ACADEMIC REGULATIONS & COURSE STRUCTURE

Common
For
SOIL MECHANICS & FOUNDATION ENGG. AND GEOTECHNICAL ENGINEERING
(Applicable for batches admitted from 2016-2017)

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY: KAKINADA
KAKINADA - 533 003, Andhra Pradesh, India
### I Semester

<table>
<thead>
<tr>
<th>S. No.</th>
<th>Subject</th>
<th>L</th>
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<tr>
<td>1</td>
<td>Advanced Mathematics</td>
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<tr>
<td>2</td>
<td>Advanced Soil Mechanics</td>
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<td>3</td>
<td>Foundation Engineering – I</td>
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<td>Ground Improvement Techniques</td>
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<td>I. Designing with Geosynthetics</td>
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<td>II. Soil-Foundation Interaction</td>
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<td>III. Critical State Soil Mechanics</td>
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<td>I. Earth Dams</td>
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<td>II. Rock Mechanics</td>
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<td>III. Remote Sensing and Geographical Information Systems</td>
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### II Semester

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<td>Soil Dynamics &amp; Machine Foundations</td>
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<td>Construction in Expansive Soils</td>
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<td>I. Pavement Analysis, Design and Evaluation</td>
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<td>II. Construction Planning and Methods</td>
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<td>III. Geotechnical Earth Quake Engineering</td>
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<td>I. Geo-Environmental Engineering</td>
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<td>II. Numerical Methods in Geotechnical Engineering</td>
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<td>III. Finite Element Method</td>
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### IV Semester

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UNIT-I

UNIT-II

UNIT-III

UNIT-IV
Tests of significance – Analysis of variance for regression – Multiple correlation coefficients – Multiple linear regression with two independent variables.

UNIT-V

TEXT BOOKS
UNIT- I

UNIT- II
Analysis of Strain – Deformation – Deformation in the Neighborhood point – Change in length of a linear element – Change in length of a linear element – Linear component – Rectangular strain components – The state of strain at a point – Shear strain components – Change in direction of a linear element - Cubical Dilation – Change in the angle between Two line elements – Principal Axes of strain and principal strains – Plane state of strain – Compatibility condition – Strain deviator and its Invariants, Stress – Strain relations – Stress – Strain relations for isotropic materials – Modules of Rigidity – Bulk modules.

UNIT- III

UNIT- IV
UNIT- V


REFERENCES

2. “Advanced Solid Mechanics” by L.S. Srinath
UNIT-I
Soil Exploration – Importance, Terminology, - Geophysical methods. Borings - Location, spacing and depth, Methods of Boring including Drilling, Stabilization of Boreholes, – Methods of sampling -Types of Samples and Samplers- Cleaning of Bore holes, Preservation, Labeling and Shipment of Samples - Design Considerations of Open Drive Samplers.

UNIT- II
Field tests - The Standard Penetration Test – its limitations and Corrections – Cone Penetration Test – Field Vane Shear Test – Bore– Hole Shear Test – Dilatometer Test – Pressure Meter test – Planning of exploration program — Preparation of Soil Report – Bore log.

UNIT- III
Shallow Foundations –Bearing capacity – General Bearing Capacity Equation, Meyerhof’s, Hansen’s and Vesic’s Bearing Capacity Factors - Bearing Capacity of Stratified Soils - Bearing Capacity Based on Penetration Resistances - Safe Bearing Capacity and Allowable Bearing Pressure.

UNIT-IV

UNIT-V
Settlement Analysis – Elastic settlement in granular soils – Meyerhof’s, De Beer and Marten’s and Schemertmann’s equations-Elastic settlements of surface and subsurface footing in clays – Skempton and Bjerrum’s pseudo three-dimensional approach to consolidation settlement, settlement from in-situ tests. Tolerable settlements.

REFERENCES
1. Principles of Foundation Engineering by Braja M. Das.
2. Soil Mechanics in Engineering Practice by Terzaghi and Peck
3. Foundation Design by Wayne C. Teng, John Wiley & Co.,
5. Analysis and Design of sub structures by Swami Saran
7. Foundation Design and Construction by MJ Tomlinson – Longman Scientific
8. A short course in Foundation Engineering by Simmons and Menzes - ELBS
UNIT- I

UNIT-II
Stabilisation- Mechanical Stabilisation, Lime Stabilisation, Cement Stabilisation, Bitumen Stabilisation, Thermal Stabilisation and Chemical Stabilisation.

