test

Demonstration & Field Practise

1. Static Cone Penetration Test
2. Dynamics Cone Penetration Test
3. Electric Resistivity
4. Seismic Refraction
5. Cation Exchange Capacity
6. Wave Propagation Test
7. SEM
8. X-Ray Diffraction

GROUND IMPROVEMENT TECHNIQUES

PCIVGTE 121

Instruction: 4 Lecture / week

End Exam: 3 hours

Credits: 3

Sessional marks: 40

End Exam Marks: 60

Course Objective:

The course content enables students to learn the different techniques for enhancing engineering properties of soil.

Course Outcomes:

At the end of the course the student will be able to;

1. Explain the method of Ground Improvement by Mechanical Stabilization.
2. Learn the grouting techniques.
3. Learn the concept of Vertical drains, its construction and design principles.
4. Outline the Soil Nailing and Dewatering Techniques.

Mapping of course outcomes with program outcomes:

		PO												PSO		
		1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO	1	2	2	3	2	2	2	2	2	1	1	1	1	2	2	1
	2	2	2	3	2	3	2	2	1	1	-	2	1	2	2	2
	3	3	2	3	2	3	2	2	2	1	1	2	2	3	2	2
	4	3	2	3	2	3	2	3	1	2	1	2	2	3	2	2

SYLLABUS

UNIT – I

Introduction – Need for Ground Improvement, Objectives of Ground Improvement, Classification of Ground Improvement Methods, Mechanical Stabilization- Triangular Chart Method and Rothfutch Method, Blasting, Dynamic Compaction/ Consolidation, Compaction piles – Micro piles: Design methods and construction techniques.

UNIT – II

Soil Stabilization & Foundation Grouting – Grouting Equipments, Applications, Classification of grouting based on Materials, Grouting Technique and Sequence of Operation, Soilcrete, Soilfrac, grouting in rocks,

UNIT – III

Vertical Drains- Sand Drains, Vacuum Consolidation, Prefabricated - Principle, Band Drains or Wick Drain, Geosynthetic Drains, Construction, Advantages and Disadvantages, Stone Columns – Mechanism of load transfer, Design principles, Construction of stone column- Vibro Compaction, Vibro Replacement, Vibro Composer and Case bore hole Methods, Geotextile Coated Stone Columns, Preloading.

UNIT – IV

In- Situ Soil Mixing – Types of In-situ Soil Mixing, Benefits and Applications, Ground Freezing and Ground Heating.

Soil Nailing – Components, Types of soil nailing systems, Equipment used, Construction of Soil Nailing System, Stability Analysis, Application, Advantages, Gabions.

Methods to improve rock mass – rock bolting and rock anchors - Beach management system.

UNIT – V

Seepage Control & Dewatering- Definition, Objectives, Methods of Dewatering- Open Sumps and Ditches, Well point Systems, Deep Well Systems, Vertical Sand Drains, Electro-Osmosis, Cut off wall, Selection of Dewatering System, Cathodic protection of marine structures.

TEXT BOOKS

1. P. Purushothama Raj(1999), Ground Improvement Techniques, Laksmi Publications, New Delhi.
2. Dr. B.N.D Narsinga Rao (2015), Soil Mechanics and Foundation Engineering, Wiley Publishers.

REFERENCES

1. Hausmann Manfred R. (1990), Engineering Principles of Ground Modification, McGraw-Hill.
2. Moseley, M.D. (1998), Ground Treatment, Blackie Academic and Professional.
3. Das, Braja M. (2015), Principles of Foundation Engineering, Cengage learning.
4. Nayak, Narayan V (1979), Foundation Design Manual: For Practising Engineers and Civil Engineering Students, Dhanpat Rai.

GEOENVIRONMENTAL ENGINEERING

PCIVGTE 122

Instruction: 4 Lecture / week

End Exam: 3 hours

Credits: 3

Sessional marks: 40

End Exam Marks: 60

Course Objectives:

From this course students will learn the following

1. To characterize waste based upon its source and safe transport and disposal of waste without any contamination.

Course Outcomes:

1. Learn about various sources and characteristics of site.
2. Understand about classification of waste and environmental concerns of waste.
3. Know about the safe transport and disposal methods of hazardous waste.

