

GEOTECHNICAL ENGINEERING

CEMAC 501 ADVANCED ENGINEERING MATHEMATICS

L + T / week : 3+1 Hrs
University Exam : 3 Hrs

Sessional Marks : 20+20
End Exam Marks : 60

UNIT – I

PARTIAL DIFFERENTIAL EQUATIONS

Formation by elimination of arbitrary constants and arbitrary functions – Solutions of equations by the methods of separation of variables in case of simple boundary conditions pertaining to (i) one dimensional wave equation and (ii) two dimensional wave equation satisfied by vibrating membrane (No numerical problems).

UNIT – II

SPECIAL FUNCTIONS

Gamma and Beta functions Bessel – function – Legendre polynomials – Recurrence relations for $J_m(x)$ and $P_n(x)$. Orthogonality of Legendre Polynomials – Rodrigues formula.

UNIT – III

STATISTICS

Emperical distributions – Log-normal-Binomial, poisson, gamma, extreme value and uniform distributions – Estimation of parameters by method of moments and maximum likely hood methods – Multiple correlation and regression.

UNIT – IV

COMPLEX VARIABLES & LAPLACE TRANSFORMS

Complex variables – Cauchy – Reimann equations – Laplace equation – Conformal transformations including Joukowski's and Schwaz and Christoffel transformations.

Laplace transformation of Impulse function (Dirac-Delta function) and its applications to differential equation.

UNIT – V

NUMERICAL METHODS

Numerical solutions of partial differential equations – Laplace and poisson equations by iteration method, heat equation by Schmidt method.

Reference Books :

1. Dr. B.S. Grewal, Higher Engineering Mathematics.
2. S.C. Guptha, V.K. Kapur Foundations of Mathematics Statistics.

--oOo--

CEGTC 502 BASIC GEOMECHANICS AND SOIL BEHAVIOUR

L + T / week : 3+1 Hrs
University Exam : 3 Hrs

Sessional Marks : 20+20
End Exam Marks : 60

UNIT – I

SOIL FORMATION & SOIL DEPOSITS

Formation, composition and classification of soils. Nature of mineral fractions of soils – Residual, Terrestrial and marine deposits – Post depositional changes.

UNIT – II

SOIL MINERALOGY & CLAY-WATER ELECTROLYTE SYSTEM

Origin, structure, classification and identification of clay minerals. Interactions and electrical forces in clay - Water - electrolyte systems. Effective stress concept.

UNIT – III

FABRIC & STRUCTURE

Soil structure and fabric. Fabric measurement. Fabric stability and its relevance to engineering behaviour of soils. Sensitivity and its causes.

UNIT – IV

VOLUME CHANGE BEHAVIOUR OF SOILS

Physical interactions in volume change – Fabric, structure and volume change – Cohesive and cohesionless soils – Osmotic pressure concept – Compression and swelling.

UNIT – V

STRENGTH BEHAVIOUR OF SOILS

Strength and deformation of granular and cohesive soils and related tests – Fabric structure and strength – Residual stresses. Influence of stress history anisotropy on strength. Pore pressure development – Strength theories.

Reference Books

1. Fundamental behaviour of soil by J. Mitchel
2. Soil Mechanics by Lambe and Whitman
3. Principles of Soil Mechanics by R.F.Scott.
4. Soil Properties and behaviour by Yong and Warkentin.

--oOo--

CEGTC 503 SOIL DYNAMICS AND MACHINE FOUNDATION

L + T / week : 3+1 Hrs

Sessional Marks : 20+20

University Exam : 3 Hrs

End Exam Marks : 60

UNIT - I

THEORY OF VIBRATIONS

Harmonic motion – undamped and damped free vibrations – Forced vibrations – Transient vibrations – Systems with one, two and multidegree freedom.

UNIT - II

WAVE PROPAGATION

Stress, strain and elastic constants – Elastic wave propagation in rods of finite and infinite length – Wave propagations in elastic half space.

UNIT - III

DYNAMIC SOIL PROPERTIES

Evaluation of design parameters – Laboratory and field tests – Stress – Strain characteristic of soil under dynamic loads – Dynamic Bracing Capacity of soils – Pseudo static analysis and dynamic analysis.

UNIT – IV

ANALYSIS AND DESIGN OF MACHINE FOUNDATIONS

Types of machine foundations – Modes of vibrations – Requirements of machine foundations – Empirical methods of analysis – Elastic half space theory – lumped parameter model – Design of block foundations – Design of framed foundations - Soil mass participating in vibrations.

