COURSE STRUCTURE & SCHEME OF EVALUATION

M.Tech (Geotechnical Engineering) - Full Time.
M.Tech (Soil Mechanics & Foundation Engineering) Part Time

Code	Name of the Subject	Hours per week		Evaluation Marks		
	Core Subject	Lecture	Tutorial	Internal	External	Total
CESE-1	Advance Soil Mechanics	3	1	50	100	150
CESE-2	Advance foundation Engineering	3	1	50	100	150
CESE-3	Soil Dynamics	3	1	50	100	150
CESE-4	Applied Soil mechanics	3	1	50	100	150
	Professional Subjects					
CESE-5	Analysis of settlement of Soil & Foundation	3	1	50	100	150
CESE-6	Sheer Strength of Soils	3	1	50	100	150
CESE-7	Applications of Soil Mechanics	3	1	50	100	150
CESE-8	Analytical & Numerical Methods in Geomechnics	3	1	50	100	150
CESE-9	Ground Improvement	3	1	50	100	150
CESE-10	Sub Surface of Geophysical Exploration	3	1	50	100	150
CESE-11	Clay Minerology	3	1	50	100	150
CESE-12	Rock Mechanics	3	1	50	100	150
CESE-13	Strength of Materials	3	1	50	100	150
CESE-14	Design of Road Pavements	3	1	50	100	150
CESE-15	Geomechanics	3	1	50	100	150
CESE-16	Structural Design & Foundation Engg	3	1	50	100	150
CESE-17	Traffic Engineering & Field Sudies	3	1	50	100	150
CESE-18	Earthen Embarkment	3	1	50	100	150
CESE-19	Case History in Geotechnical Engg	3	1	50	100	150
CESE-20	Seminar	--	2	50		50
CESE-21	Project	--	2	50	50	100

Notes: Each candidate is requires to fulfill the following requirements in order to be eligible for the award of Master of Technology in Civil (Geo -Tech / SMF) Degree.

1. 12 theory papers, subject to the requirement of four courses out of the list of Core Courses and 8 from the list of the elective Courses.
2. Seminar and Design Project will be in the third Semester.
3. Thesis (There will be a Viva -Voce test on the subject matter of the thesis. The Award shall be either 'Approved' or ' Rejected').

SYLLABUS

ADVANCED SOIL MECHANICS (CESE-1)

1. Factors influencing nature and formation of soils, Soils as multiphase materials. Complexity of soil nature , Typical soil deposits with special reference to Indian Soils/ Sits.

2. Soil Structure:- Type of bonds, Important clay minerals , Atomic and symbolic representation , Base exchange capacity, Force fields between soils particles and exchangeable ions, Guoy - Champman diffused double layer theory, Clay structural measurement.

3. Behavior of compacted soils- General , Effect of compaction on structure ,Swelling pressure, Shrinkage, Shear Strength, Pore Water pressure , Permeability, Comparison of dry of O.M.C & wet of O.M.C.

4. Elastic theories of stress distributions in soils - Boussinesq's equation, Wester-gaard, Burmister Theories, Different conditions of loads, Constitutive relationship for soils.

5. Shear strength parameters of cohesion less and saturated cohesive soils, Principles of Effective stress condition, Effect of rate of stress on shear parameters , Stress-Strain relationship , Skempton's Pore pressure coefficients, Hvorslev's true shear parameters, Effect of over consolidation on shear parameters.

6. Immediate settlement, Methods of determination, Estimation of Preconsolidation pressure. Three dimensional consolidation precompression of clay deposits with and without sand drains. Secondary consolidation factors.

7. Stability analysis of slope-effective vs. total stress analysis, Bishop's rigorous analysis , Short method , Bishop Morgenstem stability co-efficients.

Reference Books

1. Grim , R.E. " Clay Mineralogy"
2. Harr, M.E. Foundation of Theoretical soil Mechanics.
3. Lambe & Whitman " Soil Mechanics"
4. Scott, R.F. Principles of Soil Mechanics.

