A18

M.Tech. (GEO-TECHNICAL ENGINEERING)

M.Tech. Amended R18 [A18] CBCS Curriculum

VNR VIGNANA JYOTHI INSTITUTE OF ENGINEERING AND TECHNOLOGY

An Autonomous, ISO 9001:2015 & QS I-Gauge Diamond Rated Institute, Accredited by NAAC with 'A++' Grade
NBA Accreditation for B.Tech. CE, EEE, ME, ECE, CSE, EIE, IT Programmes
Approved by AICTE, New Delhi, Affiliated to JNTUH, NIRF 135th Rank in Engineering Category
Recognized as "College with Potential for Excellence" by UGC
Vignana Jyothi Nagar, Pragathi Nagar, Nizampet (S.O), Hyderabad – 500 090, TS, India.
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VISION OF THE INSTITUTE

To be a World Class University providing value-based education, conducting interdisciplinary research in cutting edge technologies leading to sustainable development of the nation

MISSION OF THE INSTITUTE

- To produce technically competent and socially responsible engineers, managers and entrepreneurs, who will be future ready.

- To involve students and faculty in innovative research projects linked with industry, academic and research institutions in India and abroad.

- To use modern pedagogy for improving the teaching-learning process.

DEPARTMENT OF

CIVIL ENGINEERING

VISION OF THE DEPARTMENT

To develop Civil Engineering Department as a Centre of excellence for imparting value based education to the students at undergraduate and post-graduate level to meet industry needs and to develop as a major research center meeting national and international standards.

MISSION OF THE DEPARTMENT

- To impart in-depth and up-to-date knowledge of Civil Engineering concepts with focus on character enhancement, leadership qualities, effective communication, social responsibility and pursuit of lifelong learning and professional development.

- To provide a platform to the students to engage in original innovative research.

M.TECH.
(GEO-TECHNICAL ENGINEERING)

M.TECH. (GTE)

PROGRAM EDUCATIONAL OBJECTIVES

PEO-I: To apply knowledge of geotechnical engineering to produce engineers to integrate and build concepts to improve professional leadership, teamwork, life-long learning, and career advancement.

PEO-II: To design and conduct experiments, to analyze and interpret data related to the geotechnical engineering, as well as to formulate systems within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability

PEO-III: To accentuate the understanding of the basic principles and exposes the student to the latest developments, with a strong research foundation so as to provide engineering solutions in a global, economic, environmental, and societal context.

M.TECH. (GTE)

PROGRAM OUTCOMES

PO-1: The graduates are capable of applying the core and multidisciplinary knowledge for understanding the problems in Geotechnical engineering and related fields.

PO-2: The graduates will possess critical thinking skills, problem solving abilities, familiarity with the computational procedures essential to the field, knowledge of various problems adhered to soil behavior.

PO-3: The graduates are able to formulate, analyse, design and execute the construction of various types of foundations with appropriate consideration for public health and safety and cultural, societal and environmental conditions.

PO-4: The graduates can use research based knowledge and research methods to conduct experiments, to analyze and interpret experimental data.

PO-5: The students get hands on training on various Geotechnical software's and are able to model critical field problems using software's.

PO-6: The students through the acquired appropriate knowledge can assess societal, health, safety, legal and cultural issues and will be able to take responsibilities relevant to Geotechnical Engineering practice.

PO-7: As the students possess substantial knowledge in multi-disciplinary areas, one is able to plan the various projects well, keeping in view its environmental effects on other related fields.

PO-8: Apply ethical principles and commitment to professional responsibilities.

PO-9: Capable of working efficiently as individual, as member or leader in driver set teams and in multi- disciplinary settings.

PO-10: The students achieve excellence in expressing his/her ideas, writing technical reports with great communication skills and managerial skills.

PO-11: Graduates will be able to understand the critical issues in professional practice such as analyzing the critical soil conditions, procurement of works and the execution of a project and the financial managerial capabilities.

PO-12: Students will maintain an awareness of contemporary issues and recognise the need for and engage in life-long learning to update with or develop technologies to meet the growing and changing needs of society.

VNR VIGNANA JYOTHI INSTITUTE OF ENGINEERING AND TECHNOLOGY, HYDERABAD
M.TECH. I YEAR COURSE STRUCTURE AND SYLLABUS

(GEO-TECHNICAL ENGINEERING)

I SEMESTER **A18**

Course Type	Course Code	Name of the Course	L	T	P	Credits
Professional Core-I	A18PC1GT01	Advanced Soil Mechanics	3	0	0	3
Professional Core-II	A18PC1GT02	Advanced Foundation Engineering	3	0	0	3
Professional Core-III	A18PC1GT03	Ground Improvement Techniques	3	0	0	3
Professional Elective-I	A18PE1GT01	Soil Structure Interaction	3	0	0	3
	A18PE1GT02	Engineering Rock Mechanics				
	A18PE1GT03	Critical Soil Mechanics				
Professional Elective -II	A18PE1GT04	Tunneling Technology	3	0	0	3
	A18PE1GT05	Design with Geosynthetics				
	A18PE1GT06	Offshore Geotechnical Engineering				
Professional Core Lab-I	A18PC2GT01	Soil Mechanics Laboratory - I	0	0	3	1.5
Professional Core Lab-II	A18PC2GT02	Soil Mechanics Laboratory - II	0	0	3	1.5
Project	A18PW4GT01	Technical Seminar	0	0	4	2
Audit	A18AU5CS01	Research Methodology and IPR	2	0	0	0
Total			**17**	**0**	**10**	**20**

VNR VIGNANA JYOTHI INSTITUTE OF ENGINEERING AND TECHNOLOGY, HYDERABAD
M.TECH. I YEAR COURSE STRUCTURE AND SYLLABUS

(GEO-TECHNICAL ENGINEERING)

II SEMESTER **A18**

Course Type	Course Code	Name of the Course	L	T	P	Credits
Professional Core-IV	A18PC1GT04	Dynamics of Soils and Foundations	3	0	0	3
Professional Core-V	A18PC1GT05	Subsurface Investigations and Instrumentation	3	0	0	3
Professional Core-VI	A18PC1GT06	Earth Retaining Structures	3	0	0	3
Professional Elective-III	A18PC1HW04	Pavement Analysis and Design	3	0	0	3
	A18PE1GT07	Earth and Rockfill Dams				
	A18PE1GT08	Environment and Ecology				
Professional Elective-IV	A18PE1GT09	FEM in Geotechnical Engineering	3	0	0	3
	A18PE1GT10	Geographical Information System				
	A18PE1GT11	Stability Analysis of Slopes				
Professional Core Lab-III	A18PC2GT03	Advanced Geotechnical Engineering Laboratory	0	0	3	1.5
Professional Core Lab-	A18PC2GT04	Geotechnical Engineering Studio	0	0	3	1.5
Project	A18PW4GT02	Mini-Project	0	0	4	2
Audit	A18AU5EN01	English for Academic and Research Writing	2	0	0	0
Total			**17**	**0**	**10**	**20**

VNR VIGNANA JYOTHI INSTITUTE OF ENGINEERING AND TECHNOLOGY, HYDERABAD
M.TECH. II YEAR COURSE STRUCTURE AND SYLLABUS

(GEO-TECHNICAL ENGINEERING)

III SEMESTER **A18**

Course Type	Course Code	Name of the Course	L	T	P	Credits
Professional Elective-V	A18PE1GT12	Foundations on Weak Rocks	3	0	0	3
	A18PE1GT13	Geotechnical Earthquake Engineering				
	A18PE1GT14	Environmental Geotechnology				
Open Elective	A18OE1CN01	Business Analytics	3	0	0	3
	A18OE1AM01	Industrial Safety				
	A18OE1AM02	Operations Research				
	A18OE1AM03	Composite Materials				
	A18OE1PS01	Waste to Energy				
Project	A18PW4GT03	Project Part - I	0	0	16	8
Total			**6**	**0**	**16**	**14**

IV SEMESTER **A18**

Course Type	Course Code	Name of the Course	L	T	P	Credits
Project	A18PW4GT04	Project Part - II	0	0	28	14
Total			**0**	**0**	**28**	**14**

VNR VIGNANA JYOTHI INSTITUTE OF ENGINEERING AND TECHNOLOGY

M.Tech. I Semester (GTE)	**L**	**T/P**	**C**
	3	**0**	**3**

(A18PC1GT01) ADVANCED SOIL MECHANICS

COURSE OBJECTIVES:

- To describe the in-depth theoretical concepts pertaining to the mechanical behaviour of soil
- To identify the various terminology and their applications in solving problems related to soil
- To differentiate between the various stress states of the soil and their consequences
- To apply the knowledge gained to solve problems in the field

COURSE OUTCOMES: After completion of the course, students should be able to
CO-1: Describe different concepts and terms used in soil mechanics
CO-2: Differentiate between the various stress states to be applied for a given problem
CO-3: Predict the kind of behavior expected from a given soil structure
CO-4: Identify the appropriate formulae to be used with the knowledge of the mechanics of soil

UNIT-I:
Compressibility and Consolidation: One dimensional compression, Oedometer test, parameters – coefficient of volume change, constrained modulus, compression index, swell or unloading, maximum past consolidation stress, Over consolidation ratio, Primary and secondary compression, consolidation -One, two and three dimensional problems, Consolidation in layered soil and Consolidation for time dependent loading. Determination of Consolidation co-efficient of Consolidation (Casagrande and Taylor's method)

UNIT-II:
Stress-Strain-Strength Behavior of Soils: Mohr Circle of Stress, drained and undrained shear strength of Sand and Clay. Significance of pore pressure parameters; Determination of shear strength; Drained, Consolidated Undrained and Unconsolidated Undrained tests; Interpretation of triaxial test results.

UNIT-III:
Geostatic Stresses: Stresses within a soil mass: Concept of stress for a particulate system, Effective stress principle, Geostatic stresses, Soil water hydraulics.

UNIT-IV:
Stress Path: Drained and untrained stress path; Stress path with respect to different initial state of the soil; Stress path for different practical situations.

UNIT-V:
Critical State Soil Mechanics: Critical state parameters; Critical state for normally consolidated and over consolidated soil; Significance of Roscoe and Hvorslev state boundary surfaces; Yielding, Bounding Surfaces. Drained and Undrained plane, critical void ratio; Effect of dilation in sands; Different dilation in Sands.

UNIT-VI:
Elastic and Plastic Deformations: Elastic wall; Introduction to yielding and hardening; Yield curve and Yield surface, Associated and non-associated flow rule.

TEXT BOOKS:
1. Advanced Soil Mechanics, Das, B. M., Taylor and Francis, Third Edition, 2007

2. The Mechanics of Soils: An Introduction to Critical State Soil Mechanics, Atkinson J. H. and Bransby P. L., McGraw Hill, 1978

REFERENCES:

1. The Mechanics of Soils and Foundation, Atkinson J. H., Second Edition, 2007, First Indian Reprint., McGraw- Hill Co., 2010
2. Soil Mechanics, Craig, R. F., Spon Press, Eighth Edition, An Imprint of Taylor & Francis, 2012

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M.Tech. I Semester (GTE)	**L**	**T/P**	**C**
	3	**0**	**3**

(A18PC1GT02) ADVANCED FOUNDATION ENGINEERING

COURSE OBJECTIVES:
- To create an ability to identify, formulate and solve foundation engineering problems
- To develop an understanding of professional and ethical responsibility
- To understand the impact of engineering solutions in economic and environmental context
- To analyze and interpret data related to foundation engineering

COURSE OUTCOMES: After completion of the course, students should be able to
CO-1: Decide the type of foundations to be recommended for construction of different engineering structures
CO-2: Design different types of foundations
CO-3: Develop an ability to apply knowledge of foundation engineering to solve problems related to geotechnical engineering
CO-4: Analyze the soil settlement problems in foundation engineering

UNIT-I:
Soil Exploration: Planning of soil exploration for different projects, methods of subsurface exploration, and methods of borings along with various penetration tests.