UNIT – V

VIBRATION ISOLATION

Active and passive types of isolation – Screening of vibrations – Isolation in existing machine foundations.

CONSTRUCTION

Construction details of machine foundations – Permissible vibrations.

Reference Books :

1. Barkan : Dynamics of bases and foundations.
2. Major : Vibration analysis and design of foundations for machines and turbines.
3. P.Sreenivasulu and C.V. Vaidyanathan (1976), Hand Book of Machine Foundations by , Tata McGraw Hill Co. Ltd., New Delhi.
4. C.Venkatramaiah (1995), Geotechnical Engineering, Wiley Eastern Ltd. (New Age International Ltd.), New Delhi,
5. A.V. Narasimha Rao & C.Venkatramaiah (2000), (Numerical Problems, Examples & Objective Questions in Geotechnical Engg. Universities Press (India) Ltd., Hyd.
6. Swamy Saran, Soil Dynamics and Machine Foundations, Galgotia Publications, New Delhi.

--oOo--

CEGTC 504 EXPERIMENTAL GEOMECHANICS

L + T / week : 3+1 Hrs
University Exam : 3 Hrs

Sessional Marks : 20+20
End Exam Marks : 60

UNIT - I

GENERAL

Purpose of soil exploration – Planning a sub-surface exploration – Stages in sub-surface exploration – Depth of exploration – Lateral extent of exploration.

UNIT - II

OPEN EXCAVATION AND BORINGS OF EXPLORATION

Pits and Trenches – Drifts and shafts – Auger Borings – Wash borings – Rotary drilling – Percussion drilling – Core drilling.

UNIT - III

SOIL SAMPLES AND SAMPLERS

Types of soil samples – Disturbed samples – Undisturbed samples – Design features affecting the Sample Disturbance – Split Spoon Samplers – Scraper Bucket Samplers – Shellby Tubes and Thin walled Samplers – Piston Samplers – Denison Samplers – Hand-curved Samplers.

UNIT – IV

IN-SITU TESTING

Standard Penetration Tests – Cone Penetration Tests – In-situ Vane Shear Test – Plate Load Test – Field Permeability Tests – In-situ Tests Using Pressure meter – Observation of Ground Water Table.

UNIT – V

GEOPHYSICAL METHODS

Seismic Methods – Electrical Resistivity Methods – Electrical Profiling Method – Electrical Sounding Method – Common Soil Tests – Sub-soil Investigation Report.

References :

1. Subsurface exploration and sampling of soils for Civil Engineering purposes by Hvorslev, M.J., Waterways Experiment Station, Vicksburg, Mississippi, 1949.
2. Foundation Engineering by S.P.Brahma Tata Mc Graw-Hill Publishing Company Limited, New Delhi, 1985.
3. Analysis and Design of Foundations and Retaining Structures by Shamsher Prakash, Gopal Ranjan and Swami Saran, Sarita Prakasham, Meerut, 1979.
4. Soil Mechanics & Foundation Engineering, Vol.2 by V.N.S. Murthy, Sai Kripa Technical Consultants, Bangalore.
5. Geotechnical Engineering by C.Venkatramaiah, Wiley Eastern Ltd., New Delhi.
6. Relevant I.S. Codes.

--oOo--

CEGTP 507 GEOTECHNICAL ENGINEERING (PRACTICAL)

Practicals / week : 3 Hrs
University Exam : 3 Hrs

Sessional Marks : 40
End Exam Marks : 60

Collection of Disturbed and Undisturbed Soil Samples from Field - Identification and Classification of Soils - Determination of shear strength (Triaxial Shear Test) and compressibility of soil - Evaluation of Allowable Bearing Pressure and Report Preparation - Testing of Expansive Soils - Free Swell Index - Swelling Pressure by Free Swell Method and Constant Volume method - Swelling Index.

—oOo—

CEGTC 601 ADVANCED FOUNDATION ENGINEERING

L + T / week : 3+1 Hrs
University Exam : 3 Hrs

Sessional Marks : 20+20
End Exam Marks : 60

UNIT – I

STRESS DISTRIBUTION IN SOILS :

Stress distribution beneath various types of loading including triangular and trapezoidal loadings
- Stress distribution in stratified soil systems.