UNIT:-III

UNIT-IV

UNIT-V

REFERENCE:
5. Ground Improvement – Edited by M.P. Moseley, Blackie Academic & Professional.
7. Ground Improvement Techniques by Bergado et al.
I Year I Semester

DESIGNING WITH GEOSYNTHETICS
(ELECTIVE – I)

UNIT-I
Geosynthetics and Properties and Testing Methods: Introduction to Geosynthetics – Basic description – History – Manufacturing methods

UNIT-II
Geotextiles: Designing for Separation – Reinforcement – Stabilization
– Filtration – Drainage and Moisture barriers.

UNIT-III

UNIT-IV

Unit-V

REFERENCE:
– New Delhi.
SOIL – FOUNDATION INTERACTION
(ELECTIVE – I)

UNIT-I

UNIT-II

UNIT-III

UNIT-IV

UNIT-V

REFERENCE:
3. Foundation analysis by RF Scott, Printice Hall
5. Elastic Analysis of soil – Foundation Interaction. APS Selvadurai – Elsevier
CRITICAL STATE SOIL MECHANICS
(ELECTIVE – I)

UNIT-I

UNIT-II

UNIT-III
Soil behaviour Before failure – Plasticity of Soils – Cam clay - Power in Cam – Clay – Critical States and Yielding of Cam – clay, Compression of Cam – Clay.

UNIT-IV

UNIT-V
Test paths in consolidation and shear testing — Soil Parameters for Design – Choice of Analysis – Methods – Choice of Strength Parameters.

REFERENCES:
UNIT I

UNIT II

UNIT III

UNIT IV

UNIT V


REFERENCE:

1. Earth Dams by HD Sharma
2. Earth and Rockfill Dams HD Sharma & Bharat Singh
ROCK MECHANICS
(ELECTIVE – II)

UNIT-I

UNIT-II
Strength and Deformation Behaviour of Rocks and Failure Theories: Typical Stress – Strawin Curves – Static and Creep Test; Strength of rock – Unconfined Shear Strength and Triaxial Shear Strength of Rocks; Creep behaviour of Rocks; rock fracture and friction; Coulomb – Navier; Mohr’s and Griffith Theory and its Modification (General discussion only – derivation of equation not included.)

UNIT-III
Laboratory Testing of Rock Samples – Factors affecting test results sampling procedure and preparation of specimens; Tensile Tests – Direct, Indirect and Flexural tests; Uniaxial compression test; Unconfined and Triaxial shear tests; Determination of Elastic constants – Pulse generation and Resonant Frequency of a vibrating bar methods.

UNIT-IV
In-Situ Testing of Rock masses Plate –bearing test, Pressure Tunnel test; Flat Jack Test; Permeability of Rock and rock masses; Pore water pressure in rocks.

UNIT-V
Methods of Improving the Properties of Rock Masses – Pressure Grouting and Rock bolting. — Design of simple – Openings in competent rocks; laminated rocks and rocks containing planes of weakness. (Distribution of stresses around simple openings discussion only without derivation)

REFERENCE:
REMOTE SENSING AND GEOGRAPHICAL INFORMATION SYSTEMS
(ELECTIVE – II)

UNIT-I

UNIT-II
Introduction to GIS: What is GIS, Components of GIS, Overview of GIS, Examples of GIS application for civil engineering, Using a GIS for Decision making under uncertainty, Georeferenced data.
Data Input/Output: Keyboard entry, Manual Digitizing, Scanning, remotely sensed data, Existing Digital data – Cartographic database, Natural resources data sets, Digital elevation data and census related data sets, Data output devices.

UNIT-III
Data Quality: Components of data Quality, Sources of error. Data management: Data Base approach, Three classic data models (Hierarchical network Relational data models), Query languages, Nature of Geographic data.
Spatial data models: Raster and Vector data models. Data bases for GIS managing Spatial and attribute data together – Organizing Geographic Information within a DBMS, Limitations and Practical Approaches.