ADVANCED FOUNDATION ENGINEERING (CESE-2)

1. Shallow Foundation: Terzaghi's bearing capacity equation, General bearing capacity equation , Balla's & Meyerhof's theory, Effect of water table, special footing problems, I.S. Code, Footing pressure for settlement on sand, Soil pressure at a depth, Boussinesq's & westergaard methods, Computation of settlements (Immediate & Consolidation) Permissible settlements, Proportioning of footing, Inclined & Eccentric loads.

2. Pile Foundation: Timber, concrete, Steel piles, estimating pile capacity by dynamic formula, By wave equation & By static methods, Point Bearing piles, Pile loads tests, Negative skin friction, Modulns of subgrade reaction for laterally loaded piles, Lateral resistance.

3. Single Pile v/s Pile Groups, Pile group consideration, Efficiency, Stresses on underlying strata, Settlement of pile group, Pile caps, Batter piles, Approximate and exact analysis of pile groups, I.S code.

4. Well foundation: Types (open end & closed or box, pneumetic, drilled) shapes, Bearing capacity and settlements, Determination of grip length by dimensional analysis, Design of well foundation construction, Tilts & shifts.

5. Machine Foundations: Types, Analysis and design by Barkens methods, Determination of coeff. of uniform elastic compression, Pauw's analogy and design of a Block type M/C foundation, I.S.I method of design, Co- vibrating soil mass.

6. Sheet Pile Structure: Types, Cantilever, Anchored sheet pilling , Design by Fixed earth Method and modifications by Anderson & Techabotarioff, Anchor Braced sheeting cofferdam , Single well cofferdams, Cellular cofferdam, Stability of cellular cofferdam, Instability due to Heave of bottom.

References

1. Barken, D.D. " Dynamic of Bases and Foundation "
2. Peek Hansen " Foundation Engineering and Thornolour"
3. Leaconards " Foundation Engineering "
4. Bowles " Foundation Design"
5. Rechartetal "Vibration of Soils - Foundations."

SOIL DYNAMICS (CESE- 3)

1. Introduction: Nature of dynamic loads, Stress conditions on soil, Elements under E.Q. loading, Theory of vibrations.

2. Dynamic Earth Pressure Problem and Retaining wall: Behavior of Retaining Walls during Earth Quakes Modification of Coulomb's Theory, Modified Coulomb's construction, Analytic solution for c- soils, Indian standard code of Practice.

3. Dynamic Bearing Capacity: General, Failure Zones & Ultimate Bearing capacity criteria for satisfactory action of footing, Earthquake load on footing, Dynamic analysis for vertical loads.

4. Liquefaction of Soils: Theory, Criterion of Liquefaction , Factor Affecting , Laboratory study on liquefaction in Triaxial shear and oscillatory simple shear, evaluation of liquefaction Potential , Vibration Table studies, Liquefaction behavior of dense sands.

5. M/C Foundations: Introduction, Criteria for satisfactory M/C foundation, Methods of analysis, Degree of freedom of a Block, I.S. for design of reciprocation M/C design Procedure for Block Foundation, Vibration Isolation & Screening of Waves.

Reference

1. Parkash S. "Soil Dynamics"
2. Das Braja M. " Soil Dynamics"
3. Leonards " Foundation Engineering"

APLIED SOIL MECHANIES (CESE- 4)

1. Introduction to stability of slopes, Stability number, Friction circle, Bishop's method of slices- simple and rigorous ; Wedge method, Factor of safety w. r . t. height and strength.

2. Earth work construction, Embankments, Earth dams, Field compaction, Seepage and piping in embankments and dams construction problems.

3. Stabilisation of soils: Mechanical, Electrical and Chemical methods of stabilisation, Problems of excavation, Dewatering, Stability of base and embankment.

4. Arching in Soil & underground culvert and conduits.

5. Swell and shrinkage, Soils characteristics, swelling pressure of soils, Mechanics of Swelling, Crack.

6. Design of open cuts.

7. Soil Freezing Permafrost: Geo thermal profile, Freezing index. Depth of frost penetration & its determination, Freezing in coarse and fine grained soil, Fields frost heaving.