UNIT – II

BEARING CAPACITY THEORIES :

Theories of Vesic and Balla for shallow foundations. Theories of Terzaghi, Meyerhof and Vesic for deep foundations. Bearing Capacity of shallow and deep foundations based on SPT and CPT values. Bearing Capacity for stratified deposits. Ultimate Resistance of laterally loaded piles (Brom's Method).

UNIT – III

SETTLEMENT ANALYSIS :

Types of settlements – Permissible settlements – Prediction of settlements of shallow and deep foundations in cohesive and cohesionless soils – Settlement from penetration tests.

UNIT – IV

ANALYSIS AND DESIGN OF SHALLOW FOUNDATIONS :

Proportioning and design of isolated footings, combined footings, strap footings for equal settlements – Common types of mat foundations – Floating rafts – B.C. and design of rafts – Conventional rigid method – Approximate flexible method (Winkler's model) – Finite difference method.

UNIT – V

COFFERDAMS

Types of Cofferdams – Uses – Stability and design of cellular Cofferdams on rock and soil.

Reference Books :

1. Soil Engineering by Spangler and Handy.
2. Foundation Analysis and Design by Joseph. E. Bowles.
3. Analysis and Design of Foundations and Retaining Structures by Shamsheer Prakash, Gopal Ranjan & Swamy Saran.
4. A short course in Foundation Engineering by N.E. Simons and B.K. Menzies.
5. Geotechnical Engineering by C.Venkatramaiah, Wiley Eastern Ltd., New Delhi, 1993.
6. Foundation Engineering by S.P.Brahma, Tata McGraw Hill, New Delhi, 1985.
7. Numerical Problems, Examples and Objective Questions in Geotechnical Engg. by A.V.Narasimha Rao & C.Venkatramaiah, University Press (India) Ltd., Hyd. 2000.

--oOo--

CEGTC 602 GROUND IMPROVEMENT TECHNIQUES

L + T / week : 3+1 Hrs
University Exam : 3 Hrs

Sessional Marks : 20+20
End Exam Marks : 60

UNIT - I

MECHANICAL STABILISATION OF SHALLOW LAYERS

Need for Engineered Ground improvement – Mechanical modification – Principles of compaction – Evolution of compaction theories – Properties of compacted soil – Compaction control – Specification of compaction requirements.

UNIT - II

PHYSICAL & CHEMICAL STABILISATION OF SHALLOW LAYERS

Lime stabilization – Lime fly ash stabilization – Cement stabilization – Other chemical admixtures – Granular admixtures – Thermal stabilization – Stabilisation by geotextiles.

UNIT - III

HYDRAULIC MODIFICATION AT DEPTH

Heavy tamping and Dynamic Consolidation – Preloading without vertical drains – Preloading with vertical drains – Electric kinetic dewatering.

UNIT - IV

PHYSICAL & CHEMICAL MODIFICATIONS AT DEPTH

Vibro compaction – Deep compaction by heavy tamping – Modification using explosives – Grouting – Stone columns – Lime columns.

UNIT – V

REINFORCED EARTH

Theory and Principles - Reinforcing strips - Design Criteria - Stability Analysis - Application.

References Books :

1. Soil stabilization principles and practice by Ingles O.G., and Met Calf J.P., Butter Worths, 1972.
2. Soil Mechanics for Road Engineers, HMSO, London.
3. Construction and Geotechnical methods in foundation engineering by Robert M. Koerner, Mc Graw Hill, New York, 1985.
4. Earth Reinforcement and Soil Structures by Colin Jones, Butter Worths, 1985.
5. Engineering with Geosynthetics by G.Venkatappa Rao and GVS Suryanarayana Raju, Tata Mc Graw Hill, New Delhi, 1990.
6. Geotechnical Engineering by C.Venkatramaiah, Wiley Eatern Ltd., New Delhi, 1993.

--oOo--

CEGTC 603 EARTH AND EARTH RETAINING STRUCTURES

L + T / week : 3+1 Hrs
University Exam : 3 Hrs

Sessional Marks : 20+20
End Exam Marks : 60

UNIT - I

EARTH PRESSURE

Advanced concepts of earth pressure – Approaches for active and passive pressures of cohesionless and cohesive soils – Log-spiral approach.

UNIT – II

DESIGN OF RETAINING WALLS

Types of retaining walls – Principles of design of retaining walls – Gravity retaining walls – Cantilever retaining walls – Counterfort retaining walls – Drainage from the back fill – Joints in retaining walls.