UNIT-IV
GIS Analysis functions: Organizing data for analysis, Classification of GIS Analysis function, Maintenance and Analysis of Spatial data – Transformations, Edge matching and editing, Maintenance and analysis of non-spatial attribute data – Editing and query functions.

UNIT-V
GIS analysis functions for Integrated analysis of spatial and attribute data: Retrieval and Classification functions, Overlay operations, Neighborhood operations, Connectivity function, Output, Formatting
– Map annotation, Text pattern and line styles, Graphic symbols, Cartographic modeling by GIS, analysis procedure with an example.
TEXT BOOKS:

REFERENCE BOOKS:
1. Remote sensing and Image Interpretation by LILESAND and KIEFER, Published by John Wiley and sons.
2. Fundamental of GIS by MICHAEL N DEMERS Published by John Wiley & Sons Inc.
List of Experiments:

1. Classification of Soil
2. Compaction Test
3. CBR
4. Triaxial tests: UU – test
5. Triaxial tests: CU – test
6. Direct shear test – Critical void ratio determination
7. Consolidation test
8. Geotextiles – Grab test I) large width ii) narrow width
10. Demonstration of Plate Load Test
11. Demonstration of Field CBR Test
UNIT-I

UNIT-II

UNIT-III

UNIT-IV
Laterally loaded vertical piles - Modulus of subgrade reaction – Piles in granular soils and cohesive soils subjected to lateral loading - Matlock & Reese analysis for piles in sands - Davisson & Gill analysis for piles in clays, Broms’ Analysis for piles in sands and clays.

UNIT-V
– Terzaghi’s analysis.

REFERENCE
1. Principles of Foundation Engineering - Braja M. Das
6. Pile Foundation Analalys & Design by Poulos and Davis.
UNIT-I
Earth pressures – Different types and their coefficients- Classical Theories of Earth pressure – Rankine’s and Coulomb’s Theories for Active and Passive earth pressure- Computation of Lateral Earth Pressure in Homogeneous and Layered soils- Graphical solutions for Coulomb’s Theory in active and passive conditions.

UNIT-II

UNIT-III

UNIT-IV

UNIT-V

REFERENCES
1. Principles of Foundation Engineering by Braja M. Das.
2. Foundation analysis and design – Bowles, JE – McGraw Hill
UNIT-I
Introduction: Types of motion- SHM- Fundamental definitions- SDOF systems- Free and forced vibration with and without damping- Types of damping-Equivalent stiffness of springs in series and parallel-Principles of vibration measuring devices- Introduction to two and multi degree freedom systems

UNIT-II

UNIT-III
Dynamic properties of soils, Determination of E, G and Poissons ratio from field and laboratory tests, recommendations of Indian codes-Stress waves in bounded elastic medium- Use of wave theory in the determination of elastic properties, Elastic coefficients of soils and their determination- damping factor from free and forced vibration tests.

UNIT-IV
Machine Foundations: Classification based on the type of dynamic force and structural form, design data, design criteria, foundations for reciprocating, impact and high speed machined like turbo generators-IS code provisions for the design of the same

UNIT-V
Vibration Isolation and Special Topics: Transmissibility, Principles of isolation- Methods of isolation- Vibration isolators- Types and their characterizes - Liquefaction of soils, Dynamic bearing capacity, Earth retaining structures under dynamic loads-Pile foundations

REFERENCES:
1. Vibrations of Soils and Foundations – Richart Hall and Woods
3. Foundations of Machines- Analysis and Design- Prakash and Puri
4. Analysis and design of Foundations for Vibrations- P J Moore
5. Fundamentals of Soil Dynamics- B M Das
6. Dynamics of bases and Foundations- D D Barkar
UNIT-I
Clay Mineralogy: Nature of soils – Clay mineral structure – Cation exchange – Soil water – Soil structure – Soil-Water interaction -

UNIT-II

UNIT-III

UNIT-IV

UNIT-V
Shear strength of expansive soils – Katti’s concept of bilinear strength envelope – Stress – state variables in partly saturated soils — Fredlund’s strength parameters Determination of matrix suction by axis translation technique Field suction measurement.