Reference

1. Tylor, D.W. " Fundamental of soil Mechanics"
2. Lamba & Whitman "Soil Mechanics"
3. Das, Braja M " Advanced Soil Mechanics"
4. USBR " Design of Small Dams"

ANALYSIS OF SETTLEMENT OF SOILS AND FOUNDATION (CESE- 5)

Stress Strain Relation ; Evaluation of parameters , Consolidation theories one and three dimensional, Settlement of footings, Rafts, Piles and piles groups, Analysis of foundation Soil system.

Reference

1. Leonards- "Foundation Engineering"
2. Das Braja M _- "Advanced Soil Mechanics"
3. Lambe & Whitman -"-Soil Mechanics"

SHEAR STRENGTH OF SOILS (CESE-6)

Engineering Geology of soils of India, Factors influencing shearing resistance .Failure theories. Stress - pore pressure relationship, Path dependent stress- deformation pore pressure, Volume of change behaviour & effective stress strength - water content relationships. Total and effective stress, Failure envelopes, Effect of stress history, Critical state model.

Reference

1. Taylor D.W. " Fundamental of Soil Mechanics"
2. Das Braja M _- "Advanced Soil Mechanics"
3. Lambe & Whitman --"Soil Mechanics"

APPLICATION OF SOIL MECHANICS (CESE- 7)

Application of the principles of soil mechanics to problems of earth dams Slopes flexible retaining structures, buried structures etc.

Reference

1. USBR -- "Design of Small Dams"
2. Leonards --"Foundation Engineering"
3. Das Braja M.--"Advanced Soil Mechanics"

ANALYSIS AND NUMERICAL METHODS IN GEOMECHANICS (CESE-8)

Finite difference , Finite element and other analytical methods of solution to (1) Elasticity and stability problems in Geomechanic (ii) Analysis of response to soil media to applied loads (iii) Limiting equilibrium , Failure theories , Method of characteristics (iv) Limit Analysis etc.

Reference

1. M.G. Salvadori and M.L. Baron "Numerical Method in Engineering."
2. Crandall S.H. " Engineering Analysis"
3. Syal & Gupta " Computer Programming & Engg. Analysis"

GROUND IMPROVEMRNT (CESE- 9)

1. Introduction , Economic considerations, Consolidation by preloading and sand drains , Strengthening by granular columns and lime columns, Compaction by vibro - flotation, Blasting , Dynamic consolidation, Grouting techniques and principles grounds anchors , Reinforced earth construction Geo- textiles Problems.

2. Stabilisation : Mechanical , Lime, Cement, Resins & Other Chemicals.

Reference

1. M.P. Moasley " Ground Improvement"
2. P. Purushothama Raj " Ground Improvement"
3. Das Braja M. " Principal of foundation Engineering"

SUB-SURFACE GEOPHYSICAL EXPLORATION (CESE-10)

1. Introduction: Necessity and Importance of soil exploration , Method of sub surface exploration Test pits , Trenches, Caissons, Tunnels and drifts, Wash boring , Percussion drilling , Rotary drilling, Factors affecting the selection of a suitable method of boring. Extent of boring, Factors controlling spacing and depth of bore holes, Spacing and depth of various Civil engineering structures.

2. Indirect method of exploration, Seismic method, Electrical resistivity, Resistivity sounding and profiling, Qualitative and quantitative interpretation of test results, Comparison of resistivity and seismic surveys, Shortcomings.

3. Stablization of bore holes, Different method of stabilisation of the bore holes, their relative merits and demerits.

4. Ground water Observation: Different method of ground water observation: Time lag in observation, Sampling of ground water.

5. Sampling: Source of disturbance and their influence, Type of sampler, Principle of design of sampler, Representative and undisturbed sampling in various types of soils, Surface sampling, Amount of sampling, Boring and sampling record, Preservation and shipment of sample preparation of bore log.

6. Penetration tests, Standard penetration tests, Dynamic cone penetration tests with and without bentonite slurry, Static cone penetration tests, factor affecting the penetration tests, Various corrections in the test results. Interpretation of test result for design and determination of modulus of deformation. Small size penetrometers. Correlation among various test results.

