MTGT-501: Soil Dynamics

Course Credits --4

Internal Marks: 50
External Marks: 100
Total Marks: 150

L	T	P
4	0	0

Course Content

1. Introduction: Nature of dynamic loads, Stress conditions on soil, Elements under E.Q. loading (basic concepts only), Fundamentals of theory of vibrations-simple harmonic motion, Response of SDOF system-Vibration analysis procedure- Free and forced vibration with and without damping. Adverse effects of Seismic hazard and Site improvement methods for mitigation of earthquake hazards.
2. Dynamic Bearing Capacity: General, Failure Zones & Ultimate Bearing capacity criteria for satisfactory action of footing. Introduction to bearing capacity and settlement analysis under earthquake loading- Seismic design considerations, Codal provisions,
3. Dynamic response of Retaining wall: Seismic design consideration of Retaining Walls during Earth Quakes, Modification of Coulomb's Theory, Indian standard code of Practice.
4. Liquefaction of Soils: Soil liquefaction - Criterion and Factor Affecting Liquefaction, Susceptibility, initiation and effects of soil liquefaction, Laboratory and Field methods for estimation of liquefaction potential- CSR and CRR. Liquefaction behaviors of dense sand.
5. M/C Foundations: Introduction, Design criteria for satisfactory M/C foundation as per IS codes, Methods of analysis- Linear elastic weightless spring and elastic half space theory approach. Design of Block Foundation for reciprocating engine and low speed machines. Vibration Isolation techniques & Screening of Waves.

References

1. Robert W Day. Geotechnical Earthquake Engineering Handbook, McGraw Hill, New York. 2007
2. Kramer, S. Geotechnical Earthquake Engineering, Pearson, New Delhi. 1995
3. Ishihara, K. Soil Behaviour in Earthquake Geotechnics, Oxford Science, NY. 1996
4. Lkuo Towhata, Geotechnical Earthquake Engineering, Springer, NY. 1995
5. Bharat Bhusan Prasad Fundamental of Soil Dynamics and Earth quake Engineering, PHI, 2005
6. Prakash S and Puri, Foundations for Machines: Analysis and design, Wiley, New York, 1988.
7. Braja M. Das and G.V. Ramana Principle of Soil Dynamics, Cengage Learning . 2010.
8. Swami Saran, Soil Dynamics and machine foundations, Galgotia Publishers, New Delhi, 1997.
9. Murthy V. N. S, Soil Mechanics and Foundation Engineering CBS Publishers & Distributors, New Delhi, 2009.

Note: All relevant Indian Standards are allowed in the Examination.

MTGT-506: Site Investigations

Course Credits --4

Internal Marks: 50
External Marks: 100
Total Marks: 150

L	T	P
4	0	0

1. Soil formation -Processes – Characteristics of major soil deposits of India. 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 for 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. 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 .
7. Water content at site: Speedy moisture tester, Their relative merits and demerits.
8. Fields Tests: Standard penetration test, Dynamic cone penetraion tests with and without bentonite mud slurry. Static cone penetration test, Surface sampling. Cylic plate load test, Large shear box test, Vane shear test, Pile load, , Block resonance test, wave propagation test. Small size penetrometers, Pressuremeter test and Diltometer test. Various corrections in the test results and interpretation of test results for design of foundations. Correlation among various test results. Precautions to be exercised during the execution of these tests. Preparation of bore hole log.
9. Investigation below sea/river bed – methods and equipments – interpretation of offshore exploration, Instrumentation in soil engineering - strain gauges - resistance and inductance type - load cells, earth pressure cells - settlement and heave gauges - piezometers and slope indicators - inclinometer, Field visit, data and report preparation.

References

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

MTGT-507: Laboratory-1

Course Credits --2

Internal Marks: 100
External Marks: 50
Total Marks: 150

L	T	P
0	0	4

1) Algorithm/flow chart for various geotechnical engineering problems using spread sheet, C++ etc.
2) Stability analysis using various softwares such as GEO5, PLAXIS etc
3) Bearing Capacity of shallow and deep foundations using software such as GEO5, PLAXIS etc.
4) Settlement analysis of shallow and deep foundations using software such as GEO5, PLAXIS etc.
5) Analysis of soil-structure interaction problems such as piled-raft, laterally loaded piles, sheet piles etc.
6) Analysis of ground improvement problems such as soil nailing, use of geogrids/geosynthesis etc

MTGT– 616 Environmental Geotechnology

Course Credits --3

Internal Marks: 50
External Marks: 100
Total Marks: 150

L	T	P
3	0	0

Books:- Introduction and soil mineralogy: Scope of environmental geotechnology and its applications, Soil Formation, Composition and Structure: Introduction, Soil formation, Solids composition and characterization, Mineral composition, Different scales of soil structure, Structural variations due to consolidation and compaction, Role of Composition and soil structure in the engineering behavior of soils.
Contamination in soils: Subsurface contamination, Mass transport mechanisms, Mass transfer mechanisms, Governing equation for mass transport, Soil as a geotechnical trap, effects of subsurface contamination its detection and monitoring.
Mechanisms of soil-water interaction: Diffuse double layer and simple DDL models; Force of attraction and repulsion; Soil-water-contaminant interaction; Effect of contaminants on engineering properties of soil.