Mapping of course outcomes with program outcomes:

		PO												PSO		
		1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO	1	1	2	1	2	1	2	3	1	1	1	-	1	2	1	2
	2	1	2	1	2	1	2	3	1	-	1	-	1	1	2	1
	3	2	2	2	2	1	2	3	1	-	1	1	1	2	2	2

SYLLABUS

UNIT – I

Sources and Site Characterization: Scope of Geoenvironmental Engineering, Various Sources of Contaminations, Need for contaminated site characterization; and Characterization methods.

UNIT – II

Solid and Hazardous Waste Management: Classification of waste, Characterization solid wastes, Environmental Concerns with waste, waste management strategies.

UNIT – III

Contaminant Transport: Transport process, Mass-transfer process, Modelling, Bioremediation, and Phytoremediation. Remediation Techniques: Objectives of site remediation, various active and passive methods, remediation NAPL sites, Emerging Remediation Technologies.

UNIT – IV

Landfills: Types of landfills, Site Selection, Components of Waste Containment system, Leachate collection system, Cover system, Gas collection system.

UNIT – V

Soil erosion and conservation – causes of soil erosion, factors contributing to erosion – climatic factors, topographical factors, vegetation factors. Erosion control – cropping systems, gullies, check dams, contouring, wind striping, ridging, bank protection.

TEXT BOOKS

1. Sharma, H. D. and Reddy, K. R. (2004) -“Geoenvironmental Engineering”, John Wiley & Sons

REFERENCES

1. Rowe, R. K. 2001 –“Geotechnical & Geoenvironmental Engineering Handbook”, Kluwer Academic
2. Reddi, L. N. and Inyang, H. I. 2000-”Geoenvironmental Engineering Principles and Applications”, Marcel. Dekker, Inc., New York .
3. LaGrega, M. D., Buckingham, P. L. and Evans, J. C. 2001 -“Hazardous Waste Management”, New York: McGraw-Hill
4. Daniel, D. E. 1993 “Geotechnical practice for waste disposal”, Chapman and Hall, London

FINITE ELEMENT METHODS FOR GEOTECHNICAL ENGINEERING

PCIVGTE 123

Instruction: 2 Lecture & 3 Practical / week

End Exam: 3 hours

Credits: 3

Sessional marks: 40

End Exam Marks: 60

Course Objectives:

The course enables to understand the concept of finite element analysis and its applications in geotechnical engineering.

Course Outcomes:

At the end of the course the student will be able to

1. Understand in general how finite elements are obtain to approximate the solutions of differential equations
2. Apply finite element methods to classical geotechnical problems like settlement, seepage, consolidation, slope stability, etc.
3. Obtain insight into the soil properties needed for finite element analysis

Mapping of course outcomes with program outcomes:

		PO												PSO		
		1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO	1	3	2	2	2	3	2	3	1	1	1	-	2	3	2	3
	2	3	2	2	2	3	2	3	1	-	1	-	2	3	2	2
	3	3	2	2	2	3	2	3	1	-	1	1	2	3	2	3

SYLLABUS

UNIT – I

Introduction: Concepts of FEM, Steps involved in Finite Element Analysis Procedure, Merits and Demerits. Principles of Elasticity: Stress equations, Strain-Displacement relationships in matrix form, Plane stress, Plane strain and axi-symmetric bodies of revolution with axi-symmetric loading.

UNIT – II

Element Properties: Concept of an element, various element shapes, Displacement models, Generalized coordinates, Shape functions, Convergent and Compatibility requirements, Geometric invariance, Natural coordinate system - area and volume coordinates.

UNIT – III

Generation of Element Stiffness and Nodal Load Matrices, Isoparametric Formulation: Concept, Different isoparametric elements for 2D analysis, formulation of 4-noded and 8-noded isoparametric quadrilateral elements, Lagrangian elements, Serendipity elements.

UNIT – IV

Assemblage of Elements: Discretization of a structure, numbering systems, Aspect ratio its effects, Assemblage, Direct Stiffness method.

UNIT – V

Geotechnical Applications Sequential construction, Excavations and embankments, Bearing capacity and Settlement analysis.

TEXT BOOKS

1. Desai, C. S. and J.F. Abel, (1972), “Introduction to the Finite Element Method”, Van Nostrand Reinhold Company.
2. Krishna Murthy, C. S., (1994), “Finite element analysis - Theory and programming”, Tata McGraw-Hill.