7. In situ Permeability. Pumping in test in a cased hole with open end, Falling head packer test constant head packer test, Pump in out tests in a single test wall and open pit or unlined hole. Piezometer merhods .

8. Water content at site: Speedy moisture tester, Their relative merits and demerits.

9. Planning of fields exploration: Case Histories.

10. Fields Tests: Washboring, Percussion boring, Standard penetration test, Dynamic cone penetraion tests with and without bentonite mud slurry. Static cone penetration test, Surface sampling.

11. Presentative Sampling. Thin walled sampling, Cylic plate load test, Large shear box test, Vane shear test, Pile load, Measurement of water table, Water sampling , Block resonance test, wave propagation test. Moisture content determination by speedy methods, Field identification of soils, Field permeability test.

12. Visit to actual project site.

Reference

1. Hvorsler M. "Subsurface exploration and sampling of soil for Civil Engg. purposes.
2. Simon and Cayton " Site investigation"

CLAY MINERALOGY (CESE- 11)

1. Origin of soils Processes and agents of earthing, Formation of clay minerals, Classification and nomenclature.

2. Structures & Properties of clay minerals-Isomorphous substitution and base exchange in clay minerals-orientation and randomness, crystal, chemistry, Nature of Bonds.

3. Clay minerals Identification: X-ray diffraction, Differential thermal analysis , Electro microscopy and dehydration

4. Colloids: Particle size, Properties, Electrical charge, Coagulation of colloids Zeta potential , Nature of the soil groups, Colloidal Properties of soil colloids and clay minerals , Adsorption and exchange of cations, Base exchange of cations, Organic soils, Percentage base saturation and its relation to soils pH . pH hydrolylic , pH Isohydric acid soil, Saline and alkaline soils.

5. Effect of clay minerals on engineering properties of soils: Permeability, Swelling potential, Plasticity & characteristics, compressibility, sensitivity strength.

6. Soil Admixture with lime, cement & other materials, Effect on the properties of the stabilized clay soils.

Reference

1. Grim R.E." Clay Minerology"
2. Blyth " Engineering Geology"

ROCK MECHANICS (CESE-12)

1. INTRODUCTION: Introduction on the rock mechanics its relation with engineering Geology and soil Mechanics-Importance and application of the rock mechanics to Civil Engineering.

2. CLASSIFICATION: Review of litho-logical classification of rocks, Engineering classification of intact and fissured rock- Deere & Miller and Deere classification - RQD classification on wave velocity relation classification on fissures joints and faults.

3. ENGINNERING PROPERTIES OF ROCK MASSES LAB. TESTS: Void- index test, Compression & tensile tests, Permeability, Strength characteristics, Strength of intact and fissured rocks, Effect of test conditions.

4. STABILITY IN ROCK SLOPES: Modes of failures in rock masses simplified Bishop's method, Janbu's method, Hock's method, Wedge's method.

5. IN SITU TESTING OF ROCKS: Field direct shear test, Triaxial test, Use of flat jacks, Cable jacking, Chamber test & Plate load test.

6. STABILISATION OF ROCKS: Rock Bolting, Principle of rock Bolting, Rock grouting, Grouting materials, Grouting operations & method of grouting.

Reference

1. Goodman R.E." Rock Mechanics"
2. Robert,A " Geotechnology"

STRENGTH OF MATERIALS (CESE-13)

Elastic creep & in -elastic behavior of materials. Plastic deformation, creep & fatigue, brittleness and ductility, strain hardening, Buckling causing failure, Theories of failures, Non planner bending, Torsion of non circular bars, Thick cylinders, Curved bars & rings, Beams curved in plan, Stress concentration failures, Notch sensitivity, Reducing effect of stress concentration, Deep beams, Three moment theorem, Elastic instability, Beams on elastic foundation, Shear centre, Beam of channel section, Z section & equal angle section.

Reference

1. Timoshenko---- Theory of Elasticity
2. Paper --"Strength of Materials"
3. R.S. Khurana " Strength of Elasticity"

DESIGN & PERFORMANCE OF ROAD PAVEMENTS (CESE- 14)

1. GENERAL CONSIDERATION: Components of road pavement such as subgrade, Sub base, Base course and wearing course and their functions. Comparison of flexible and rigid pavements highway and air port pavements.