REFERENCES:
4. D.R. Katti, AR Katti, Behaviour of Saturated Expansive Soils and Control methods, Taylor and Francis
UNIT-I

UNIT-II

UNIT-III

UNIT-IV

UNIT-V

REFERENCES:

5. IRC codes of practice.
CONSTRUCTION PLANNING AND METHODS
(ELECTIVE –III)

UNIT-I

UNIT-II

UNIT-III
Trucks and Handling Equipment: Rear dump trucks – Capacities of trucks and handling equipment – calculation of truck production – compaction equipment – types of compaction rollers – quality control – soil stabilization

UNIT-IV

UNIT-V

REFERENCES:
UNIT-I


UNIT-II


UNIT-III

Dynamic Soil Properties: Representation of Stress conditions by the Mohr Circle – Measurement of Dynamic properties – field, laboratory, interpretation of observed ground response — One dimensional response analysis - linear approach, Equivalent linear approach.

UNIT-IV


UNIT-V

Seismic Design of Foundation, Slopes and Retaining Structures:
Seismic Design requirements for Foundation – Seismic Bearing capacity - Seismic Settlement — Internal stability and weakened instability of slopes - Seismic design of retaining walls: Dynamic Response of Retaining walls - Seismic Displacement of Retaining walls -Seismic Design Considerations.

1. “Geotechnical Earth Quake Engineering” by SL Kramer, Pearson Education.
UNIT-I

Introduction to Ground water contamination, pollutant transport and ground water remediation. Sources and Types of ground water contamination – introduction – under ground storage tanks, Land fills, surface impoundments, waste disposal injection wells, Septic system, Agricultural wastes, Land application, radioactive contamination, other sources of contamination.

UNIT-II


UNIT-III


UNIT-IV

Flow and Transport of Pollutants in Unsaturated zone: Capillarity, soil-water characteristic curves, Unsaturated Hydraulic conductivity, Governing equation for unsaturated flow, measurement of soil properties.

UNIT-V

Non – Aqueous Phase Liquids (NAPLs): Introduction – Comparison of fate of dissolved mass versus NAPL mass- Types of NAPLs – LNAPL – DNAPL; NAPL Transport – general process – NAPL transport at the pore level - Downward Migration of DNAPLs in saturated zone – NAPL movement through Vadose zone – LNAPL behaviour at the water table – NAPL
Transport at the site level – LNAPL conceptual models – DNAPL conceptual models, NAPL transport.

TEXT BOOKS:

REFERENCES
NUMERICAL METHODS IN GEOTECHNICAL ENGINEERING
(ELECTIVE – IV)

UNIT- I

UNIT- II

UNIT-III
Consolidation: Finite Difference Solution for One Dimensional, Two and three dimensional consolidations. Multi layered systems. Consolidation of Ground for Construction Load and Static Load.

UNIT-IV

UNIT-V
Pile Foundation: Pile Stresses – Static loading – Finite Element Method Solution (Direct approach) of the pile static pile capacity- wave equation — Lateral piles by Finite Element Method (Direct Approach) and Finite Difference method.

REFERENCE:
3. Foundation analysis and design, JE Bowles, McGraw Hill publications
4. Foundation analysis by RF Scott, Printice Hall
7. Pile Foundation Analysis & Design by Poulos and Davis.
UNIT- I

UNIT- II

UNIT- III
Finite element formulation of Beam elements: Beam stiffness-assemblage of beam stiffness matrix- Examples of beam analysis for concentrated and distributed loading- Galerkin’s method - 2-D Arbitrarily oriented beam element – inclined and skewed supports – rigid plane frame examples

UNIT- IV
Finite element formulation for plane stress, plane strain and axisymmetric problems- Derivation of CST and LST stiffness matrix and equations-treatment of body and surface forces-Finite Element solution for plane stress and axisymmetric problems- comparison of CST and LST elements – convergence of solution- interpretation of stresses

UNIT- V

REFERENCES:
2. Net Settlement Pressure
3. Hyperbolic Curve Fitting of Tri-axial Compression Data
4. Terzaghi One dimensional consolidation solution by FDM
5. Beam on Elastic Foundation by FDM
6. FDM Solution for Raft Foundation
7. Axial Loaded Piles by Direct FEM
8. Laterally Loaded Piles by FDM & FEM
9. Stability Analysis by Bishop theory
10. Stability Analysis by Method of Slices.