UNIT – III

DESIGN OF SHEET PILE WALLS

Types of sheet pile walls – Free cantilever sheet pile – Cantilever sheet pile in cohesionless soils – Cantilever sheet pile in cohesive soils. Anchored sheet pile wall with free earth support method – Rowe's moment reduction curves – Anchored sheet pile with fixed earth support method – Design of Anchors.

UNIT – IV

BRACED CUTS

Lateral earth pressure on sheetings – Different types of sheeting and bracing systems – Design of various components of bracing – Other criteria for design of braced cuts.

UNIT – V

SHAFTS, TUNNELS AND UNDERGROUND CONDUITS

Stress distribution in the vicinity of shafts and around tunnels – Arching in soils – Types of conduits – Loads on conduit due to surface loads – Construction of earth tunnels and conduits.

References :

1. Soil Mechanics - Jumikis
2. Foundation Engineering : Peck, Hanson & Thornburn
3. Foundation Analysis & Design : Bowles
4. Foundation Design : Teng
5. Soil Engineering : Merlin Grant Spangler.
6. Numerical Problems, Examples and Objective Questions in Geotechnical Engg. by A.V.Narasimha Rao & C.Venkatramaiah, University Press (India) Ltd., Hyd. 2000.

--oOo--

CEGTC 604 NUMERICAL METHODS IN GEOTECHNICAL ENGINEERING

L + T / week : 3+1 Hrs

Sessional Marks : 20+20

University Exam : 3 Hrs

End Exam Marks : 60

UNIT - I

BASIC CONCEPTS OF FINITE DIFFERENCE METHOD

Introduction - Basic Concept – Finite Difference Approximations : Diagonal five point formula. Laplace's Equation : Jacobi Method Gauss-Siedal Method. Parabolic Equations.

UNIT – II

GEOTECHNICAL APPLICATIONS OF FINITE DIFFERENCE METHOD

Applications of Geotechnical Engineering : Finite Difference formulations for one dimensional consolidation and two dimensional seepage.

UNIT – III

BASIC OF FINITE ELEMENT METHOD

Introduction; Boundary and Initial Value Problems; Methods of approximation : The Reyleigh Ritz Method and the Galerkin Method. One Dimensional Finite Elements, Interpolation function, Shape Function, Stiffness Matrix, Connectivity, Boundary Conditions.

UNIT – IV

FINITE ELEMENT MODELLING

Two dimensional problems using constant strain triangles. Introduction, Finite Element Modelling, Constant Strain Triangle. Problem Modelling and Boundary Conditions. Finite Element Applications to Geotechnical engineering problems such as stress distribution and stress-strain behaviour.

UNIT – V

CONSTITUTE MODELS FOR SOILS

Use of models in Engineering, Elasticity : Isotropic Elasticity, soil elasticity, anisotropic elasticity, the role of elasticity in soil mechanics. Plasticity and yielding : Introduction, Basic features : Yield function, failure criteria; Hardening law. Flow rule, examples of von mises criterion and cam clay model.

References

1. Introductory Methods of Numerical Analysis by SS Sastry, Prentice Hall of India.
2. Soil Mechanics and Foundations by Muni Budhu, John Wiley and Sons, INC.
3. Finite Element Analysis by George R. Buchanan, Schaum's Out line series, Mcgraw-Hill Internations Editions.
4. Introduction to Finite Elements in Engineering by TR Chadrupatla and AD Belegundu.
5. An Introduction to Critical State Soil Mechanics by Atkinson and Bransby, Mc Graw hill.
6. Analytical and Computer Methods in Foundation Engineering by Bowels JE, Mc Graw Hill.
7. Numerical Methods in Geotechnical Engineering by Desai and Christian JT, Mc Graw hill.

--oOo--

CEGTP 607 COMPUTING TECHNIQUES (PRACTICAL)

Practicals / week : 3 Hrs
University Exam : 3 Hrs

Sessional Marks : 40
End Exam Marks : 60

Analysis of geotechnical engineering laboratory test results and design of geotechnical problems using spread sheets – Use of Software like MATLAB, Statistical Software, AUTOCAD, etc.

--oOo--

ELECTIVES

01 CRITICAL STATE SOIL MECHANICS

L + T / week : 3+1 Hrs

Sessional Marks : 20+20

University Exam : 3 Hrs

End Exam Marks : 60

UNIT - I

STRESSES AND STRAINS IN SOILS :

Introduction - Normal stress and strain - Shear stress and strain - Soil as a continuum - Pore pressure and total stress - The principal of effective stress - The significance of effective stress.