2. PAVEMENTS MATERIALS: Stabilising base viz., Mechanical, Stablised with admixture like cements, Bitumen lime and other chemicals.

3. FACTOR AFFECTING THE PAVEMENTS DESIGN: Traffic factor , Moisture and climate factors, Soil factor, Stress distribution factors, Design method of Flexible pavements, General classification of various methods and their approach Emperial methods using soil classification tests . Theoretical and semi theoretical methods. General observation and limitation of various methods.

4. DESIGN METHOD OF RIGID PAVEMENTS: Analysis of stresses in concrete pavements due to various wheel loads. Cyclic changes in temperature. Changes in moisture and volumetric change in subgrade and base course. Comparison of analysis of stress due to wheel loads on liquid and solids subgrade theorem. Thicknes design methods such as P.C. A. design method F.A.A. methods etc. Design of distributed steel reinforcement design of dowels, Design of spacing of joints.

5. PAVEMENT EVALUATION AND STRENTHENING: Method of pavement evaluation including LCN method for airport, Design of various type of overlays for flexible and rigid pavements, Mechanics of pumping and blowing, Factor affecting pumping, preventive measures.

6. PAVMENTS PERFORMANCE: Pavements performance, Road Mechanic and their applications, The AASHO road test. Evaluation of performance of the flexible and rigid pavements. Analysis of results from flexible and rigid pavements.

Reference

1. S.K. Khurana " Principles ,Practice and Design of highway Engineering"
2. Khannna & Justo " Highway Engineering"
3. Oglesby " Highway Engineering (3rd Edition)

GEOMECHANIC (CESE- 15)

1. Superficial deposits. wastharing and erosion processes, Mechanism involved , Detailed description of the resulting geomorphologic feat covering weather effects river actions ,Sea action , Wind action and ice action, Their origin, Mechanism involved and engineeing significance.

2. Detailed geologic and physiographic account of extra peninsular India and Indo gangetic Plains.

3. Study of important Rock: forming minerals, Quartz group. Mica. Felsper group, Pyroxene group. Amphibola group and miscellaneous mine of common occurance. Structures and texture of the main rock group geological and engineering characteristics of the important rock by: Microscopic study of important rock and minerals including prepration of thin sections.

4. Geotectonics: North movement, Diastrophism, Oscstasy and central drafts, formation of major structural feature in rock folds. Faults, Joints and unconformities, Their effects on cut crops mechanism involved, Their engineering significance.

5. Rock as a constructional materials: sand and gravel characteristics of aggregates, Stability of slopes and cutting, Landslides and Landoidence. Geological exploration of engineering sites. Geological investigation in the case of Dams and Reservoirs Canals. Building foundation and highways.

6. Earthquakes: Mechanism involved; Geological consideration for construction; Reservoir related earthquakes.

7. Groundwater: Ground water investigation in Civil engineering, Ground water provinces in India.

8. Geological Mapping: Interpretation of geological mapping sections.

Reference

1. Leggey "Engg. Geology"
2. Slyth "Engg Geology"
3. D.S. Arora " Geology for Engineers"

STRUCTURAL DESIGN & FOUNDATION ENGG. (CESE-16)

Building foundation design: Design of footing, Isolated footing in B.B.C. and steel grillage, Combined footings of rectangular, Trapezoid cantilever types. Mat or raft foundation of dry and saturated soil floating foundations, Design of Piles, Pile caps and pile foundations buildings, Design of retaining structures , Design of retaining walls for dry and Saturated back fills with surcharge loads . Retaining walls resting on piles, Design of bridge abutments, Design of sheet piles used for coffer dams , Design of sheeting bracing in excavation trenches , Design of foundation for transmission :- Design of basement walls , Bridges structures Analysis and Design : Design of walls foundation and caissons of different types , Design of bridge pairs resting on piles.