UNIT-II:
Shallow Foundations: Requirements for satisfactory performance of foundations, methods of estimating bearing capacity, settlements of footings and rafts, proportioning of foundations using field test data and IS codes.

UNIT-III:
Pile Foundations: Methods of estimating load transfer of piles, settlements of pile foundations, pile group capacity and settlement, negative skin friction of piles, laterally loaded piles, pile load tests, analytical estimation of load - settlement behavior of piles, proportioning of pile foundations, lateral and uplift capacity of piles.

UNIT-IV:
Well Foundation: IS and IRC codal provisions, elastic theory and ultimate resistance methods

UNIT-V:
Foundations on Problematic Soils: Foundations for collapsible and expansive soil

UNIT-VI:
Coffer Dams: Various types, analysis and design Foundations under uplifting loads

TEXT BOOKS:
1. Soil Mechanics and Foundation Engineering, Murthy V. N. S, CBS Publications, Delhi, 2007
2. Geotechnical Engineering, Das B. M., Cengage Learning, New Delhi, 2009

REFERENCES:
1. Basic and Applied Soil Mechanics, Gopal Ranjan, Rao A. S. R., New Age Publication, Delhi, 2000
2. Geotechnical Engineering, Iqbal H. Khan, Prentice Hall, Delhi, 2007
3. Foundation Analysis and Design, Bowles J. E., 5th Edition, Tata McGraw-Hill International Edition, 1997
4. Shallow Foundations: Bearing Capacity and Settlement, Das B. M., CRC Press, 1999

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M.Tech. I Semester (GTE)	**L**	**T/P**	**C**
	3	**0**	**3**

(A18PC1GT03) GROUND IMPROVEMENT TECHNIQUES

COURSE OBJECTIVES:
- To know the needs and objectives of ground improvement techniques
- To comprehend the principles of various ground improvement methods
- To compare different methods of ground improvement and understand their suitability
- To apply the relevant method to remedy a difficult soil condition

COURSE OUTCOMES: After completion of the course, students should be able to
CO-1: Apply the principles of ground improvement to a given site conditions
CO-2: Work out the choice of right technique to improve different difficult grounds
CO-3: Ensure safe, stable and economical construction for any structure
CO-4: Learn the issues affecting design and construction of various methods for soil improvement

UNIT-I:
Introduction to Ground Modification: Need and objectives of Ground Improvement, Classification of Ground Modification Techniques – suitability and feasibility.

UNIT-II:
Mechanical: Methods of compaction, Shallow compaction, Deep compaction techniques - Vibro-floatation, Blasting, Dynamic consolidation, pre-compression and compaction piles, Field compaction control.

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

UNIT-IV:
Physical and Chemical Modification: Stabilization with admixtures like Cement, Lime, Calcium Chloride, fly Ash and Bitumen. Grouting: Categories of grouting, Art of grouting, Grout materials, Grouting techniques and control.

UNIT-V:
Soil Confinement Systems: Soil reinforcement: Reinforced earth, basic mechanism, type of reinforcements, selection of stabilisation/improvement of ground using Geotextiles, Goegrid, geomembranes, geocells, geonets, and soil nails. Unit.

UNIT-VI:
Application of Soil Reinforcement: Shallow foundations on reinforced earth, design of reinforced earth retaining walls, reinforced earth embankments structures, wall with reinforced backfill, analysis and design of shallow foundations on reinforced earth, road designs with geo- synthetics.

TEXT BOOKS:
1. Engineering Principles of Ground Modifications, Hausmann M. R., McGraw Hill, 1990
2. Designing with Geosynthetics, Koerner R. M, Prentice Hall, New Jersey, 1994

REFERENCES:
1. Engineering Principles of Ground Modification, Hausmann M. R., McGraw-Hill International Edition, 1990

2. Grouting and Deep Mixing, Yonekura R., Terashi M. and Shibazaki M. (Eds.), A. A. Balkema, 1966
3. Ground Improvement, Moseley M. P., Blackie Academic & Professional, 1993
4. Earth Reinforcement and Soil Structures, Jones C. J. F. P., Butterworths, London, 1985
5. Ground Control and Improvement, Xianthakos, Abreimson and Bruce, John Wiley & Sons, 1994

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M.Tech. I Semester (GTE)	**L**	**T/P**	**C**
	3	**0**	**3**

(A18PE1GT01) SOIL STRUCTURE INTERACTION

COURSE OBJECTIVES:
- To introduce the concepts and terminology of soil structure interaction
- To analyze different type of framed structures resting on natural deposits
- To develop knowledge on behavior of piles and pile groups on soils
- To create and formulate advance programming to solve interaction problems

COURSE OUTCOMES: After completion of the course, students should be able to
CO-1: Evaluate soil structure interaction for different types of structure under various conditions of loading and subsoil characteristics
CO-2: Prepare comprehensive design-oriented computer programs for interaction problems based on theory of sub grade reaction such as beams, footings, rafts etc.
CO-3: Analyze different types of frame structure founded on stratified natural deposits with Linear and non-linear stress-strain characteristics
CO-4: Understand action of group of piles considering stress-strain characteristics of real soils

UNIT-I:
Importance of Soil Structure Interaction: Critical Study of Conventional Methods of Foundation design, Nature and Complexities of Soil Structure Interaction.

UNIT-II:
Numerical Techniques in SSI: Application of Advanced Techniques of Analysis such as FEM and Finite Difference Method

UNIT-III:
Relaxation and Interaction Studies: Relaxation and Interaction for the Evaluation of Soil Structure Interaction for Different Types of Structure under various Conditions of Loading and Subsoil Characteristics.

UNIT-IV:
Simulation Program: Effect of seismic load on structure interaction, Preparation of Comprehensive Design Oriented Computer Programs for simple seismic soil structure interaction model, Interaction of Beams, Footings, Rafts Etc. based on Sub Grade Reaction.

UNIT-V:
Soil Structure Interaction of Framed Structure: Analysis of Different Types of Framed Structures Founded on Stratified Natural Deposits with Linear and Non-Linear Stress- Strain Characteristics.

UNIT-VI:
Analysis of Laterally and Axially Loaded Pile Groups: Determination of Pile Capacities and Negative Skin Friction, Action of Group of Piles considering Stress-Strain Characteristics of Real Soils, Anchor Piles and Determination of Pullout Resistance.

TEXT BOOKS:
1. Analytical and Computer Methods in Foundation, Bowels J. E., McGraw Hill Book Co., New York, 1974
2. Elastic Analysis of Soil-Foundation Interaction, Selvadurai A. P. S, Elsevier Scientific Publishing Company
3. Numerical Methods in Geotechnical Engineering, Desai C. S. and Christian J. T., McGraw Hill Book Co., New York

REFERENCES:

1. Soil Structure Interaction - The Real Behaviour of Structures, Institution of Structural Engineers
2. Elastic Analysis of Soil Foundation Interaction, Developments in Geotechnical Engineering, Vol-17, Elsevier Scientific Publishing Company
3. Analysis & Design of Substructures, Swami Saran, Oxford & IBH Publishing Co. Pvt. Ltd.
4. Design of Foundation System-Principles & Practices, Kurian N. P., Narosa Publishing

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M.Tech. I Semester (GTE)	**L**	**T/P**	**C**
	3	**0**	**3**

(A18PE1GT02) ENGINEERING ROCK MECHANICS

COURSE OBJECTIVES:

- To understand the concepts of Rock Mechanics and various terminology involved
- To conduct experiments as well as to analyze and interpret data related to the rock mechanics
- To impart the understanding of the basic principles, latest developments on real world problems
- To connect the theoretical knowledge to real life problems

COURSE OUTCOMES: After completion of the course, students should be able to
CO-1: Understand the formation of rocks and its properties
CO-2: Determine different engineering properties of rock
CO-3: Relate to the latest trends, modern standards and state-of-the-art techniques for understanding rock mechanics and engineering
CO-4: Predict the mode of failure of Rock Structures and to implement appropriate preventive measures

UNIT-I:
Introduction to Rock Mechanics: Development of rock mechanics, problems of rock mechanics, applications and scope of rock mechanics. Classification by Rock Quality Designation, Rock structure Rating, Geomechanics and NGI classification systems.

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

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

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

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

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

TEXT BOOKS:
1. Introduction to Rock Mechanics, Goodman, Wiley, Second Edition 1989

2. Engineering in Rocks for Slopes, Foundations and Tunnels, Ramamurthy T., Third Edition, Prentice Hall of India, PHI Learning Pvt. Ltd., 2014

REFERENCES:

1. Fundamentals of Rock Mechanics, Jaeger J. C. and Cook N. G. W., Third Edition, Chapman and Hall, London, 1979
2. Underground Excavation in Rock, Hoek E. and Brown E. T., 1982
3. Rock Mechanics for Underground Mining, Brady B. H. G. and Brown E. T., Third Edition, Chapman & Hall, Springer Science & Business Media, 2007

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M.Tech. I Semester (GTE)	**L**	**T/P**	**C**
	3	**0**	**3**

(A18PE1GT03) CRITICAL SOIL MECHANICS

COURSE OBJECTIVES:
- To describe the in-depth theoretical concepts pertaining to the critical behavior of soil
- To identify the various terminology and their applications in solving problems related to soil
- To differentiate between the various critical stress states of the soil and their consequences
- To enable the students to connect the knowledge gained to solve field problems

COURSE OUTCOMES: After completion of the course, students should be able to
CO-1: Describe different concepts and terms used in critical soil mechanics
CO-2: Differentiate between the various critical stress states to be applied for a given problem
CO-3: Predict the kind of critical behavior expected from a given soil structure
CO-4: Identify the appropriate formulae to be used with the knowledge of the critical mechanics of soil

UNIT-I:
Soil Behavior: State of stress and strain in soils, Stress and strain paths and invariants, behavior of soils under different laboratory experiments.

UNIT-II:
The Critical State Line and the Roscoe Surface: Families of undrained tests, Families of drained tests, the critical state line, drained and undrained surfaces, The Roscoe surface.

UNIT-III:
Behavior of Over Consolidated Samples: The Hvorslev surface: Behaviour of over consolidated samples, drained and undrained tests, The Hvorslev surface, complete State Boundary Surface, Volume changes and pore water pressure changes.

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

UNIT-V:
Behaviour of Soils before Failure: Elastic and plastic deformations, Plasticity theory, Development of elastic-plastic model based on critical state soil mechanics.

UNIT-VI:
Cam-Clay Model: Description of Cam-Clay, modified Cam-clay model.

TEXT BOOKS:
1. The Mechanics of Soils: An Introduction to Critical State Soil Mechanics, Atkinmson J. H. and Bransby P. L., McGraw Hill, 1982
2. Advanced Soil Mechanics, Das B. M., Third Edition, Taylor and Francis, 2007

REFERENCES:
1. Soil Behaviour and Critical State Soil Mechanics, D. M. Wood, Cambridge University Press, 1990
2. Fundamental of Geotechnical Engineering, B. M. Das, Cengage Learning, 2013

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M.Tech. I Semester (GTE)	**L**	**T/P**	**C**
	3	**0**	**3**

(A18PE1GT04) TUNNELING TECHNOLOGY

COURSE OBJECTIVES:

- To understand the use of elastic and plastic analysis in the design of underground support system
- To explain the field tests generally conducted during and after construction of under structures
- To use of codes and standards in design of underground structures
- To classify the rock mass system and ground condition in tunneling

COURSE OUTCOMES: After completion of the course, students should be able to

CO-1: Explain the various principles used in design of underground construction projects

CO-2: Estimate and analyze various moduli of deformation of rocks by performing the suitable rock test

CO-3: Apply the knowledge gained to the design of tunnel in different ground conditions

CO-4: Design the underground structure using empirical, analytical and numerical approaches

UNIT-I:

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

UNIT-II:

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

UNIT-III:

Classification Systems: Application of rock mass classification systems, ground conditions in tunneling, analysis of underground openings in squeezing and swelling ground, empirical methods.