REFERENCES

1. J. N. Reddy, (1993), “Introduction to the Finite Element Method”, McGraw-Hill Publishers.
2. Zienkiewicz, O. C., (1971), “Finite element Methods”, McGraw-Hill Publishers.

DYNAMICS OF SOILS AND FOUNDATIONS

PCIVGTE 124

Instruction: 4 Lecture / week

End Exam: 3 hours

Credits: 3

Sessional marks: 40

End Exam Marks: 60

Course Objectives:

The course enables to understand the theory of vibrations, dynamic properties of soil and apply them in design foundations for machines.

Course Outcomes:

At the end of the course the student will be able to

1. Understand the concept of vibrations in soil-structure medium.
2. Know the dynamic properties of soil and their importance
3. Gain knowledge about the importance of designing machine foundations.
4. Demonstrate the ability to design machine foundations

Mapping of course outcomes with program outcomes:

		PO												PSO		
		1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO	1	2	2	1	2	1	2	3	1	1	1	-	1	2	2	3
	2	2	2	2	2	1	2	3	1	-	1	-	1	2	2	3
	3	2	2	2	2	1	2	3	1	-	1	1	1	2	2	3
	4	2	2	2	2	1	2	3	1	-	1	1	1	2	2	3

SYLLABUS

UNIT – I

Theory of Vibration: Free and forced vibrations with and without damping for single mass system with single degree freedom, Logarithmic Decrement and Damping Ratio, Principles of Design of Vibration measuring Devices, Transmissibility of force, vibrations of Two degree freedom system, vibrations of Systems under transient loads.

UNIT – II

Natural frequency of foundation soil system- Barkan's Method, Pressure Bulb Concept, Pauw's Analogy, Tschebetorioff's concept of reduced natural Frequency

UNIT – III

Dynamic Soil Properties: Tests for determination of dynamic soil properties - Cyclic Plate load test, Block vibration test, Up Hole, down Hole and Cross Hole wave Propagation tests, Hammer Test, Resonant Column Test, Seismic Reflection and Refraction tests.

UNIT – IV

Design of Machine Foundation: Types of Machine Foundations, design criteria, Degrees of Freedom of Block foundation, Analysis of Block foundations under sliding, rocking, yawing and Coupled motions, Design Aspects and Construction details of foundations for reciprocating and Impact,

UNIT – V

Vibration Isolation - Passive and active isolation - use of springs and damping materials
construction aspects of machine foundations.

TEXT BOOKS

1. S. Saran, (1999), "Soil Dynamics and Machine Foundations", Galgotia Publications Private Ltd.
2. N. S. V. Kameswara Rao, (1998), "Vibration Analysis and Foundation Dynamics", Wiley New Delhi.

REFERENCES

1. B M Das, (1992), "Principles of Soil Dynamics", Thomsons Engineering.
2. Narasinga Rao. B N D., (2015), "Soil Mechanics and Foundation Engineering", Wiley India Pvt Ltd.

ROCK MECHANICS

PCIVGTE 125

Instruction: 4 Lecture / week

End Exam: 3 hours

Credits: 3

Sessional marks: 40

End Exam Marks: 60

Course Objective

The course content enables students to learn the Rock structure, properties, strength and failures.

Course Outcomes

At the end of the course the student will be able to;

1. Classify the rocks and defects in rocks.
2. Learn the different properties of rocks.
3. Learn the different tests on rocks.
4. Outline the Creep behaviour, strength and failure of rock.

Mapping of course outcomes with program outcomes:

		PO												PSO		
		1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO	1	2	2	3	2	2	2	2	2	1	1	1	1	2	2	1
	2	2	2	3	2	3	2	2	1	1	-	2	1	2	2	2
	3	3	2	3	2	3	2	2	2	1	1	2	2	3	2	2
	4	3	2	3	2	3	2	3	1	2	1	2	2	3	2	2

UNIT – I

Introduction: Structure of the Earth, Classification of Rocks - Igneous Rocks, Metamorphic Rocks and Sedimentary Rocks, Sequence of formation of Different groups of Rocks, Rock cycle.

Defects in Rock Mass- Strike and Dip, Bedding Planes, Joints, Faults, Folds, Unconformity and their Civil Engineering Importance.