Site investigation: Introduction, Site investigation approach, phase investigations, Geophysical techniques, Hydro-geological investigations, Hydro-geochemical investigations, Geochemical data collection and analysis.
Concepts of waste containment facilities: Desirable properties of soil; contaminant transport and retention; containment of solid waste in landfills, environmental impact of slurry waste and containment of slurry wastes, contaminated site remediation.
Case histories: Case histories on geoenvironmental problems pertaining to use of readily available local soils, bioremidation of spills etc.

Books:-

1. Mitchell, J.K. and Soga, K., Fundamentals of Soil Behaviour, John Wiley & Sons, Inc., New Jersey., 2005
2. Reddy, L.N. and Inyang. H. I., Geoenvironmental Engineering –Principles and Applications, Marcel Dekker, Inc., New York., 2000
3. Mohamed, A.M.O. and Antia, H.E., Geoenvironmental Engineering, Elsevier, Netherlands., 1998
4. Hsai_Yang Fang and Daniels, J.L. Introductory Geotechnical Engineering an Environmental Perspective, Taylor & Francis, Oxon., 2006
5. Yong, R. N., Geoenvironmental Engineering: Contaminated Soils, Pollutant Fate and Mitigation", CRC press LLC, Florida., 2001.
6. Fang, H.Y, Introduction to Environmental Geotechnology, CRC Press, 1997.
7. " Proceedings of the International symposium of Environmental Geotechnology (Vol. I and Vol. II) ",4. Environmental Publishing Co., 1986 and 1989

MTGT 620 Highway Materials and Construction

Course Credits --3

Internal Marks: 50
External Marks: 100
Total Marks: 150

L	T	P
3	0	0

Subgrade Soil:- significance, characteristics of soil, desirable properties, Index Properties, Soil classification based on grain size, IS soil classification, GI of soil, Subgrade strength, Evaluation of soil strength- Direct Shear Test, Triaxial Comp. test, UCS test, plate bearing test, Modulus of subgrade reaction, CBR Test.

Stone Aggregates:- Introduction, desirable properties, crushing test, impact test, soundness test, shape test, specifics gravity & water absorption, bitumen adhesion test.

Bituminous Materials:- Introduction, types of bitumen materials, desirable properties, penetration test, ductility test, viscosity test, float test, specific gravity test, softening point test, flash & fire point test, solubility test, spot test, loss on heating test, water content test, Cutback bitumen, bitumen emulsion, tar.

Bituminous Paving Mixes:- Requirements of bituminous mixes, design of bituminous mix, Marshall Method of bituminous mix design, modified Hubbard field method of bituminous mix design, Hveem method of bituminous mix design.

Bituminous Pavement Construction:- Introduction, types of pavement construction, excavation equipments, embankment construction, preparation of subgrade, compaction equipments, field control for compaction, construction of earth roads, construction of gravel roads, construction of WBM roads, construction of bituminous pavements, Bituminous construction procedures.

Cement Concrete Pavement Construction:- Introduction, Mix design, concrete strength, size of aggregates & gradation, workability, construction of cement concrete pavement slab, construction of joints, joints filler & sealer, pre-stressed concrete pavements.

References:

1. Atkins, N. Harold, Highway Materials, Soils and Concretes, Fourth Edition, 2002, Prentice-Hall.

2: Kerbs Robert D. and Richard D. Walker, Highway Materials, McGraw-Hill, 1971.

3. Relevant IRC and IS Codes of Practices (Separate List will be given).

4. Read, J. And Whiteoak, D., "The Shell Bitumen Handbook", Fifth edition, Shell Bitumen, Thomas Telford Publishing, London 2003

5 Relevant IRC and IS codes

MGT-113 PAVEMENT ANALYSIS AND DESIGN

(Credits - 3:0:0 = 3)

Teaching Scheme

Lectures: 3 hrs/ week

Course Outcomes:

On completion of the course, the student will have the ability to:

1. appreciate the functions of various components of a pavement.
2. identify the factors affecting design of pavements
3. design flexible pavements
4. design of rigid pavements.
5. evaluate performance of pavement and .
6. design the overlay on flexible and rigid pavement.