UNIT-IV:

Tunneling Methods: Estimation of elastic modulus and modulus of deformation of rocks; uniaxial jacking / plate jacking tests, radial jacking and Goodman jacking tests, long term behaviour of tunnels and caverns, New Austrian Tunneling Method (NATM), Norwegian Tunneling Method (NTM), construction dewatering.

UNIT-V:

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

UNIT-VI:

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

TEXT BOOKS:

1. Underground Excavations in Rocks, Hoek E. and Brown E. T., Institute of Mining Engineering
2. Rock Mechanics and Design of Structures in Rocks, Obert L. and Duvall W. I., John Wiley

REFERENCES:

1. Rock Mass Classification-A Practical Engineering Approach, Singh B. and Goel R. K., Elsevier
2. Tunnelling in Weak Rocks, Singh B. and Goel R. K., Elsevier

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M.Tech. I Semester (GTE)	**L**	**T/P**	**C**
	3	**0**	**3**

(A18PE1GT05) DESIGN WITH GEO-SYNTHETICS

COURSE OBJECTIVES:

- To create awareness of the latest trends, modern standards and state of the art techniques for solving geotechnical engineering problems
- To develop an ability to design a geosynthetic system to meet desired needs such as economic, environmental and sustainability related
- To identify latest trends in the curriculum consisting mostly of practical courses in numerous special aspects of civil engineering
- To apply the basic knowledge and to solve critical civil engineering problems in the field like landslides, pavements, dams etc.

COURSE OUTCOMES: After completion of the course, students should be able to
CO-1: Describe different concepts used in Civil Engineering
CO-2: Identify the critical awareness of current issues in Geotechnical Engineering
CO-3: Interpret various techniques, skills, and modern engineering tools for successful carrier in geotechnical engineering practices
CO-4: Solve various Geotechnical Engineering problems using geosynthetics

UNIT-I:
An Overview of Geosynthetic: Geosynthetics classifications, functions, applications, raw materials used. Different types of Geosynthetics, manufacturing, system, Design and sustainability

UNIT-II:
Geosynthetic Testing: Various properties of Geosynthetics - physical properties, mechanical properties, hydraulic properties & endurance properties.

UNIT-III:
Geosynthetic in Filtration, Drainage and Erosion Control: Mechanism of filtration and drainage functions & their applications, Design step for erosion control and geocomposite drainage

UNIT-IV:
Geosynthetics in Pavements & Embankments: Mechanisms and concept of pavement, design of unpaved road, Giroud and Noiray method, U.S. Forest services, airfield pavement design, reflection cracking, pavement rehabilitation and repair
-Design of basal reinforced embankment, placement of Geosynthetics, construction procedure, widening of existing road embankments

UNIT-V:
Geosynthetic in Reinforced Soil Retaining Wall & Slopes: Different types of facing elements, construction procedure, design of Geosynthetics wrap around faced wall, geogrid reinforced soil walls, geocell wall, gabion wall. Design of reinforced slopes, guidelines for design of reinforced slopes

UNIT-VI:
Geosynthetic in Ground Improvement, Landfills & Bearing Capacity: Consolidation techniques, Development of design chart for prefabricated vertical drains, ground instrumentation and monitoring, Design of encased stone columns, geocell/geofoam systems.

Design of landfill liners, Bearing capacity of Geosynthetics reinforced soil system, geocell reinforced sand overlaying soft clay

TEXT BOOKS:

1. Geosynthetics – An Introduction, G. V. Rao, Sai Master Geo-environmental Services Pvt. Ltd. Hyderabad, 2011
2. Designing with Geosynthetics, Vol. 1, Koerner R. M., Sixth Edition, Xlibris Corporation, 2012

REFERENCES:

1. Engineering Principles of Ground Modifications, Hausmann M. R., McGraw-Hill Ryerson Limited, 1990
2. Ground Control and Improvement, Xianthakos Abremson and Bruce, John Wiley & Sons, 1994
3. Ground Improvement, Mosley, Second Edition, CRC Press, 2004
4. Earth Reinforcement and Soil Structures, Jones C. J. F. P., Elsevier, 2013

VNR VIGNANA JYOTHI INSTITUTE OF ENGINEERING AND TECHNOLOGY

M.Tech. I Semester (GTE)	**L**	**T/P**	**C**
	3	**0**	**3**

(A18PE1GT06) OFFSHORE GEOTECHNICAL ENGINEERING

COURSE OBJECTIVES:
- To understand the behavior of marine soils in offshore and coastal zones
- To investigate Marine soil samples under regular and cyclic loads
- To analyze and design foundations for offshore structures
- To study and Prepare solutions for coast protection

COURSE OUTCOMES: After completion of the course, students should be able to
CO-1: Execute investigation program for marine soil deposits
CO-2: Select necessary design parameters
CO-3: Design suitable marine foundation as per project requirement
CO-4: Develop numerical model for response of marine foundation for offshore conditions

UNIT-I:
Marine Soil Deposits: Offshore environment, Offshore structures and foundations, Specific problems related to marine soil deposits, Physical and engineering properties of marine soils.

UNIT-II:
Behavior of Soils Subjected to Repeated Loading: Effect of wave loading on offshore foundations, Behavior of sands and clays under cyclic loading, Laboratory experiments including repeated loading, Cyclic behavior of soils based on fundamental theory of mechanics, Approximate engineering methods which can be used for practical cases.

UNIT-III:
Site Investigation in the Case of Marine Soil Deposits: Challenges of site investigation in marine environment, Different site investigation techniques, sampling techniques, Geophysical methods, Recent advancements in site investigation and sampling used for marine soil deposits.

UNIT-IV:
Foundations in Marine Soil Deposits: Different offshore and near shore foundations, Gravity platforms, Jack-up rigs, pile foundations, caissons, spud cans.

UNIT-V:
Numerical Modeling of Marine Foundations Subjected to Wave Loading: Numerical modeling of cyclic behavior of soils, empirical models, elastic-plastic models, FEM analysis of marine foundations subjected to wave loading.

UNIT-VI:
Sediment Transport Mechanism: In Coastal Zones, Shore Protection through Geosynthetics, Dredging-Techniques and Equipments, Sea Bed Anchors-Types and Mechanism of functioning.

TEXT BOOKS:
1. Numerical Methods in Geotechnical Engineering, S. Chandrakant Desai and John T. Christian, McGraw Hill Book Company, 1977
2. Numerical Methods for Scientific and Engineering Computations, M. K. Jain, S. R. K. Iyengar and R. K. Jain, Third Edition, New Age International (P) Ltd. Publishers, New Delhi

REFERENCES:

1. Finite Elements in Geotechnical Engineering, D. J. Naylor and G. N. Pande, Pineridge Press Ltd., UK
2. Applied Soil Mechanics, Sam Helwany, John Wiley & Sons, Inc.

VNR VIGNANA JYOTHI INSTITUTE OF ENGINEERING AND TECHNOLOGY

M.Tech. I Semester (GTE)	**L**	**T/P**	**C**
	0	**3**	**1.5**

(A18PC2GT01) SOIL MECHANICS LABORATORY-I

COURSE OBJECTIVES:

- To know the concepts of various types of soils
- To understand the real-world problem related to geotechnical engineering
- To apply the knowledge of science, mathematics and engineering with the context of applications in geotechnical engineering
- To conduct experiments, analyze and interpret data related to the various laboratory tests studied in geotechnical engineering

COURSE OUTCOMES: After completion of the course, students should be able to

CO-1: Identify the various types of soils existing at the site

CO-2: Use the techniques, skills, and modern engineering tools necessary for engineering practice

CO-3: Predict probable problems that may be encountered in any Geotechnical Engineering project

CO-4: Identify, formulate and solve geotechnical engineering related issues

LIST OF PRACTICALS:

1. Determination of Moisture Content and Specific gravity of soil
2. Grain Size Distribution Analysis
3. Hydrometer Analysis
4. Atterberg Limits (Liquid Limit, Plastic limit, Shrinkage limit)
5. Visual Classification Tests
6. Test for relative density of sand
7. Standard and modified proctor compaction test
8. Falling head permeability test and Constant head permeability test
9. Consolidation test
10. Free swell index test

VNR VIGNANA JYOTHI INSTITUTE OF ENGINEERING AND TECHNOLOGY

M.Tech. I Semester (GTE)	**L**	**T/P**	**C**
	0	**3**	**1.5**

(A18PC2GT02) SOIL MECHANICS LABORATORY-II

COURSE OBJECTIVES:

- To know the concepts of various types of soils
- To introduce traditional program consisting mostly of practical courses related to geotechnical engineering
- To apply the knowledge of science, mathematics and engineering with the context of applications in geotechnical engineering
- To conduct experiments, analyze and interpret data related to the various laboratory tests studied in geotechnical engineering

COURSE OUTCOMES: After completion of the course, students should be able to
CO-1: Identify the various types of soils existing at the site
CO-2: Use the techniques, skills, and modern engineering tools necessary for engineering practice
CO-3: Predict probable problems that may be encountered in any project
CO-4: Identify, formulate and solve geotechnical engineering related issues

LIST OF PRACTICALS:

1. Unconfined compression test
2. Direct shear test
3. Tri-axial compression test – UU, CU, CD tests
4. Laboratory vane shear test
5. Field Density test
6. Modified direct shear test
7. California Bearing Ratio test
8. Brazilian Test
9. Swell Pressure test

VNR VIGNANA JYOTHI INSTITUTE OF ENGINEERING AND TECHNOLOGY

M.Tech. I Semester (GTE)	**L**	**T/P**	**C**
	0	**4**	**2**

(A18PW4GT01) TECHNICAL SEMINAR

COURSE OUTCOMES: After completion of the course, students should be able to
CO-1: Identify a research topic related to advanced/state-of-the-art technologies
CO-2: Collect the literature and comprehend/analyze critically the technological advancements
CO-3: Engage in effective oral communication through presentation of seminar
CO-4: Engage in effective written communication through report

COURSE OUTLINE:

- A student shall present a seminar on a technical topic during I semester of the M.Tech. programme.
- A student, under the supervision of a faculty member, shall collect literature on a technical topic of his / her choice, critically review the literature and submit it to the Seminar Review Committee (SRC) in a prescribed report form.
- The SRC shall consist of Head of the Department, faculty supervisor and a senior faculty member of the specialization / department.
- Student shall make an oral presentation before the SRC after clearing the plagiarism check.
- Prior to the submission of seminar report to the SRC, its soft copy shall be submitted to the PG Coordinator for PLAGIARISM check.
- The report shall be accepted for submission to the SRC only upon meeting the prescribed similarity index.

VNR VIGNANA JYOTHI INSTITUTE OF ENGINEERING AND TECHNOLOGY

M.Tech. I Semester (GTE)	**L**	**T/P**	**C**
	2	**0**	**0**

(A18AU5CS01) RESEARCH METHODOLOGY AND IPR

COURSE PRE-REQUISITES: None

COURSE OBJECTIVES:
- To introduce the characteristics of a good research problem
- To choose appropriate approaches of investigation of solutions for research problem
- To familiarize with basic Intellectual Property Rights
- To understand different Patent Rights

COURSE OUTCOMES: After completion of the course, students should be able to
CO-1: Understand research problem formulation, analyze research related information and follow research ethics
CO-2: Realize the importance of ideas, concept, and creativity in the present-day context
CO-3: Recognize that when IPR would take such important place in growth of individuals and nation, it is needless to emphasize the need of information about IPR to be promoted among students in general and engineering in particular
CO-4: Appreciate IPR protection which leads to creation of new and better products, and in turn brings about, economic growth and social benefits

UNIT-I:
Introduction: Meaning of research problem, Sources of research problem, Criteria Characteristics of a good research problem, Errors in selecting a research problem, Scope and objectives of research problem.
Approaches of investigation of solutions for research problem, data collection, analysis, interpretation, necessary instrumentations.