Reference

1. Hool and kinne- "Reinforced Concrete and masonry Structures"
2. Ramanathan "Design of Concrete Structures."

TRAFFIC ENGINEERING AND FIELD STUDIES (CESE-17)

1. Introduction, Definition and scope of Traffic engineering, Traffic characteristics. Road user characteristics: General human characteristics, Physical characteristics, Mental and emotional factors, Factor affecting reaction time. PIEV theory. Vehicular characteristics; Vehicle characteristics affecting road design , Width , Height ,Length and other dimensions , Weight, Power speed and braking capacity, IRC and international standards for max vehicular dimensions & weight, Resistance to trading & power requirements.

2 . VARIOUS TRAFFIC STUDIES: Spot speed studies data analysis and interpretations. Speed and delay studies - purpose, cause of delay, various methods of speed and delay studies. Traffic volume studies and characteristics. Origin and destination studies, various methods of CSD studies. Traffic capacity studies: Volume and density relationships, critical density, basic, possible and practical capacities. Parking studies and characteristics: Public interest in parking studies, cordon count, splace inventory, parking practices, Evaluation of parking controls. Accident studies and characteristics- Cause of accident, studies and records, application of accidents studies, Preventive measures.

3. TRAAFIC CONTROLS & OPERATIONS: Traffic regulations & various means of traffic controls traffic in lanes and rotaries. Traffic Management, Techniques & applications.Roadways lighting - Design and layout.

4 . PLANNING & ADMINISTRATATION: Major streets and express ways, Ribbons development mass transportation, traffic engg. functions overall functional planning. Suitable organisation setup for India - guide lines & experiences from other countries for implementation of traffic engg, functions.

5 . FIELD STUDIES: Discussion of field studies.

Reference

1. Mason, T.N. & Smith W.S. "Traffic Engineering " Mc Graw Hill Books Inc. New York"
2. Kashyap L.R. " Traffic Engineering & Transport"

EARTHEN EMBANKMENTS (CESE- 18)

1. Investigation of dams sites: General & extent of investigation, Preliminary and Final investigation, Geological investigation, Sub - surface investigation, Drilling and Sampling.

2. Soil test & other utility: General various soil test for coarse, Sand and gravels, Clay, Silts & fine sands, Tests of foundation material shear consideration and settlement tests O.M.S. consideration.

3. Earth Dams: General History, Advantages and disadvantages, General features of earth & rock-fill dams, Design consideration for the various components.

4. Flow through saturated Porous Media: Darcy' s law - its applications , Laplace equation for isotropic and anisotropic soils , theory of flownets.

5. Seepage through embankments and its controls: General determination of pheratic line by different methods, Effect of seepage, Piping, control of seepage and exit gradients by different structures such as cut off, Sheet pilling upstream blankets, filters, internal drains etc.

6. Construction material and Methods: General consideration for the construction of materials, suitability of different materials for various components earth dams. Soil unsuitable for dam construction by roll, Hydraulic- fill & semi hydraulic fill methods.

7. Failure & Maintenance of earth Dams: Cause & remedies of hydraulic seepage and structure failures , Causes of foundation failure and maintenance of Earth dams.

Reference

1. U.S.B.R. " Design of small Dams"
2. Creger Justin and Hinds "Engineering for Dams Vol. 2 & 3.
3. J.Nemec " Engineering Hydrology"

CASE HISTORY IN GEOTECHINAL ENGINEERING (CESE- 19)

1. Geotechnical Problems in civil Engineering foundation , Soil as Construction Materials in slopes and earth retaining structures

2. Soils as different types of materials in behaviour, Design and abuses of soil mechanics.

3. Role of calculated risk and safety factors in applied soil mechanics, Uses and abuses of soil mechanics.

4. Role of calculated risk and safety factors in applied soil mechanic and foundation engineering.

5. New concept in consolidation, settlement & bearing, capacity.

6. Observational procedure, its suitability for different problems in Geotechnical Engineering.

7. Limitations of the observations, Measurements of displacement of earth pressure.

8. Prediction in Geotechnical Engineering.

9. Case history, typical case of performance failure of representative soil engg. project viz. Shallow foundation and piles, slope stability , earth dams, retaining structure, machine foundation etc.