STATES OF STRESS AND STRAIN SOILS :

Introduction - Two-dimensional states of stress - Mohr's circle of stress - Principal stresses and principal planes - Mohr's circles of total and effective stress - Two dimensional states of strain-plane strain - Relationships between states of stress and states of strain.

UNIT - II

STRESS AND STRAIN AND INVARIANTS :

Introduction - Stress paths - Stress paths with $\sigma_1 : \sigma_2$ axes - Stress paths with $t':s'$ and $t'':s''$ axes - Invariants of stress - Stress paths with $q':p'$ or $q:p$ axes - Invariants of strain - strain paths - Volumetric strains - Correspondence between parameters for stress and strain - Stress-strain behaviour of an ideal elastic soil.

UNIT - III

THE CRITICAL STATE LINE AND THE ROSCOE SURFACE :

Introduction - Families of undrained tests - Families of drained tests - The critical state line - Drained and undrained planes - The Roscoe surface - The shape of the Roscoe surface - The Roscoe surface as a state boundary surface.

UNIT - IV

THE BEHAVIOUR OF OVERCONSOLIDATED SAMPLES :

Introduction - Drained tests - The Hvorslev surface - The critical state line - The complete state boundary surface - Volume changes and pore water pressure changes.

UNIT - V

THE BEHAVIOUR OF SANDS :

Introduction - The critical state line for sand - Normalized plots - The effect of dilation - Consequences of Taylor's model.

BEHAVIOUR OF SOILS BEFORE FAILURE :

Introduction - Elastic and Plastic deformations : the elastic wall - Calculation of elastic strains - Calculation of elastic strains for undrained loading in terms of total stresses - Essential plasticity theory - Plasticity for soils - Cam-clay.

Reference Books :

1. Atkinson and Branaby Mechanics of Soils - An introduction to critical state soil mechanics, Mc Graw Hill (1978).
2. Schofield and Wroth, Critical State Soil Mechanics Mc Graw Hill (1968).

--oOo--

02 DEEP FOUNDATIONS

L + T / week : 3+1 Hrs
University Exam : 3 Hrs

Sessional Marks : 20+20
End Exam Marks : 60

UNIT - I

INTRODUCTION

Pile foundation – Necessity – Classification of piles – Methods of installation – Axially Loaded Piles - Single pile in cohesive and cohesionless soils – Piles in layered soils – Compressive and uplift loads – Negative skin friction – Settlement analysis.

UNIT – II

Laterally Loaded Piles – The occurrence of lateral loading - Rigid and flexible piles - Ultimate lateral resistance and deflection of vertical piles carrying lateral loads by I.S. Code method, Brom's method and Reese and Matlock method.

UNIT – III

PILE GROUPS

Pile groups – Necessity – Spacing – Group efficiency – Pile groups in cohesive and cohesionless soils – Individual pile failure – Block failure – Negative skin friction – Free standing pile groups and piled rafts – Settlement analysis.

UNIT - IV

Well Foundations – Types of wells - Depth of well foundation - Bearing capacity and stability considerations - Terzaghi's analysis - IRC method.

UNIT - V

Computer Aided Design

Pile Foundations – Axially Loaded Piles – Laterally Loaded Piles and Pile Groups.

Reference Books :

1. Bowles : Foundation Analysis and Design.
2. V.N.S.Murthy : Soil Mechanics & Foundation Engineering.
3. Bowles : Analytical and Computer Methods in Foundation Engineering.
4. Zeevaret : Foundations for difficult subsoil conditions.
5. Chellis : Pile foundations.
6. Tschebotarioff : Soil Mechanics, Foundations and earth structure.
7. C.Venkatramaiah (1995), Geotechnical Engineering, Wiley Eastern Ltd. (New Age International Ltd.), New Delhi.
8. AV Narasimha Rao and C.Venkatramaiah, (2000), Numerical Problems, Examples and Objective Questions in Geotechnical Engg., Universities Press (India) Ltd., Hyderabad.
9. M.J.Tomlinson, Pile Design and Construction Practice, A View Point Publication, London.
10. H.G. Poules, Pile Foundation Analysis and Design, Ed. Davis, John Wiley & Sons, New York.
11. IS 2911 Part 1-1979 - Code of Practice for design and construction of pile foundations.