UNIT-II:
Literature Survey: Effective literature studies approaches, analysis. Plagiarism, Research ethics.

UNIT-III:
Effective Technical Writing: How to write report, Paper. Developing a Research Proposal, Format of research proposal, a presentation and assessment by a review committee

UNIT-IV:
Nature of Intellectual Property: Patents, Designs, Trade and Copyright. Process of
Patenting and Development: technological research, innovation, patenting, development.
International Scenario: International cooperation on Intellectual Property. Procedure for grants of patents, Patenting under PCT.

UNIT-V:
Patent Rights: Scope of Patent Rights. Licensing and transfer of technology. Patent information and databases. Geographical Indications.

UNIT-VI:
New Developments in IPR: Administration of Patent System. New developments in IPR; IPR of Biological Systems, Computer Software etc. Traditional knowledge Case Studies, IPR.

TEXT BOOKS:
1. Research Methodology: An Introduction for Science & Engineering Students, Stuart Melville and Wayne Goddard

2. Research Methodology: An Introduction, Wayne Goddard and Stuart Melville
3. Resisting Intellectual Property, Halbert, Taylor & Francis Ltd., 2007

REFERENCES:

1. Research Methodology: A Step-by-Step Guide for Beginners, Ranjit Kumar, 2nd Edition
2. Research Methodology: Methods and Techniques, C. R. Kothari and Gaurav Garg, New Age International
3. Intellectual Property in New Technological Age, Robert P. Merges, Peter S. Menell, Mark A. Lemley, 2016
4. Intellectual Property Rights Under WTO, T. Ramappa, S. Chand, 2008

VNR VIGNANA JYOTHI INSTITUTE OF ENGINEERING AND TECHNOLOGY

M.Tech. II Semester (GTE)	**L**	**T/P**	**C**
	3	**0**	**3**

(A18PC1GT04) DYNAMICS OF SOILS AND FOUNDATIONS

COURSE OBJECTIVES:

- To understand the fundamental concepts of vibrations
- To calculate and assess liquefaction behavior of soil
- To determine the dynamic properties of soil by conducting laboratory and field test
- To design foundation for supporting different types of vibrating machines

COURSE OUTCOMES: After completion of the course, students should be able to
CO-1: Differentiate propagation of body waves and surface waves through soil
CO-2: Perform different methods for estimation of dynamic soil properties required for design purpose
CO-3: Predict dynamic bearing capacity and assess liquefaction potential of any site
CO-4: Apply theory of vibrations to design machine foundation based on dynamic soil properties and bearing capacity

UNIT-I:
Fundamentals of Vibrations: single, two and multiple degree of freedom systems, vibration isolation, vibration absorbers, vibration measuring instruments

UNIT-II:
Wave Propagation: elastic continuum medium, semi-infinite elastic continuum medium, soil behaviour under dynamic loading.

UNIT-III:
Liquefaction of Soils: liquefaction mechanism, factors affecting liquefaction, studies by dynamic tri-axial testing, oscillatory shear box, shake table and blast tests, assessment of liquefaction potential.

UNIT-IV:
Dynamic Elastic Constants of Soil: determination of dynamic elastic constants, various methods including block resonance tests, cyclic plate load tests, wave propagation tests, oscillatory shear
box test.

UNIT-V:
Machine Foundations: Design criteria for machine foundations; Elastic homogeneous half space and lumped parameter solutions, analysis and design of foundations for reciprocating and impact type machines, turbines, effect of machine foundation on adjoining structures.

UNIT-VI:
Bearing Capacity of Foundations: Introduction to bearing capacity of dynamically loaded foundations, such as those of water towers, chimneys and high rise buildings, response of pile foundations.

TEXT BOOKS:

1. Handbook of Machine Foundations, Srinivasulu P., Vaidyanathan C. V., Tata McGraw- Hill Education, 1976
2. Soil Dynamics and Machine Foundation, Swami Saran, Galgotia Publishing, 1999

REFERENCES:

1. Design of Structures and Foundations for Vibrating Machines, Arya S. D., O'Neil M. and Pincus G., Gulf Publishing Co., 1979
2. Foundation for Machines: Analysis and Design, Prakash S. and Puri V. K., John Wiley & Sons, 1998
3. Soil Dynamics, Prakash S., McGraw Hill, 1981
4. Vibration Analysis and Foundation Dynamics, Kameswara Rao N. S. V., Wheeler Publication Ltd., 1998
5. Dynamics of Structures and Foundation, I. Chowdhary and S. P. Dasgupta, 2009

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M.Tech. II Semester (GTE)	**L**	**T/P**	**C**
	3	**0**	**3**

(A18PC1GT05) SUBSURFACE INVESTIGATIONS AND INSTRUMENTATION

COURSE OBJECTIVES:

- To apply the various methods of geotechnical investigation and the field tests based on field conditions
- To develop clear idea about planning and execution of geotechnical investigation programme
- To analyze and take proper engineering decisions in practical situations
- To gain the knowledge about the instrumentation for critical sites

COURSE OUTCOMES: After completion of the course, students should be able to

CO-1: Examine subsurface investigation based on the requirement of civil engineering project and site condition

CO-2: Execute different subsurface exploration tests, collect disturbed/undisturbed samples for laboratory tests and can suggest design parameters

CO-3: Understand various methods for estimation of dynamic soil properties required for design purpose

CO-4: Develop instrumentation scheme for monitoring of critical sites

UNIT-I:

Planning an Investigation Programmes: factors to be considered; Exploration for preliminary and detailed design; Guidelines for location, depth and spacing of drilling bore holes;

UNIT-II:

Exploration Techniques: Accessible exploration and Semi-direct methods; Drilling methods, equipments and applicable soil types; Stabilization of boreholes.

UNIT-III:

Sampling: Disturbed and undisturbed soil sampling, representative samples; Methods to minimize sample disturbance; Types of samplers; Preservation and handling of samples.

UNIT-IV:

Field Tests: Standard Penetration Test; Dynamic and static cone penetration tests; Pressure meter test; Field vane shear; Field permeability test; Soil Investigation report.

UNIT-V:

Instrumentation: Settlement gauges, inclinometers, Stress measurements, Seismic measurements and Pore pressure measurements.

UNIT-VI:

Geophysical Methods: Geophysical methods-types-Seismic Methods – Electrical Resistivity Methods – Electrical Profiling Method –Electrical Sounding Method – seismic refraction method – Sub-soil Investigation Report.

TEXT BOOKS:

1. Foundation Analysis and Design, Bowles J. E., McGraw-Hill International Edition, 1997
2. In Situ Testing in Geomechanics, Schnaid F., Taylor and Francis
3. Advanced Soil Mechanics, Das B. M., 2nd Edition, Taylor and Francis, Washington, 1997

REFERENCES:

1. Geotechnical Engineering Investigation Manual, Hunt R. E., Second Edition, McGraw Hill, New York, 2005
2. Principles of Geotechnical Engineering, Braja M. Das, Seventh Edition, Cengage Learning Inc, 2010
3. Soil Mechanics & Foundation Engineering, Purushothama Raj P., Pearson Education India, 2008
4. American Society of Civil Engineers: Soil Sampling, 1999
5. Engineering Properties of Soil and Their Measurements, Bowles B., McGraw-Hill Companies, 1992

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M.Tech. II Semester (GTE)	**L**	**T/P**	**C**
	3	**0**	**3**

(A18PC1GT06) EARTH RETAINING STRUCTURES

COURSE OBJECTIVES:

- To describe the theoretical concepts considered in design of retaining structures
- To explain and arrive at the design methodology prescribed for various retaining structures
- To identify the kind of retaining structure required to serve the design purpose adequately
- To connect the knowledge gained to real life earth retaining structure problems

COURSE OUTCOMES: After completion of the course, students should be able to

CO-1: Describe different concepts and terms used in retaining structures

CO-2: Explain various formulae used and the design procedures of different retaining structures

CO-3: Relate and explain the effectiveness of any kind of retaining structure for a given situation

CO-4: Design the retaining structures using the appropriate methodology and formulas

UNIT-I:

Earth Pressure: Rankine and Coulomb theories, active, passive and pressure at rest; concentrated surcharge above the back fill, earth pressure due to uniform surcharge, earth pressure of stratified backfills, saturated and partially saturated backfill.

UNIT-II:

Retaining Walls: Types of retaining walls, proportioning of retaining walls, stability of retaining walls, mechanically stabilized retaining walls/reinforced earth retaining walls.

UNIT-III:

Sheet Pile Walls: Construction methods- Cantilever and Anchored sheet pile wall, free earth system, fixed earth system.

UNIT-IV:

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

UNIT-V:

Tunnel and Conduit: Stress distribution around tunnels, Types of conduits, Load on projecting conduits; Arching and Open Cuts: Arching in soils- Analysis of Arching in Soil.

UNIT-VI:

Braced Excavations: Earth pressure against bracings in cuts-Design of various components, Heave of the bottom of cut in soft clays, Diaphragm walls –slurry support; Soil Nailing.

TEXT BOOKS:

1. Principles of Foundation Engineering, Das B. M, Eighth Edition, Cengage Learning, 2015
2. Foundation Analysis and Design, Bowles J. E., 5th Edition., Tata McGraw-Hill International Edition, 1997

REFERENCES:

1. Foundation Engineering Handbook, Rowe R. K., Springer Science & Business Media, 2001
2. Foundation Engineering Handbook, Winterkorn and Fang, Springer Science & Business Media, 2013
3. Foundation Analysis & Design, Bowles J. E., Fifth Edition, McGraw-Hill, 2004

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M.Tech. II Semester (GTE)	**L**	**T/P**	**C**
	3	**0**	**3**

(A18PC1HW04) PAVEMENT ANALYSES AND DESIGN

COURSE OBJECTIVES:

- To understand the basic modeling concepts used to analyze flexible and rigid pavements
- To appreciate pavement management concepts to better manage road pavement
- To apply the various types of highway appurtenance to enhance the safety of motorists
- To learn on rigid pavement design components

COURSE OUTCOMES: After completion of the course, students should be able to
CO-1: Understand the design factors flexible and rigid pavements
CO-2: Explain the assumptions in pavement layers and carryout design of flexible and rigid pavement
CO-3: Discriminate different methods of flexible pavement design
CO-4: Different methods of rigid pavement design

UNIT-I:
Introduction: Road Pavements and pavement layers - types, functions, choice Factors affecting design, loads – axle load distribution, ESWL, EWL, VDF due to varying loads.

UNIT-II:
Stresses and Deflection / Strain in Flexible Pavements: Application of elastic theory, stresses, deflections / strains in single, two layer and multi-layer system, Applications in pavement design, KENLAYER.

UNIT-III:
Flexible Pavement Design: Empirical, semi empirical and theoretical design approaches, principle, advantages and application. Outline of other common design methods such as AASHTO and Asphalt Institute methods. Mechanistic-Empirical Pavement Design Guide - I (MEPDG).

UNIT-IV:
Stresses in Rigid Pavements: Types of stresses and causes; Introduction to Westergaard's equation for calculation of stresses in rigid pavements due to wheel loads and temperature; Considerations in rigid pavement analysis, wheel load stresses, warping stresses, frictional stresses, combined stresses, KENSLAB.