UNIT – II

Physical and index Properties of Rocks: Texture, Structure, Composition, Colour, Grain Size, Durability and Rock Quality Designation.

Mechanical Properties: Compressive Strength, Tensile Strength, Shear Strength, Point Load Strength, Scale Effect, Elasticity, Plasticity, Poisson's Ratio, Deformability, Hardness.

UNIT – III

Laboratory Testing on Rocks: Sampling, Sample Preparation, Specimen, Uniaxial Compressive Strength test, Tensile strength test, Brazillian test, flexure strength Test, Flexural strength Test, Shear Strength Test, Test for Elastic Constants

Insitu Test on Rocks: Deformability- Cable Jacking Test, Pressure Tunnel Test, Bore hole Test, Shear Tests- Single Jack Test, Strength Test- Dilatometer Test, Stress Relief

Techniques, Insitu Stress, Hydro fracturing technique, Flat Jack Techniques, Indirect Methods.

UNIT – IV

Creep Behaviour and Rheological Models: Loading Diagrams, Creep, Creep in Rocks, Rheology, Rheological Models - St.Venant Model, Kelvin Model, Maxwell Model, Bingham Model and Burger Model.

Strength and Failure of Rocks: Failure Criteria in Rock Masses, Yield Criteria of Failure Theories- Maximum Stress Theories, Maximum Elastic Strain Theories, Constant Elastic Strain Energy Theory, Maximum Shear Stress Theory, Mohr's Theory, Coulomb Theory, Griffith's Theory of Fracture Initiation- Stress Around Boundary of an open flow and Equations defining Fracture Initiation.

UNIT – V

Foundation on rocks: Estimation of bearing capacity – stress distribution in rocks – settlement in rocks – pile foundation in rocks.

Sub-Surface Exploration: Introduction – Planning and stages in sub-surface exploration – Methods of exploration – Test pit – Trenches – Seismic refraction and Electrical resistivity method – Methods of Boring – Types of soil sample – Design Features of soil sampler – standard penetration test – static and dynamic cone penetration test – Pressuremeter test – Rock exploration – Core boring – Core Recovery – RQD - bore log – preparation of sub-soil investigation report.

TEXTBOOKS

1. Verma, B. P. (2006), "Rock Mechanics for Engineers" Khanna Publishers, 3rd Edition.
2. Ramamurthy, T. (2007), "Engineering in Rocks for Slopes, Foundations and Tunnels", Prentice Hall India.

REFERENCES

1. Brown, E.T. (1981), "Rock Characterisation, Testing and Monitoring", Pergamon Press, London, U.K, 1st Edition.
2. Singh, B. and Goel, R. K.(1999) "Rock Mass Classification Systems – A Practical Approach in Civil Engineering "Elsevier Publisher, 1st Edition

Elective – II
FORENSIC GEOTECHNICAL ENGINEERING

PCIVGTE 126 (a)

Instruction: 4 Lecture / week

End Exam: 3 hours

Credits: 3

Sessional marks: 40

End Exam Marks: 60

Course Objective

The course content enables students to learn the significance of Forensic Geotechnical Engineering.

Course Outcomes

At the end of the course the student will be able to;

1. Explain the need of Forensic Geotechnical investigation.
2. Learn the data collection and laboratory test to be done on soil.
3. Learn the concept of Back Analysis.
4. Outline the Instrumentation, Monitoring and Case studies in Forensic Geotechnical Investigation.

Mapping of course outcomes with program outcomes:

		PO												PSO		
		1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO	1	2	2	1	2	2	2	2	2	1	1	1	1	2	2	1
	2	2	2	3	2	3	2	2	1	1	-	2	1	2	2	2
	3	1	2	1	2	3	2	2	2	1	1	2	2	3	2	2
	4	1	2	2	2	3	2	3	1	2	1	2	2	3	2	2

UNIT – I

Introduction-Scope of forensic geotechnical investigation, types of distress, analysis, legal issues.

Failure-Definition, causes of failures, classification of distress, distress pattern and mode of deformation, distress-cause relationship, case studies of distress during construction.

UNIT – II

Investigation and data collection- Scope of investigation, recording of data, compilation of data.

Laboratory test- Introduction, classification of tests, compaction test, strength test, permeability test, water table fluctuation, swelling pressure.