Syllabus Content:

- **Introduction:** Types and component parts of pavements, Factors affecting design and performance of pavements. Highway and airport pavements, functions of pavement components
- **Pavement Design Factors:** Design wheel load, strength characteristics of pavement materials, climatic variations, traffic - load equivalence factors and equivalent wheel loads, Axles configuration and tyre pressure. Drainage – Estimation of flow, surface drainage, sub-surface drainage systems, design of sub-surface drainage structures.
- **Flexible Pavement Design:** Empirical, semi-empirical and theoretical approaches as Methods for design of flexible pavements; Group Index method, California Bearing Ratio (CBR) method, California Resistance Value method, Triaxial Test method, Burmister method, McLeod's method. Design of highway by IRC as per latest IRC code, AASHTO Methods, applications of pavement design software.
- **Rigid Pavements Design:** Westergaard's Theory and Assumptions, Stresses due to Curling, Stresses and Deflections due to Loading, Frictional Stresses. Wheel load & its repetition, sub grade strength & proportion, strength of concrete- modulus of elasticity. Reinforcement in slab. Design of joints. Design of Dowel bars. Design of Tie bars. IRC methods of Rigid Pavement design.
- **Pavement Evaluation and Rehabilitation:** Pavement evaluation and rehabilitation, condition and evaluation surveys – PSI models, Need for Overlays, Overlays design methods for Flexible and Rigid pavements.

Reference Books:

1. Yang and H. Huang, Pavement Analysis and Design, Pearson Prentice Hall
2. Yoder and Witzech, Pavement Design, McGraw Hill
3. Sharma and Sharma, Principles and Practice of Highway Engg., Asia Publishing House
4. Teng, Functional Designing of Pavements, McGraw Hill

MGT-115 ENVIRONMENTAL GEOTECHNOLOGY

(Credits - 3:0:0 = 3)

Teaching Scheme

Lectures: 3 hrs/ week

Course Outcomes:

On completion of the course, the student will have the ability to:

1. Understand soil environment interaction, composition, soil structure and its behaviour.
2. Specify site investigation techniques for characteristics of contaminated site.
3. Identify contaminant transport mechanisms in soils.
4. Specify site investigation techniques for characterization of contaminated site
5. Understand the principles of soil treatment techniques
6. Identify contaminants transport mechanism in soil.

Syllabus Content:

- **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.
- **Soil mineralogy:** significance of mineralogy in determining soil behaviour; Mineralogical characterization.
- **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.
- **Concepts of waste containment:** Sources, production and classification of wastes, Environmental laws and regulations, physico-chemical properties of soil, ground water flow and contaminant transport, desirable properties of soil; contaminant transport and retention; contaminated site remediation.
- **Soil characterization techniques:** volumetric water content; gas permeation in soil; electrical and thermal properties; pore-size distribution; contaminant analysis. contaminated site characterization, estimation of landfill quantities, landfill site location, design of various landfill components such as liners, covers, leachate collection and removal, gas generation and management, ground water monitoring, end uses of landfill sites, slurry walls and barrier systems, design and construction, stability, compatibility and performance, remediation technologies, stabilization of contaminated soils and risk assessment approaches.

Reference Books:

1. Mitchell J.K and Soga K., Fundamentals of Soil Behavior, John Wiley and Sons Inc.
2. Fang H-Y., Introduction to Environmental Geotechnology, CRC Press
3. Daniel D.E, Geotechnical Practice for Waste Disposal, Chapman and Hall
4. Rowe R.K., Quigley R.M. and Booker J.R., Clayey Barrier Systems for Waste Disposal Facilities, CRC Press
5. Rowe R.K, Geotechnical and Geoenvironmental Engineering Handbook, Kluwer Academic Publishers
6. Reddi L.N. and Inyang H.F, Geoenvironmental Engineering - Principles and Applications, Marcel Dekker Inc.
7. Sharma H.D. and Lewis S.P, Waste Containment Systems, Waste Stabilization and Landfills: Design and Evaluation, John Wiley & Sons Inc.

MGT-120 Earth Retaining Structures

(Credits - 3:0:0 = 3)

Teaching Scheme

Lectures: 3 hrs/ week

Course Outcomes:

On completion of the course, the student will have the ability to:

1. Analyze the earth retaining structures for their stability against earth pressure.
2. Apply engineering knowledge for the designing of earth retaining structures in various site conditions and evaluation of retaining structures using appropriate design methods, factors of safety, earth pressure diagrams and check their stability.
3. Determine the required depth of penetration and embedment of free and fixed sheet pile walls in cohesion and cohesionless soils.
4. Evaluate anchored sheet pile walls in free and fixed earth support conditions, spacing between bulkheads and anchors, resistance of anchor plates.
5. Explain the stress distribution around tunnels, types of conduits, arching and open cuts in soils.
6. Evaluate earth pressure against bracings in cuts and heave of the bottom of clay.

Syllabus Content:

- **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.
- **Retaining walls:** Proportioning of retaining walls, stability of retaining walls, mechanically stabilized retaining walls/reinforced earth retaining walls
- **Sheet Pile wall:** Free earth system, Fixed earth system
- **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
- **Tunnel and Conduit:** Stress distribution around tunnels, Types of conduits, Load on projecting conduits; Arching and Open Cuts: Arching in soils,
- **Braced excavations:** Earth pressure against bracings in cuts, Heave of the bottom of cut in soft clay

Reference Books:

1. Das, Braja M., Principles of Foundation Engineering, PWS Publishing
2. Bowles. J.E., Foundation Analysis and Design, Tata McGraw Hill