UNIT-V:
Rigid Pavement Design: Design of cement concrete pavements for highways; PCA and AASHTO Methods: Design of joints, reinforcements, tie bars, dowel bars and slab thickness as per IRC guidelines. Design features of continuously reinforced concrete pavements. Mechanistic-Empirical Pavement Design Guide - II (MEPDG).

UNIT-VI:
Design of Pavement Drainage: Detrimental effects of water, methods for controlling water in pavements. Drainage materials: aggregates, geo-textiles, pipes. Estimation of inflow, determination of drainage capacity

TEXT BOOKS:

1. Pavement Design and Materials, Papagiannakis A. T. and E. A. Masad, John Wiley and Sons, New Jersey, USA, 2008
2. Pavement Analysis and Design, Huang Y. H., Second Edition, Dorling Kindersley (India) Pvt. Ltd., New Delhi, India, 2008
3. Asphalt Institute, Thickness Design – Asphalt Pavements for Highways and Streets Manual Series No. (MS-1), Asphalt Institute, Kentucky, USA, 1999

REFERENCES:

1. The Design and Performance of Road Pavements, McGraw-Hill Book Company, London, UK, 1991.
2. Mechanistic-Empirical Pavement Design Guide, A Manual of Practice, Interim Edition, Publication Code: MEPDG-1, American Association of State Highway and Transportation Officials (AASHTO), July 2008
3. IRC: 37-2017 Guidelines for the Design of Flexible Pavements, The Indian Roads Congress, New Delhi, India, 2017
4. IRC:58-2011 Guidelines for the Design of Plain Jointed Rigid Pavements for Highways, The Indian Roads Congress, New Delhi, India, 2011
5. Ministry of Road Transport and Highways. Specifications for Road and Bridge Works, Fifth Edition, Indian Roads Congress, New Delhi, India, 2013

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M.Tech. II Semester (GTE)	**L**	**T/P**	**C**
	3	**0**	**3**

(A18PE1GT07) EARTH AND ROCKFILL DAMS

COURSE OBJECTIVES:

- To differentiate between the various kinds of structures depending upon its composition and usage
- To impart the ability to design dams without leading to failure
- To recognize the importance of various hazards involved in building dams and to take up suitable precautions or repairs
- To identify the type of material which is appropriate for the purpose

COURSE OUTCOMES: After completion of the course, students should be able to
CO-1: Identify the appropriate formulae to be used in the design of various structures
CO-2: Design a dam with high efficiency
CO-3: Connect the knowledge gained to solve problems in the field
CO-4: Differentiate between the methods of providing drainage in earthen dams

UNIT-I:
Earthen Dams: General features, Selection of site; Merits and demerits of the earth dams.

UNIT-II:
Design of Earthen Dams: Classification of earth dams, Materials of construction and requirements, Causes of failure, Nature and importance of failure, Safe design criteria.

UNIT-III:
Instrumentation in Earth Dams: Pore pressure measurements, Settlement gauges, Inclinometers, Stress measurements, seismic measurements.

UNIT-IV:
Failures and Prevention in Earthen Dams: Piping through embankment and foundations, Methods of seepage control through embankments and foundations, Design Criteria for filters, Treatment of upstream and downstream of slopes, Drainage control and Filter design.

UNIT-V:
Rock-fill Dams: Types and Historical development, General characteristics of Rock fill dams, Requirements of compacted rock fill, Merits and demerits of the Rock fill dams.

UNIT-VI:
Strength and Settlement: Materials for the Rock fill dams, Shear strength of rock fill, Settlement for Rock fill dams, Movements in rock fill dams.

TEXT BOOKS:

1. Earth and Earth Rock Dams, Sherard, John Wiley, 1967
2. Earth and Rockfill Dams, Sowers G. F. and Salley H. I., Asia Pub. House, 1962

REFERENCES:

1. Earth and Rockfill Dams, Bharat Singh and Sharma H. D, Central Board of Irrigation and Power, 1986
2. Earth & Rockfill Dams–Principles of Design and Construction, Christian, Kutzner, Oxford and IBH, 1997

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M.Tech. II Semester (GTE)	**L**	**T/P**	**C**
	3	**0**	**3**

(A18PE1GT08) ENVIRONMENT AND ECOLOGY

COURSE OBJECTIVES:

- To create ability to identify, formulates, and solve environment related problems
- To develop an understanding of professional responsibility
- To understand the impact of engineering solutions in economic and environmental context
- To apply the knowledge of recent environmental issues

COURSE OUTCOMES: After completion of the course, students should be able to
CO-1: Develop an ability to apply knowledge of environment and ecology to solve problems
CO-2: Design a process for economic and safe aspects for the society
CO-3: Identify, formulate and solve stability related problems
CO-4: Identify and analyze the recent environmental issues

UNIT-I:
Environment: Introduction, Components of Environment, types of Environment, Environmental Ethics Ecosystems: Concept of an ecosystems, structure and functions of Ecosystem, producers, consumers and decomposers, energy flow and bio geo chemical cycles.

UNIT-II:
Ecological Succession Food Chains: Food webs and ecological pyramids, types, characteristic feature structures and functions of eco system.

UNIT-III:
Human Population and Environment: Population growth, variation among nations-Biotech potential and population growth, growth rate formula, carrying capacity, variation among nations, demographic transition, Developed and developing countries, Population explosion, consumption and affluence urbanization and environmental impacts, Industrialization and environmental impacts, family welfare program, immunization.

UNIT-IV:
Recent Environmental Issues: Global warming, Global dimming Greenhouse gas, Ocean acidification, Urban Heat Islands, Ozone depletion- CFC, Biological effects of UV exposure, Nuclear Issues: Nuclear fallout, Nuclear meltdown, Nuclear power, Nuclear weapons, Nuclear and radiation accidents, Nuclear safety, High-level radioactive waste management.

UNIT-V:
Pollution: Nonpoint source pollution, Point source pollution, Light pollution, Noise pollution, Visual pollution Water Pollution: Acid rain, Eutrophication, Marine pollution, Ocean dumping, Oil spills, Thermal pollution, Land Degradation: Land pollution, Desertification, Soil conservation, Soil erosion, Soil contamination, Soil salination, Alkali soils.

UNIT-VI:
Air Pollution: Effects and control of air pollution, Smog, Troposphere ozone, Indoor air quality, volatile organic compound, atmospheric particulate matter, effects and control, control devices.

TEXT BOOKS:

1. Comprehensive Environmental Studies, Dr. J. P. Sharma, Laxmi Publications, 2009
2. Text Book of Environmental Studies, Dr. K. Raghavan Nambiar

REFERENCES:

1. Text Book of Environmental Studies, Kaushik, New Age Publishers, 2009
2. Environmental Science, Tyley Miller, Eleventh Edition, Cengage Learning, 2005
3. Concepts of Ecology, E. J. Kormondy, Prentice-Hall, 1969

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M.Tech. II Semester (GTE)	**L**	**T/P**	**C**
	3	**0**	**3**

(A18PE1GT09) FEM IN GEOTECHNICAL ENGINEERING

COURSE OBJECTIVES:

- To provide the fundamental concepts of the theory of the finite element method
- To develop proficiency in the application of the finite element method to realistic engineering problems
- To understand the theory of elasticity including strain/displacement and Hooke's law relationships
- To learn to model complex geometry problems and solution techniques

COURSE OUTCOMES: After completion of the course, students should be able to

CO-1: Understand basic stress-strain relationship for soil and develop Stress deformation analysis

CO-2: Develop finite element formulation for different geotechnical problems like shallow foundation

CO-3: Apply this knowledge onto Plaxis for plotting stress distribution and settlement curves

CO-4: Analyze and give appropriate solution to practical geotechnical concerns like seepage and consolidation problems

UNIT-I:

Stress-Deformation Analysis: One dimensional, Two dimensional and Three-dimensional formulations.

UNIT-II:

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

UNIT-III:

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.

UNIT-IV:

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

UNIT-V:

Settlement Analysis: 2-D elastic solutions for homogeneous, isotropic medium, Steady Seepage Analysis.

UNIT-VI:

Finite element solutions of Laplace's equation, Consolidation

Analysis: Terzaghi consolidation problem, Choice of Soil Properties for Finite Element Analysis.

TEXT BOOKS:

1. Concepts and Applications of Finite Element Analysis, Robert D. Cook, David S. Malkus, Michael E. Plesha, John Wiley & Sons
2. Fundamentals of Finite Element Analysis, David V. Hutton, McGraw-Hill

REFERENCES:

1. Finite Element Analysis, Seshu P., Prentice-Hall of India, 2005
2. Finite Element Methods in Engineering, Belegundu A. D., Chandrupatla T. R., Prentice Hall India, 1991
3. Finite Element Methods Vol. I & Vol. II, O. C. Zienkiewicz and R. L. Taylor, McGraw Hill, 1989 & 1992
4. Finite Element Procedures, K. J. Bathe, PHI Ltd., 1996
5. Finite Element Analysis in Geotechnical Engineering Theory and Application, David M. Potts and LidijaZdravkovic, Thomas Telford, 1999

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M.Tech. II Semester (GTE)	**L**	**T/P**	**C**
	3	**0**	**3**

(A18PE1GT10) GEOGRAPHICAL INFORMATION SYSTEM

COURSE OBJECTIVES:

- To describe and define various concepts of Remote Sensing and GIS
- To enable the students to analyze Remote sensing and GIS data
- To make the students appraise the importance accuracy of remote sensing and GIS data
- To enable the students to apply remote sensing and GIS knowledge in solving various Geotechnical engineering related problems

COURSE OUTCOMES: After completion of the course, students should be able to
CO-1: Describe different concepts and terms used in remote sensing and GIS
CO-2: Compare and process different data sets
CO-3: Evaluate the accuracy and decide whether a data set can be used or not
CO-4: Demonstrate various applications in RS and GIS

UNIT-I:
Remote Sensing: Introduction- Principle of remote sensing, components of remote sensing, Remote sensing platforms, Radiometric quantities, Electromagnetic radiation and its properties, Electromagnetic energy laws, Interaction of EMR with earth features, Interaction of EMR with atmospheric features, atmospheric effects on remote sensing data, spectral reflectance curves, Spectral properties of soil, water, vegetation. Advantages and Disadvantages of Remote Sensing Data.

UNIT-II:
Sensors: Sensors - Remote sensing sensors types, Along track scanners, Across track scanners Sensor Characteristics – Swath, IFOV, Nadir view, Spatial Resolution, Spectral Resolution, Temporal, Resolution, Radiometric resolution, Atmospheric, Radiometric, Geometric corrections

UNIT-III:
Satellites: Satellite orbits, Geostationary and polar satellites, various satellites and their main applications, IRS satellites
Remote Sensing Data Interpretation: Elements of visual interpretation, converging evidence.

UNIT-IV:
Remote Sensing Data Processing and Enhancement: Image enhancement techniques - necessity and importance, contrast enhancement techniques, low pass (smoothing) filters and high pass (sharpening) filters, linear and non-linear filtering techniques, edge detection, supervised classification, unsupervised classification, and Classification accuracy. Introduction to GPS and DGPS.