--oOo--

03 EARTH AND ROCKFILL DAMS

L + T / week : 3+1 Hrs
University Exam : 3 Hrs

Sessional Marks : 20+20
End Exam Marks : 60

UNIT – I

EMBANKMENT DAMS – BASIC CONSIDERATIONS

Selection of dam site – Choice of type of dam – Classification of embankment dams – Types of failures – Criteria for safe design – Foundation investigation – laboratory tests – Construction of earth dams – Quality control and instrumentation.

UNIT – II

SEEPAGE THEORY

Fundamentals of seepage flow – Kozeny's solution – Anisotropic seepage – Top flow line – Flownet for earth dams – Seepage force and its effects – Control of seepage through embankment dams – Filter design – Drainage measures.

UNIT – III

FOUNDATION TREATMENT

Rock foundations – Alluvial foundations – Primary foundation – Clayey soils – Seepage containment – Upstream impervious blanket – Dam stream drainage.

UNIT – IV

STABILITY ANALYSIS

Critical stage & pore pressures in earth dams – Stability analysis – Effective and total stress approach – Method of slices – Location of critical circle – Earthquake considerations.

UNIT – V

ROCKFILL DAMS

General characteristics – Materials – Foundations – Design of dam suction – Drainage – Construction.

References

1. Earth and Earth Rock Dams by J.L. Sherard et al.
2. Earth and Rockfill Dams by Bharat Singh and H.D. Sharma.
3. Development in Soil Mechanics – I edited by C.R. Scott.

--oOo--

04 ENVIRONMENTAL GEOTECHNIQUES

L + T / week : 3+1 Hrs
University Exam : 3 Hrs

Sessional Marks : 20+20
End Exam Marks : 60

UNIT – I

INTRODUCTION TO ENVIRONMENTAL GEOTECHNIQUES :

Impact of wastes on ground water quality - Current methodology of land disposal of solid wastes - Contaminant migration - Pollution control barriers - Cut-off walls and permeable surrounds - Synthetic liners.

SOURCE PRODUCTION AND CLASSIFICATION OF WASTES :

Sources and types of wastes, hazardous waste - Characteristics and classification of hazardous wastes - Generation rates.

UNIT – II

SOIL POLLUTANT INTERACTION :

Soil structure, geotechnical parameters, practical implications, soil-water interaction.

UNIT – III

DOUBLE LAYER THEORY AND COMPRESSIBILITY OF CLAYS :

Fundamentals of double layer theory, factors influencing the compressibility behaviour : ion concentration, clay type, cation valency, dielectric constant, temperature.

UNIT – IV

CRITERIA FOR SELECTION OF SITES FOR WASTE DISPOSAL FACILITIES :

Process selection, criteria for selection, construction facility.

UNIT – V

RIGID OR FLEXIBLE MEMBRANE LAYERS :

Introduction - Clay liners, construction of clay liners, geomembranes, design considerations, composite liners - Case studies.

Reference Books :

1. Kays W.D. (1986), Construction of Lining for Reservoirs, Tanks and Pollution Control Facilities, John Wiley.
2. Fetter C.W. (1988), Applied Hydrogeology, Merrit Publishing Co. U.S.A.

--oOo--

05 MARINE FOUNDATIONS

L + T / week : 3+1 Hrs
University Exam : 3 Hrs

Sessional Marks : 20+20
End Exam Marks : 60

UNIT – I

OFFSHORE STRUCTURES

Ocean resources – Types of offshore structures – Fixed and floating platforms – Design considerations – Wind, wave and current loads – Construction and installation.

UNIT – II

MARINE SOILS

Origin, nature and distribution of marine soils - their engineering properties - sampling and sample disturbance - in-situ testing – Soil behaviour under cyclic loading – Practical approaches for sands and clays.

UNIT – III

MARINE GEOTECHNICAL INVESTIGATIONS

Phases of investigations – Geophysical surveying – Drilling and sampling procedures – Insitu testing – laboratory testing.

UNIT – IV

SHALLOW FOUNDATIONS

Site investigation – Types of shallow foundations for structures on sea bed – Bearing capacity – Effect of eccentric and inclined loads – Construction.

UNIT – V

DEEP FOUNDATIONS AND ANCHORS :

Pile foundation – Axial capacity – Lateral capacity – Deflections – Construction – Anchored foundations.

Reference Text Books :

1. Swamisaran, Analysis & Design of Substructures, OXFORD & IBH Publishing Company Private Limited, Delhi.
2. H.G. Poulos, Marine Geotechniques, Unwin Hyman, London.
3. Pienne Le Tirant, Sea Bed Recermaissque and Offshore Soil Mechanics for the installation of petroleum structures, Gulf Publishing Company, Houghton, Texas.