UNIT – III

Back Analysis- Introduction, Basic consideration, Scope, Example of potential error, common causes of failures.

Back analysis of slope failure- Introduction, failure envelope parameters, procedure for back analysis, Design of remedial measures, Application.

UNIT – IV

Instrumentation and Monitoring- Legal Process and jurisprudence, technical issues, ethical issues, legal issues, case studies.

UNIT – V

Case Studies-Collapse of Heethro airport-Hull waste water flow transfer tunnel, the Hague tramp tunnel, failure of London house foundation.

REFERENCES

Rao. V.V.S.(2009), “Forensic GTE” Internatinal Society for Soil Mechanics and GTE TC40

GEOTECHNICS OF UNDERGROUND STRUCTURES

PCIVGTE 126 (b)

Instruction: 4 Lecture / week

End Exam: 3 hours

Credits: 3

Sessional marks: 40

End Exam Marks: 60

Course Objective:

The course contents enable the students to learn about various underground structures and their design concepts.

Course outcomes:

By the end of the course the students will be able to

1. Know about the types of conduits and soil pressure on conduits.
2. Learn the construction of earth tunnels.
3. Learn the design concepts of tie backs and braced cuts.
4. Understand the soil nailing concepts.

Mapping of course outcomes with program outcomes:

		PO												PSO		
		1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO	1	3	2	2	2	1	2	2	1	1	2	1	3	3	3	2
	2	3	2	2	2	2	2	2	1	1	2	1	3	3	3	2
	3	3	3	3	2	1	2	2	1	1	2	1	3	3	3	2
	4	3	3	2	2	2	2	2	1	1	2	1	3	3	3	2

SYLLABUS

UNIT – I

Arching in soils: prerequisites and features of arching, Theory of arching in soils, Application of arching in cohesive frictional soils.

UNIT – II

Soil pressures on conduits: Loads on ditch, negative and positive projecting conduits, Bedding conditions for conduits and types of conduits, Pressures in silos, Janssen's theory for pressures in silos.

UNIT – III

Stresses: Stresses in Vicinity of Vertical Shafts, Tunnels, Construction of Earth Tunnels. Retaining Systems for Underground Excavations.

UNIT – IV

Braced Cuts: Lateral Earth pressure on Sheet piling, Types of Sheet piling and Bracing Systems, Design of Braced Cuts

Tie Backs: Components, advantages over Braced Cuts, Design concepts

UNIT – V

Soil Nailing: Components of nailing system, Driven and Grouted Nails, Design of nailing system, anchored Spider Netting. Types of Anchorage Systems for anchored Sheet pile walls, Design of anchorages, considerations in positioning of anchorages.

TEXT BOOKS

1. Leonards, G.A (1962) “Foundation Engineering”, Mc Graw Hill Co.
2. Shamsheer Prakash, Gopal Ranjan and Swami Saran (1987) “Analysis and Design of Foundations and Retaining Structures”, Sarita Prakasha.

REFERENCES

1. Arora K.R. (2001), Soil Mechanics and Foundation Engineering, Standard Publishers, Delhi – 110 006.
2. Punmia, B.C. (1995) Soil Mechanics and Foundation Engineering, Laxmi Publications Pvt. Ltd., New Delhi.
3. Braja M. Das, (2005) Fundamentals of Geotechnical Engineering, Thomson Asia Pvt. Ltd., Singapore.
4. P. Raj (1995) Geotechnical Engineering, Tata McGraw Hill

PAVEMENT ANALYSIS AND DESIGN

PCIVGTE 126 (c)

Instruction: 4 Lecture / week

End Exam: 3 hours

Credits: 3

Sessional marks: 40

End Exam Marks: 60

Course Objective

The course content enables students to learn the design of pavements and pavement management systems.

Course Outcomes

At the end of the course the student will be able to;

1. Categorize the types of pavements and design the flexible and rigid pavements.
2. Design the heavy duty pavements.
3. Learn the Concept of pavement evaluation and type of pavement distress.
4. Learn environment effects and pavement maintenance.