UNIT-V:
Geographical Information System: Introduction, Definition and Terminology, Components of GIS, GIS Data Input - Keyboard entry, Manual digitizing, scanning methods, Errors in digitizing, Data output formatting and output devices, GIS Data Models – Raster, Vector, TIN, Spatial Data Analysis – Interpolation, Buffering techniques, Overlay operations

UNIT-VI:

Applications of GIS in Geotechnical Engineering: Developing a Soil information system for Multiple decisions, GIS and Remote Sensing based Soil mapping, Soil moisture investigation, land slide hazard zonation using remote sensing and GIS, Land use land cover classification, Agriculture applications, Dam site selection using RS and GIS

TEXT BOOKS:

1. Remote Sensing and Image Interpretation, Thomas M. Lillesand and Ralph W. Kiefer, John Wiley & Sons, Seventh Edition 2014
2. Remote Sensing and GIS, Basudeb Bhatta, Oxford University Press, 2008

REFERENCES:

1. Introduction to Geographic Information Systems, Kang-tsung Chang, McGraw-Hill Education (Indian Edition), Seventh Edition, 2013
2. Basics of Remote sensing and GIS, S. Kumar, Laxmi Publications, 2005
3. Textbook of Remote Sensing and Geographical Information Systems, M. Anji Reddy, B.S. Publications, Third Edition 2008
4. Textbook of Remote Sensing and Geographical Information Systems, Kali Charan Sahu, Atlantic Publishers and Distributors, Atlantic Publishers, 2007

VNR VIGNANA JYOTHI INSTITUTE OF ENGINEERING AND TECHNOLOGY

M.Tech. II Semester (GTE)	**L**	**T/P**	**C**
	3	**0**	**3**

(A18PE1GT11) STABILITY ANALYSIS OF SLOPES

COURSE OBJECTIVES:
- To inculcate the ability to identify, formulate and solve soil stability related problems
- To impart the ability to design soil slopes without leading to failure
- To recognize the importance of various hazards involved in building slopes and dams and to take up suitable precautions or repairs
- To apply limit equilibrium methods for slopes

COURSE OUTCOMES: After completion of the course, students should be able to
CO-1: Choose the appropriate formulae to be used in the design of various structures
CO-2: Analyze a given structure and predict its behavior
CO-3: Design and check stability of slope with high efficiency
CO-4: Identify the appropriate the slope stabilization methods

UNIT-I:
Slopes: Types and causes of slope failures, mechanics of slope failure, failure modes.

UNIT-II:
Stability Analysis: Infinite and finite slopes with or without water pressures; concept of factor of safety, pore pressure coefficients, Mass analysis, Wedge methods

UNIT-III:
Stability Methods: Friction circle method; Method of slices, Bishop's method, Janbu's method, Morgenstern and Price, Spencer's method

UNIT-IV:
Stability Analysis in the Presence of Seepage: Two-dimensional flow – Laplace equation and it's solution, graphical method, determination of phreatic line, flow nets in homogeneous and zoned earth dams under steady seepage and draw-down conditions, seepage control in earth dams, influence of seepage on slope stability, stability analysis of dam body during steady seepage.

UNIT-V:
Strengthening Measures: Stabilization of slopes by drainage methods, surface and subsurface drainage, use of synthetic filters, retaining walls, stabilization and strengthening of slopes.

UNIT-VI:
Rock Stabilization: Shotcreting, rock bolting and rock anchoring, instrumentation and monitoring of slopes, slope movements, warning devices, maintenance of slopes

TEXT BOOKS:
1. Geotechnical Slope Analysis, Chowdhary R. and Chowdhary I., CRC Press
2. Ground Water and Seepage, Harr M. E., McGraw Hill

REFERENCES:
1. Soil Strength and Slope Stability, Duncan J. and Wrught G., Wiley Publishers
2. Slope Stability and Stabilization Methods, Abramson, L. W., Lee, T. S. and Sharma, S., John Wiley & Sons

3. The Stability of Slopes, Bromhead, E. N., Blackie Academic and Professional, London Second Edition, 1992

VNR VIGNANA JYOTHI INSTITUTE OF ENGINEERING AND TECHNOLOGY

M.Tech. II Semester (GTE)	**L**	**T/P**	**C**
	0	**3**	**1.5**

(A18PC2GT03) ADVANCED GEOTECHNICAL ENGINEERING LABORATORY

COURSE OBJECTIVES:

- To know the effect of contamination on the behavior of soil
- To identify the influence of stress on the permeability of soil
- To determine the properties of geosynthetics
- To conduct in situ experiments on soil

COURSE OUTCOMES: After completion of the course, students should be able to

CO-1: Evaluate the field properties of soil

CO-2: Identify suitability of geosynthetics for specific application

CO-3: Understand the influence of contaminants on the chemical properties of soil

CO-4: Perform experiments to determine the variation permeability with the application of pressure

LIST OF EXPERIMENTS:

1. Exploration of sub soil by Auger Boring
2. Dynamic cone penetration test
3. Determination of permeability using Flexi wall permeameter
4. Determination of pH, electrical conductivity and total dissolved solids in contaminated soil
5. Estimation of specific surface area of soil
6. Determination of chlorides, sulphates, hardness and presence of organic content in
    a. soil
7. Measurement of physical properties of Geosynthetic materials
    a. Thickness
    b. Stiffness
    c. Mass/ unit area
8. CBR Puncture test for geosynthetics
9. Determination of percentage open area and apparent opening size for geosynthetics material
10. Radial in-plane flow test on geotextiles

VNR VIGNANA JYOTHI INSTITUTE OF ENGINEERING AND TECHNOLOGY

M.Tech. II Semester (GTE)	**L**	**T/P**	**C**
	0	**3**	**1.5**

(A18PC2GT04) GEOTECHNICAL ENGINEERING STUDIO

COURSE OBJECTIVES:

- To apply theoretical knowledge on the numerical computation techniques
- To analyse the stability the slope using softwares
- To create templates for the design different types of foundation
- To design land fill liner, embankments, retaining earth structures etc.

COURSE OUTCOMES: After completion of the course, students should be able to

CO-1: Conduct stress deformation analysis using softwares
CO-2: Perform stability analysis of slopes, embankments, and retaining earth structures
CO-3: Evaluate the amount of contamination on the field
CO-4: Design templates for the design of various geotechnical structures

LIST OF PRACTICALS:

1. Design of templates for foundations using MS Excel
2. Slope stability Analysis using Slope/W
3. Contaminant transport analysis using CTRAN
4. Creation of template for design of land fill liners using MS Excel
5. Creation of template for the design of Machine Foundations
6. Creation of template for the design of Soil Reinforcement
7. Conceptual modelling using Visual MODFLOW Flex
8. Numerical modelling using Visual MODFLOW Flex
9. Linear frequency analysis using DEEP SOIL
10. Equivalent linear frequency domain analysis using DEEP SOIL

VNR VIGNANA JYOTHI INSTITUTE OF ENGINEERING AND TECHNOLOGY

M.Tech. II Semester (GTE)	**L**	**T/P**	**C**
	0	**4**	**2**

(A18PW4GT02) MINI-PROJECT

COURSE OUTCOMES: After completion of the course, students should be able to
CO-1: Understand the formulated industry / technical / societal problems
CO-2: Analyze and / or develop models for providing solution to industry / technical / societal problems
CO-3: Interpret and arrive at conclusions from the project carried out
CO-4: Demonstrate effective communication skills through oral presentation
CO-5: Engage in effective written communication through project report

COURSE OUTLINE:

- A student shall undergo a mini-project during II semester of the M.Tech. programme.
- A student, under the supervision of a faculty member, shall collect literature on an allotted project topic of his / her choice, critically review the literature, carry out the mini-project, submit it to the department in a prescribed report form.
- Evaluation of the mini-project shall be done by a Project Review Committee (PRC) consisting of the Head of the Department, faculty supervisor and a senior faculty member of the specialization / department.
- Prior to the submission of mini-project report to the PRC, its soft copy shall be submitted to the PG Coordinator for PLAGIARISM check.
- The mini-project report shall be accepted for submission to the PRC only upon meeting the prescribed similarity index.

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M.Tech. II Semester (GTE)	**L**	**T/P**	**C**
	2	**0**	**0**

(A18AU5EN01) ENGLISH FOR ACADEMIC AND RESEARCH WRITING

COURSE OBJECTIVES:

- To understand the usage of appropriate vocabulary (Formal, Informal, Gender Insensitive etc.)
- To understand the features and processes of academic writing
- To identify the resources
- To understand standard documentation styles

COURSE OUTCOMES: After completion of the course, students should be able to

CO-1: Use appropriate vocabulary (Formal, Informal, Slang, Gender Insensitive etc.)

CO-2: Employ processes of academic writing

CO-3: Identify the resources

CO-4: Understand standard documentation styles

UNIT- I:

Introduction to Research:

i. Identifying the topic
ii. Identifying Sources; Finding Sources
iii. Defining the broad area; Defining the specific area; Difference between a broad area and specific area
iv. Choosing a topic
v. Mechanics of Writing – Language, Tone, Style, Ethics

UNIT-II:

Referencing & Library Skills:

i. Literature Survey
ii. Writing Objectives
iii. Hypothesis
iv. Methodology
v. Prospects for Future Research

UNIT-III:

Academic Writing Skills:

i. Paraphrasing
ii. Summarizing
iii. Quoting
iv. Rewriting
v. Expansion

UNIT-IV:

Kinds of Academic Writing:

i. Essays
ii. Reports
iii. Reviews
iv. SOPs
v. Abstracts
vi. Proposals

UNIT-V:

Research Process:

i. Selection of Topic

ii. Formulation of Hypothesis
iii. Collection of Data
iv. Analysis of Data
v. Interpretation of Data
vi. Presentation of Data

UNIT-VI:

i. Title
ii. Abstract
iii. Introduction
iv. Literature Survey
v. Methodology
vi. Discussion
vii. Findings/Results
viii. Conclusion
ix. Documenting Sources

TEXT BOOKS:

1. Writing for Science, Goldbort R., Yale University Press, 2006
2. Handbook of Writing for the Mathematical Sciences, Highman N., SIAM. Highman's Book, 1998

REFERENCES:

1. How to Write and Publish a Scientific Paper, Day R., Cambridge University Press, 2006
2. English for Writing Research Papers, Adrian Wall Work, Springer New York Dordrecht Heidelberg London, 2011
3. MLA Handbook for Research

VNR VIGNANA JYOTHI INSTITUTE OF ENGINEERING AND TECHNOLOGY

M.Tech. III Semester (GTE)	**L**	**T/P**	**C**
	3	**0**	**3**

(A18PE1GT12) FOUNDATIONS ON WEAK ROCKS

COURSE OBJECTIVES:

- To understand the Engineering properties of weak rocks
- To classify different types of rock mass
- To design different types of foundations placed over rock mass
- To identify the pressure settlement criteria of weak rocks

COURSE OUTCOMES: After completion of the course, students should be able to

CO-1: Explain the various types rock mass classification systems
CO-2: Determine in-situ shear strength of rocks and rock masses
CO-3: Apply the knowledge gained to the design shallow foundation and treatment of it
CO-4: Analyze the bearing capacity and settlement of pile in weak rocks

UNIT-I:

Engineering properties of weak rocks, different rock mass classification systems, relative merits and demerits, Failure criteria for weak rocks, bi-linear Mohr-Coulomb failure criterion, Hoek and Brown criterion and modified Hoek and Brown failure criterion etc.