--oOo--

06 PAVEMENT DESIGN

L + T / week : 3+1 Hrs
University Exam : 3 Hrs

Sessional Marks : 20+20
End Exam Marks : 60

UNIT – I

GENERAL PRINCIPLES OF PAVEMENT DESIGN

Pavement types, comparison of Highway and Airport Pavements, Wheel loads, Design factors.

UNIT – II

DESIGN OF FLEXIBLE HIGHWAY PAVEMENTS

Stresses in flexible pavements and design of flexible highway pavements.

UNIT – III

DESIGN OF RIGID HIGHWAY PAVEMENTS

Stresses in rigid pavements, Design of rigid highway pavements and joints and reinforcement requirements.

UNIT – IV

DESIGN OF AIRPORT PAVEMENTS

Flexible Pavements : Design methods for flexible airport pavements including LCN system of flexible pavement.

Rigid Pavements : Design methods for rigid airport pavement, LCN system of rigid pavement and joints and reinforcement requirements.

UNIT – V

PAVEMENT EVALUATION AND STRENGTHENING

Pavement evaluation – Structural evaluation and evaluation of pavement surface condition.
Strengthening of existing pavements – Types of overlay and their design.

References :

1. Principles of Pavement Design (Second Edition) – E.J.Yoder & M.W.Witzak – John Wiley & Sons, Inc.
2. Highway Engineering – S.K. Khanna & C.E.G. Justo – Nemchand & Bros., Roorkee.
3. Airport Planning & Design – S.K. Khanna, M.G. Arora & S.S.Jain – Nemchand & Bros., Roorkee.
4. Principles of Transportation and Highway Engineering – G.V. Rao – Tata McGraw Hill, New Delhi.

--oOo--

07 ROCK MECHANICS

L + T / week : 3+1 Hrs
University Exam : 3 Hrs

Sessional Marks : 20+20
End Exam Marks : 60

UNIT – I

PHYSICAL AND MECHANICAL PROPERTIES OF ROCKS

Physical Properties – Porosity; Density; Moisture Content; Degree of saturation; Coefficient of permeability; Electrical properties ; Thermal properties ; Swelling ; Anisotropy; Durability.

Mechanical Properties – Strength; Elasticity; Plasticity; Deformability; Hardness.

UNIT – II

STRENGTH AND FAILURE OF ROCKS

Failure; Types of failure; Yield criteria or failure theories – Maximum principal stress theory; Maximum principal strain theory; Maximum shear stress theory; Maximum strain energy theory; Maximum shear strain energy theory; Mohr's theory; Coulomb's theory; Griffith criterion of brittle failure.

UNIT – III

LABORATORY & IN-SITU TESTS

Uniaxial compressive strength test; Tensile strength test; Flexural strength test; Shear strength test; Tests for elastic constants.

IN-SITU TESTS

In-situ test for deformability-plate load test – Pressure tunnel test – Bore hole test; Shear tests; Strength tests – Bearing capacity test – Compressive strength tests – Tensile strength tests; Tests for internal stress in rock.

UNIT – IV

DYNAMIC PROPERTIES OF ROCK

Types of waves; Theory of wave propagation; Factors influencing wave velocity; In-situ determination of elastic properties of rocks.

UNIT – V

METHODS OF IMPROVING THE PROPERTIES OF ROCK MASSES

Grouting, Grouting material – Cement grout – Chemical grouts – Bituminous grouts; Grouting operations; Methods of grouting; rock bolting – Mechanism – Principles of design.

Text Books

1. Engineering Properties of Rocks by I.W. Farmer.
2. Engineering Properties of Soils and Rocks by F.G. Bell.
3. Introduction to Rock Mechanics by R.F. Goodman
4. Fundamentals of rock Mechanics by J.C. Jaeger and N.G.W. Cook.

--oOo--

08 STRUCTURAL ANALYSIS AND DESIGN OF FOUNDATIONS

L + T / week : 3+1 Hrs
University Exam : 3 Hrs

Sessional Marks : 20+20
End Exam Marks : 60

UNIT – I

Structural analysis and design of the following types of footings and foundations :

Eccentrically loaded footings and footings subjected to moments.

UNIT – II

Combined footings, strap footings.

UNIT – III

Raft foundations (Conventional design).

UNIT – IV

Rafts - modulus of subgrade reaction approach, finite difference approach (Design examples excluded).