Mapping of course outcomes with program outcomes:

		PO												PSO		
		1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO	1	3	2	-	1	3	2	1	1	2	2	2	2	2	2	2
	2	2	3	-	3	2	2	1	1	2	1	2	2	3	2	2
	3	3	2	2	2	1	2	1	1	1	1	2	1	2	2	2
	4	3	3	2	2	2	2	1	1	2	2	2	2	3	2	2

UNIT – I

Pavement types, stress distribution pavements - theoretical and actual Sub grade conditions and traffic loading. Design principle and methods for flexible and rigid pavements.

UNIT – II

Design of heavy duty pavements. Concrete block pavements.

UNIT – III

Evaluation of pavement condition, pavement instrumentation: Types of pavement distresses, their origins and remedy.

UNIT – IV

Roughness and skid resistance. Environmental effects and influences.

UNIT – V

Pavement maintenance, overlays. Pavement management systems.

TEXT BOOKS

1. Khanna S.K. & Justo C.E.G. (2011), “Highway Engineering” , Nem Chand & Bros ,9th Edition.
2. Yang H. Huang (2008), “Pavement Analysis and Design”, Prentice Hall publishers, 2nd Edition.

REFERENCES

1. Yoder & Wit Zorac (2012), "Principles of Pavement Design", John Wiley and Sons.
2. IRC Codes for Flexible Pavements- IRC-37-2001.v2.

DESIGN PROJECT

PCIVGTE 127

Instruction: 3 Tutorial / week

End Exam: 3 hours

Credits: 3

Sessional marks: 40

End Exam Marks: 60

Course objectives:

The objective of this course is to provide exposure to the students to the practical aspects of Civil Engineering projects

Course outcomes:

At the end of this course the student will be able to

1. Investigate and analyze at least one complex geotechnical engineering problem with substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
2. Select and apply appropriate techniques, resources, and modern engineering and IT tools to complex civil engineering activities with an understanding of the limitations.
3. Demonstrate knowledge and understanding of the engineering and management principles and apply these in designing at least one geotechnical engineering structure.

Mapping of course outcomes with program outcomes:

		PO												PSO		
		1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO	1	-	2	-	-	-	-	-	-	-	-	-	-	2	-	-
	2	-	-	-	-	2	-	-	-	-	-	-	-	-	2	-
	3	-	-	-	-	-	-	-	-	2	2	-	-	-	-	-

SYLLABUS

The students should carry out typical foundation design under varying soil conditions or revision of IS codes & IRC guidelines or any project suggested by course instructor. The design project may consist of

1. Soil and Structural Design of Combined footings, rafts
2. Design of Pile Groups
3. Design of Laterally loaded Piles
4. Design of well Foundations
5. Landfill Design
6. Reinforced Soil Structures
7. Design of Bulk heads
8. Case studies
9. Any other suitable topic

ADVANCED GEOTECHNICAL ENGINEERING LAB – II

PCIVGTE 128

Instruction: 3 Practical / week

End Exam: 3 hours

Credits: 3

Sessional marks: 40

End Exam Marks: 60

Course Objectives:

To enable a student to understand the various physical properties of Geosynthetics by experimentation

Course outcomes:

By the end of the course, student will be able to:

3. Determine physical properties of different types of Geosynthetics.
4. Gain basic knowledge towards rock specimen preparation and testing.

Mapping of course outcomes with program outcomes:

		PO												PSO		
		1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO	1	2	2	2	3	2	1	1	1	3	3	1	2	3	2	2
	2	2	1	2	2	1	2	1	1	2	2	2	2	2	2	2

SYLLABUS

Geosynthetics Laboratory

1. Determination of physical properties of Geotextiles, Geogrids and Geomembranes
2. Determination of Grab and wide width tensile strengths of geotextiles
3. Determination of Interfacial frictional characteristics of Geotextiles with Fill material
4. Determination of Puncture Resistance of geotextiles
5. Determination of A.O.S of geotextiles

Demonstration

6. Determination of in plane and cross plane permeability of geotextiles
7. Evaluation of long term flow ability of geotextiles by Gradient ratio test
8. Cone Drop Test on geotextiles

Computational Laboratory

Students have to solve geotechnical problems using relevant software.

Rock Mechanics Laboratory

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|--|---|---------------|
| <ol style="list-style-type: none"> 1. Preparation of Rock Specimen 2. Slate Durability Test 3. Brazilian Test 4. Point Load Test 5. Unconfined Compression Test | } | Demonstration |
|--|---|---------------|