UNIT-II:

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

UNIT-III:

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

UNIT-IV:

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

UNIT-V:

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

UNIT-VI:

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

TEXT BOOKS:

1. Foundations on Rock: Engineering Practice, Wyllie Duncan C., E & FN Spon, Taylor and Francis
2. Engineering Rock Mechanics: An Introduction to the Principles, Hudson J. A. and J. P. Harrison, Oxford, Elsevier, 1977

REFERENCES:

1. Rock Mass Classification-A Practical Engineering Approach, Singh B. and Goel R. K., Elsevier
2. Engineering in Rocks, Ramamurthy T., PHI Learning
3. Practical Rock Engineering, Hoek E., Rock Science

VNR VIGNANA JYOTHI INSTITUTE OF ENGINEERING AND TECHNOLOGY

M.Tech. III Semester (GTE)	**L**	**T/P**	**C**
	3	**0**	**3**

(A18PE1GT13) GEOTECHNICAL EARTHQUAKE ENGINEERING

COURSE OBJECTIVES:

- To understand the basics of earthquake seismology
- To predict the nature of ground motion during earthquake
- To analyse the ground response using computer code
- To learn the phenomena of liquefaction

COURSE OUTCOMES: After completion of the course, students should be able to
CO-1: Know the causes and quantification of earthquake
CO-2: Understand the effect of earthquake
CO-3: Perform seismic stability analysis of slopes, dams and earth retaining structures
CO-4: Gain knowledge on the design criterions to be followed for the design different geotechnical structures

UNIT-I:
Earthquake Seismology: Causes of earthquake, Plate tectonics, Earthquake fault sources, Seismic waves, Elastic rebound theory, Quantification of earthquake, Intensity and magnitudes, Earthquake source models.

UNIT-II:
Earthquake Ground Motion: Seismograph, Characteristics of ground motion, Effect of local site conditions on ground motions, Design earthquake, Design spectra, Development of sites specification and code-based design.

UNIT-III:
Ground Response Analysis: One-dimensional ground response analysis: Linear approaches, Equivalent linear approximation of non-linear approaches, Computer code "SHAKE".

UNIT-IV:
Liquefaction and Lateral Spreading: Liquefaction related phenomena, Liquefaction **Susceptibility:** Historical, Geological, Compositional and State criteria. Evaluation of liquefaction by cyclic stress and cyclic strain approaches, Lateral deformation and spreading, Criteria for mapping liquefaction hazard zones.

UNIT-V:
Seismic Design of Foundations, Seismic Slope Stability Analysis: Internal stability and Weakening instability and Seismic design of retaining walls.

UNIT-VI:
Seismic Analysis and Design of Various Geotechnical Structures: Pseudo-static method, Pseudo dynamic method, Seismic slope stability analysis, Behavior of reinforced soil under seismic conditions, Seismic analysis of Tailings Dam, seismic design of shallow foundations, seismic design of Municipal Solid Waste (MSW) landfills. Codal provisions/guidelines for seismic design of geotechnical structures.

TEXT BOOKS:

1. Geotechnical Earthquake Engineering, Steven Kramer, Pearson, 2008
2. Seismic Behaviour of Ground and Geotechnical Structure, Pinto P. A., Secoe

REFERENCES:

1. The Seismic Design Handbook, Naeim F., Kluwer Academic Publication, 2nd Edition, 2001
2. Seismic Design Criteria for Soil Liquefaction, Ferrito J. M., Tech. Report of Naval Facilities Service Center, Port Hueneme, 1997
3. The Seismic Design Handbook, 2nd Edition, Kluwer Academic Publication, 2001
4. Geotechnical Earthquake Engineering Handbook, Robert W. Day, McGraw-Hill
5. Geotechnical Earthquake Engineering, Ikuo Towhata, Springer-Verlag, Heidelberg

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M.Tech. III Semester (GTE)	**L**	**T/P**	**C**
	3	**0**	**3**

(A18PE1GT14) ENVIRONMENTAL GEOTECHNOLOGY

COURSE OBJECTIVES:

- To understand the basics concepts of properties of water in relation to soil media
- To differentiate various mineralogical characteristics
- To develop a clear idea on soil-water interaction mechanism
- To classify various waste containment systems & remediation techniques

COURSE OUTCOMES: After completion of the course, students should be able to

CO-1: Understand Soil-environment interaction, Soil mineralogy and Mechanisms of soil-water interaction

CO-2: Learn about ground water flow and predict contaminant transport phenomenon

CO-3: Apply remediation techniques for contaminated site

CO-4: Create an idea in the development of various landfill design techniques

UNIT-I:

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.

UNIT-II:

Soil Mineralogy: Significance of mineralogy in determining soil behavior; Mineralogical characterization.

UNIT-III:

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.

UNIT-IV:

Concepts of Waste Containment: Sources, production and classification of wastes, Environmental laws and regulations, ground water flow, desirable properties of soil; contaminant transport and retention; contaminated site remediation.

UNIT-V:

Soil Characterization Techniques: Physico-Chemico mineralogical, electrical and thermal properties and volumetric water content; gas permeation in soil; pore-size distribution; contaminant analysis. Contaminated site characterization.

UNIT-VI:

Quantification and Remediation: Estimation of landfill quantities, landfill site location, design of various landfill components such as liners, covers, leach ate collection and removal, gas generation and management, ground water monitoring, end uses of landfill sites, Engineered landfills, slurry walls and barrier systems, design and construction, stability, compatibility and performance, remediation technologies, stabilization of contaminated soils and risk assessment approaches.

TEXT BOOKS:

1. Introduction to Environmental Geotechnology, Fang H. Y., CRC Press, Second Edition, 2016
2. Environmental Geotechnology, R. W. Sarsby, Thomas Telford, 2000

REFERENCES:

1. Fundamentals of Soil Behavior, Mitchell J. K. and Soga K., John Wiley and Sons Inc., 2005
2. Geotechnical Practice for Waste Disposal, Daniel D. E., Chapman and Hall, 2012
3. Clay Barrier Systems for Waste Disposal Facilities, Rowe R. K., Quigley R. M. and Booker J. R., E & FN Spon,1997, 2004, 2nd Edition
4. Geotechnical and Geo-environmental Engineering Handbook, Rowe R. K., Kluwer Academic Publishers, 2001
5. Geo-environmental Engineering Principles, Reddi L. N. and Inyang H. F.

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M.Tech. III Semester (GTE)	**L**	**T/P**	**C**
	3	**0**	**3**

(A18OE1CN01) BUSINESS ANALYTICS

COURSE OBJECTIVES:

- To understand the role of business analytics within an organization and to analyze data using statistical and data mining techniques and understand relationships between the underlying business processes of an organization
- To gain an understanding of how managers use business analytics to formulate and solve business problems and to support managerial decision making and to become familiar with processes needed to develop, report, and analyze business data
- To use decision-making tools/Operations research techniques and to manage business process using analytical and management tools
- To analyze and solve problems from different industries such as manufacturing, service, retail, software, banking and finance, sports, pharmaceutical, aerospace etc.

COURSE OUTCOMES: After completion of the course, students should be able to
CO-1: Apply knowledge of data analytics
CO-2: Think critically in making decisions based on data and deep analytics
CO-3: Use technical skills in predicative and prescriptive modeling to support business decision-making
CO-4: Translate data into clear, actionable insights

UNIT-I:
Business Analytics: Overview of Business analytics, Scope of Business analytics, Business Analytics Process, Relationship of Business Analytics Process and organization, competitive advantages of Business Analytics.
Statistical Tools: Statistical Notation, Descriptive Statistical methods, Review of probability distribution and data modelling, sampling and estimation methods overview.

UNIT-II:
Trendiness and Regression Analysis: Modelling Relationships and Trends in Data, simple Linear Regression. Important Resources, Business Analytics Personnel, Data and models for Business analytics, problem solving, Visualizing and Exploring Data Business Analytics Technology.

UNIT-III:
Organization Structures of Business analytics, Team management, Management Issues, Designing Information Policy, Outsourcing, Ensuring Data Quality, Measuring contribution of Business analytics, Managing Changes.
Descriptive Analytics, predictive analytics, predicative Modelling, Predictive analytics analysis, Data Mining, Data Mining Methodologies, Prescriptive analytics and its step in the business analytics Process, Prescriptive Modelling, nonlinear Optimization.

UNIT-IV:
Forecasting Techniques: Qualitative and Judgmental Forecasting, Statistical Forecasting Models, Forecasting Models for Stationary Time Series, Forecasting Models for Time Series with a Linear Trend, Forecasting Time Series with Seasonality, Regression Forecasting with Casual Variables, Selecting Appropriate Forecasting Models.
Monte Carlo Simulation and Risk Analysis: Monte Carle Simulation Using Analytic Solver Platform, New-Product Development Model, Newsvendor Model, Overbooking Model, Cash Budget Model.

UNIT-V:

Decision Analysis: Formulating Decision Problems, Decision Strategies without Outcome Probabilities, Decision Trees, The Value of Information, Utility and Decision Making.

UNIT-VI:

Recent trends in Embedded and collaborative business intelligence, Visual data recovery, Data Storytelling and Data journalism.

TEXT BOOKS:

1. Business Analytics-Principles, Concepts, and Applications, Marc J. Schniederjans, Dara G. Schniederjans, Christopher M. Starkey, Pearson FT Press
2. Business Analytics, James Evans, Pearson Education
3. Business Analytics, Purba Halady Rao, PHI, 2013

REFERENCES:

1. Business Analytics for Managers: Taking Business Intelligence Beyond Reporting, Gert H. N. Laursen, Jesper Thorlund, 2nd Edition, Wiley Publications
2. Business Analytics: Data Analysis & Decision Making, S. Christian Albright, Wayne L. Winston 5th Edition, 2015
3. Business Intelligence Guidebook: From Data Integration to Analytics, Rick Sherman Elsevier, 2014

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M.Tech. III Semester (GTE)	**L**	**T/P**	**C**
	3	**0**	**3**

(A18OE1AM01) INDUSTRIAL SAFETY

COURSE PRE-REQUISITES: Elements of Mechanical, Civil, Electrical and Industrial Engineering

COURSE OBJECTIVES:

- To achieve an understanding of principles, various functions and activities of safety management
- To communicate effectively information on Health safety and environment facilitating collaboration with experts across various disciplines so as to create and execute safe methodology in complex engineering activities
- To anticipate, recognize, and evaluate hazardous conditions and practices affecting people, property and the environment, develop and evaluate appropriate strategies designed to mitigate risk
- To develop professional and ethical attitude with awareness of current legal issues by rendering expertise to wide range of industries

COURSE OUTCOMES: After completion of the course, students should be able to

CO-1: Apply risk management principles to anticipate, identify, evaluate and control physical, chemical, biological and psychosocial hazards

CO-2: Communicate effectively on health and safety matters among the employees and with society at large

CO-3: Demonstrate the use of state-of-the-art occupational health and safety practices in controlling risks of complex engineering activities and understand their limitations

CO-4: Interpret and apply legislative / Legal requirements, industry standards, and best practices in accident prevention programmes in a variety of workplaces

UNIT-I:

Safety Management: Evaluation of modern safety concepts – Safety management functions – safety organization, safety department – safety committee, safety audit - performance measurements and motivation – employee participation in safety and productivity.

UNIT-II:

Operational Safety: Hot metal Operation – Boiler, pressure vessels – heat treatment shop - gas furnace operation-electroplating-hot bending pipes – Safety in welding and cutting. Cold-metal Operation- Safety in Machine shop-Cold bending and chamfering of pipes – metal cutting – shot blasting, grinding, painting – power press and other machines

UNIT-III:

Safety Measures: Layout design and material handling - Use of electricity – Management of toxic gases and chemicals – Industrial fires and prevention – Road safety– Safety of sewage disposal and cleaning – Control of environmental pollution – Managing emergencies in industrial hazards.

UNIT-IV:

Accident Prevention: Human side of safety – personal protective equipment – Causes and cost of accidents. Accident prevention programmes - Specific hazard control strategies - HAZOP – Training and development of employees – First Aid – Firefighting devices – Accident reporting investigation.

UNIT-V:

Safety, Health, Welfare & Laws: Safety and health standards – Industrial hygiene – occupational diseases prevention - Welfare facilities – History of legislations related to safety–

pressure vessel act- Indian boiler act- The environmental protection act – Electricity act - Explosive act.