UNIT – V

Precast concrete piles and pile cap.
(NOTE : Limit State Method of Design only is included).

Reference Books :

1. Bowles : Foundation Analysis and Design.
2. Teng : Foundation Design.
3. Vazirani and Ratwani : Analysis and Design of Structures - Vol. II (Concrete Structures).
4. Analysis and Design of Substructures by Swamy Saran, OXFORD & IBH Publishing Company Pvt. Ltd., Delhi.

--oOo--

09 GEOSYNTHETICS IN CIVIL ENGINEERING

L + T / week : 3+1 Hrs
University Exam : 3 Hrs

Sessional Marks : 20+20
End Exam Marks : 60

UNIT – I

AN OVERVIEW

Historical Development – Types of Geosynthetics – Geotextiles – Geogrids – Geonets – Geomembranes – Geocomposites – Functions – Reinforcement – Separation – Filtration – Drainage – Barrier Functions.

UNIT – II

RAW MATERIALS AND MANUFACTURING METHODS

Methods – Polyamide – Polyester – Polyethylene – Polypropylene – Poly Vinyl chloride – Woven – Monofilament – Multifilament – Slit Filament – Non-Woven – Mechanically bonded – Chemically bonded – Thermally bonded.

UNIT – III

PHYSICAL AND HYDRAULIC PROPERTIES

Physical Properties : Mass per unit area – Thickness – Specific gravity
Hydraulic properties : Apparent open size – Permittivity – Transmissivity.

UNIT – IV

MECHANICAL PROPERTIES AND DURABILITY

Mechanical Properties : Uniaxial Tensile Strength – Burst and Puncture Strength – Soil Geosynthetic friction tests
Durability : Abrasion resistance – Ultraviolet resistance.

UNIT – V

APPLICATIONS OF GEOSYNTHETICS

Use of geosynthetics for filtration and drainage – Use of geosynthetics in roads – Use of reinforced soil in Retaining walls – Improvement of bearing capacity – Geosynthetics in land fills.

References :

1. Engineering with Geosynthetics by G. Venkatappa Rao and G.V.S. Suryanarayana Raju – Tata Mc Graw Hill, New Delhi, 1990.
2. Construction and Geotechnical Methods in Foundation Engineering by Robert M. Koerner – Mc Graw Hill, New York, 1985.
3. Designing with Geosynthetics by Robert M. Koerner, Prentice Hall, New Jersey, USA, 1989.

--oOo--

10 FOUNDATIONS ON EXPANSIVE SOILS

L + T / week : 3+1 Hrs
University Exam : 3 Hrs

Sessional Marks : 20+20
End Exam Marks : 60

UNIT – I

GENERAL PRINCIPLES :

Origin of expansive soils - Physical properties of expansive soils – Mineralogical composition - Identification of expansive soils - Field conditions that favour swelling - Consequences of swelling .

UNIT – II

SWELLING CHARACTERISTICS :

Swelling characteristics – Laboratory tests – Prediction of swelling characteristics – Evaluation of heave.

UNIT – III

TECHNIQUES FOR CONTROLLING SWELLING

Horizontal moisture barriers – Vertical moisture barriers – Surface and subsurface drainage – Prewetting – Soil replacement – Sand cushion techniques – CNS layer technique.

UNIT – IV

FOUNDATIONS ON EXPANSIVE SOILS :

Belled piers - Bearing capacity and skin friction - Advantages and disadvantages - Design of belled piers - Underreamed piles - Design and construction.

UNIT – V

MODIFICATION OF SWELLING CHARACTERISTICS

Lime stabilization – Mechanisms – Limitations – Lime injection – Lime columns – Mixing – Chemical stabilization – Construction.

Reference Books :

1. FU HUA CHEN, Foundations on Expansive Soils, Elsevier Scientific Publishing Company, New York.
2. Gopal Ranjan & A.S.R.Rao, Basic and Applied Soil Mechanics, New Age International Publishers - New Delhi.
3. Hand Book on Underreamed and Bored Compaction Pile Foundation, CBRI, Roorkee.
4. IS : 2720 (Part XLI) - 1977 - Measurement of Swelling Pressure of Soils.
5. R.K.Katti, Search for Solutions in Expansive Soils.
6. Alam Singh, Modern Geotechnical Engineering, Geo-Environ Academia, Jodhapur.
7. Swami Saran, Analysis and Design of Substructures, Oxford & IBH, New Delhi.

--oOo--