UNIT-VI:

Safe Handling and Storage: Material Handling, Compressed Gas Cylinders, Corrosive Substances, Hydrocarbons, Waste Drums and Containers

TEXT BOOKS:

1. Safety Management, John V. Grimaldi and Rollin H. Simonds, All India Travellers Bookseller, New Delhi, 1989.
2. Safety Management in Industry, Krishnan N. V., Jaico Publishing House, 1996.

REFERENCES:

1. Occupational Safety Manual, BHEL
2. Industrial Safety and The Law, P. M. C. Nair Publisher's, Trivandrum
3. Managing Emergencies in Industries, Loss Prevention of India Ltd., Proceedings, 1999
4. Safety Security and Risk Management, U. K. Singh & J. M. Dewan, A. P. H. Publishing Company, New Delhi, 1996
5. Industrial Safety Management: Hazard Identification and Risk Control, L. M. Deshmukh, McGraw-Hill Education (India) Private Limited, 2005

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M.Tech. III Semester (GTE)	**L**	**T/P**	**C**
	3	**0**	**3**

(A18OE1AM02) OPERATIONS RESEARCH

COURSE PRE-REQUISITES: Mathematics, Industrial Engineering

COURSE OBJECTIVES:
- To analyze linear programming models in practical and their practical use
- To apply the transportation, assignment and sequencing models and their solution methodology for solving problems
- To apply the theory of games, replacement, inventory and queuing models and their solution methodology for solving problems
- To evaluate the dynamic programming and simulation models

COURSE OUTCOMES: After completion of the course, students should be able to
CO-1: Apply and solve the dynamic programming problems
CO-2: Apply the concept of non-linear programming
CO-3: Carry out sensitivity analysis
CO-4: Model the real-world problem and simulate it

UNIT-I:
Introduction to Operations Research-Definitions of OR, Characteristics of OR, Scope of OR, Classification of Optimization Techniques, models in OR, General L.P Formulation, Graphical solution, Simplex Techniques.

UNIT-II:
Revised simplex method - duality theory - dual simplex method – sensitivity or post optimality analysis - parametric programming

UNIT-III:
Nonlinear programming problem - Kuhn-Tucker condition, min cost flow problem - max flow problem - CPM/PERT

UNIT-IV:
Scheduling and sequencing, Inventory models, deterministic inventory, models - Probabilistic inventory control models - Geometric Programming.

UNIT-V:
Waiting line Models, Single and Multi-channel Problems, Dynamic Programming, Game Theory, Simulation.

UNIT-VI:
Introduction to Genetic Algorithms, Operators, applications to engineering optimization, Problems.

TEXT BOOKS:
1. Operations Research, S. D. Sharma, Kedarnath Ramnath, Meerut, New Delhi
2. Engineering Optimization, S. S. Rao, New Age International Publications, 2014
3. Introduction to Genetic Algorithms, S. N. Sivanandam, Springer

REFERENCES:
1. Operations Research-An Introduction, H. A. Taha, PHI, 2008
2. Principles of Operations Research, H. M. Wagner, PHI, Delhi, 1982
3. Introduction to Optimization: Operations Research, J. C. Pant, Jain Brothers, Delhi, 2008

4. Operations Research, Hitler Liebermann McGraw-Hill, 2009
5. Operations Research, Pannerselvam, Prentice Hall of India, 2010

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M.Tech. III Semester (GTE)	**L**	**T/P**	**C**
	3	**0**	**3**

(A18OE1AM03) COMPOSITE MATERIALS

COURSE PRE-REQUISITES: Maths, Physics, Chemistry, Engineering Mechanics, Mechanics of Solids

COURSE OBJECTIVES:
- To understand composite materials and their properties, relationship between them and manufacturing methods
- To understand the principles of material science applied to composite materials
- To study the equations to analyze problems by making good assumptions and learn systematic engineering methods to solve practical composite mechanics problems

COURSE OUTCOMES: After completion of the course, students should be able to
CO-1: Apply fundamental knowledge of mathematics to modeling and analysis of composite materials
CO-2: Understand the manufacturing methods of various composite materials
CO-3: Analyze the failure modes of composites

UNIT-I:
Introduction: Definition – Classification and characteristics of Composite materials. Advantages and application of composites. Functional requirements of reinforcement and matrix. Effect of reinforcement (size, shape, distribution, volume fraction) on overall composite performance.

UNIT-II:
Reinforcements: Preparation-layup, curing, properties and applications of glass fibers, carbon fibers, Kevlar fibers and Boron fibers. Properties and applications of whiskers, particle reinforcements.
Mechanical Behavior of Composites: Rule of mixtures, Inverse rule of mixtures. Isostrain and Isostress conditions.

UNIT-III:
Manufacturing of Metal Matrix Composites: Casting – Solid State diffusion technique, Cladding – Hot isostatic pressing. Properties and applications.
Manufacturing of Ceramic Matrix Composites: Liquid Metal Infiltration – Liquid phase sintering. Manufacturing of Carbon – Carbon composites: Knitting, Braiding, Weaving. Properties and applications.

UNIT-IV:
Manufacturing of Polymer Matrix Composites: Preparation of Moulding compounds and prepregs – hand layup method – Autoclave method – Filament winding method – Compression moulding – Reaction injection moulding. Properties and applications, Introduction to Machining of Composites.

UNIT-V:
Elastic Behavior of Laminate: Basic assumptions, Strain-displacement relations, Stress-strain relation of layer within a laminate, Force and moment resultant, General load–deformation relations, Analysis of different types of laminates

UNIT-VI:
Strength: Laminar Failure Criteria-strength ratio, maximum stress criteria, maximum strain criteria, interacting failure criteria, hygrothermal failure. Laminate first ply failure-insight

strength; Laminate strength-ply discount truncated maximum strain criterion; strength design using caplet plots; stress concentrations.

TEXT BOOKS:

1. Material Science and Technology, Vol. 13–Composites, R. W. Cahn – VCH, West Germany
2. Analysis and Performance of Fiber Composites, Third Edition, B. D. Agarwal, Wiley Publishers

REFERENCES:

1. Mechanics of Composite Materials, Second Edition. Robert M. Jones, Scripta Book Company
2. Materials Science and Engineering-An Introduction, W. D. Callister Jr., Adapted by R. Bala Subramaniam, John Wiley & Sons, NY, Indian Edition, 2007
3. Composite Materials, K. K. Chawla
4. Composite Materials Science and Applications, Deborah D. L. Chung
5. Composite Materials Design and Applications, Danial Gay, Suong V. Hoa and Stephen W. Tasi

VNR VIGNANA JYOTHI INSTITUTE OF ENGINEERING AND TECHNOLOGY

M.Tech. III Semester (GTE)	**L**	**T/P**	**C**
	3	**0**	**3**

(A18OE1PS01) WASTE TO ENERGY

COURSE PRE-REQUISITES: None

COURSE OBJECTIVES:
- To create awareness in students of energy conservation
- To identify the use of different types of Bio waste energy resources
- To understand different types of bio waste energy conservations
- To detect different waste conversion into different forms of energy

COURSE OUTCOMES: After completion of the course, students should be able to
CO1: Find different types of energy from waste to produce electrical power
CO2: Estimate the use of bio waste to produce electrical energy
CO3: Understand different types of bio waste and its energy conversions
CO4: Analyze the bio waste utilization to avoid the environmental pollution

UNIT-I:
Introduction to Energy from Waste: Classification of waste as fuel, Agro based, Forest residue, Industrial waste, MSW (Municipal solid waste) – Conversion devices – Incinerators, Gasifiers, Digestors

UNIT-II:
Biomass Pyrolysis: Pyrolysis – Types, slow fast – Manufacture of charcoal – Methods - Yields and application – Manufacture of pyrolytic oils and gases, yields and applications.

UNIT-III:
Biomass Gasification: Gasifiers – Fixed bed system – Downdraft and updraft gasifiers – Fluidized bed gasifiers – Design, construction and operation – Gasifier burner arrangement for thermal heating – Gasifier engine arrangement and electrical power – Equilibrium and kinetic consideration in gasifier operation.

UNIT-IV:
Biomass Combustion: Biomass stoves – Improved chullahs, types, some exotic designs, Fixed bed combustors, Types, inclined grate combustors, Fluidized bed combustors, Design, construction and operation - Operation of all the above biomass combustors.

UNIT-V:
Biogas: Properties of biogas (Calorific value and composition) - Biogas plant technology and status - Bio energy system - Design and constructional features - Biomass resources and their classification - Biomass conversion processes - Thermo chemical conversion - Direct combustion - biomass gasification - pyrolysis and liquefaction - biochemical conversion - anaerobic digestion.

UNIT-VI:
Types of biogas Plants – Applications - Alcohol production from biomass - Bio diesel production - Urban waste to energy conversion - Biomass energy programme in India.

TEXT BOOKS:
1. Biogas Technology-Transfer and Diffusion, M. M. EL-Halwagi, Elsevier Applied Science Publisher, New York, 1984
2. Introduction to Biomass Energy Conversions, Sergio Capareda

REFERENCES:

1. Non-Conventional Energy, Desai Ashok V., Wiley Eastern Ltd., 1990
2. Biogas Technology - A Practical Handbook, Khandelwal, K. C. and Mahdi, S. S., Vol. I & II, Tata McGraw-Hill Publishing Co. Ltd., 1983
3. Food, Feed and Fuel from Biomass, Challal, D. S., IBH Publishing Co. Pvt. Ltd., 1991
4. Biomass Conversion and Technology, C. Y. WereKo-Brobby and E. B. Hagan, John Wiley & Sons, 1996

VNR VIGNANA JYOTHI INSTITUTE OF ENGINEERING AND TECHNOLOGY

M.Tech. III Semester (GTE)	**L**	**T/P**	**C**
	0	**16**	**8**

(A18PW4GT03) PROJECT PART-I

M.Tech. IV Semester (GTE)	**L**	**T/P**	**C**
	0	**28**	**14**

(A18PW4GT04) PROJECT PART-II

COURSE OUTCOMES: After completion of the course, students should be able to
CO-1: Identify and formulate the problem (Industry/technical/societal)
CO-2: Analyze, design and develop a solution to industry/technical/societal problems
CO-3: Implement and execute the solution
CO-4: Demonstrate effective communication skills through oral presentation
CO-5: Engage in effective written communication through project report

COURSE OUTLINE:

- M.Tech. project work shall be for a minimum duration of 40 weeks spread over two semesters i.e., Project Part-I in III semester and Project Part-II in IV semester.
- A student shall be permitted to register for the major project after satisfying the attendance requirement in all the courses, i.e., theory and practical courses.
- Project reviews namely Project Review I and Project Review II in III semester and Project Review III and Project Pre-submission Seminar in IV semester shall be conducted during the course of Project work.
- A Project Review Committee (PRC) consisting of the Head of the Department as Chairperson and PG Coordinator, Project Supervisor and one senior faculty member of the Department offering the M. Tech. programme as members shall evaluate the progress of project work.
- In Project Review I, a student, in consultation with his Project Supervisor, shall present the title, objective and plan of action of his/her project work to the PRC for approval within four weeks from the commencement of III semester.
- A student can initiate the project work only after obtaining the approval of the PRC.
- The work on the project shall be initiated at the beginning of the III semester.
- Project Review II shall be conducted and evaluated at the end of the III semester.
- Project Review III shall be conducted during IV semester to examine the overall progress of the project work.
- A project pre-submission seminar shall be conducted to decide whether or not the project is eligible for final submission.
- After approval from the PRC, a soft copy of the thesis shall be submitted for PLAGIARISM check to the Examination Branch.
- At the end of IV semester upon fulfilling the above conditions, project viva-voce shall be conducted.
- A student shall submit project progress in prescribed report format during each of the project reviews.