S Y L L A B U S

MASTER OF TECHNOLOGY
(Geotechnical Engineering)

M. Tech.

M. Tech., First Year Examination, 2015
M. Tech., Second Year Examination, 2016

JODHPUR NATIONAL UNIVERSITY
JODHPUR

Jodhpur National University

M.Tech. Programme, CIVIL (Geotechnical Engineering)

TEACHING/EXAMINATION SCHEME & SYLLABUS

I SEMESTER

| Subject Code | Subject | Hrs. / Week | | | | Marks | | | Exam Hrs |
		L	T	P	Total	Theory Exam/Viva voce	Internal Assessment	Total	
MCE 131	Strategic Management	4	2	-	6	100	50	150	3
MCE 132	Advanced Geotechnical Engg. I	4	2	-	6	100	50	150	3
MCE 133	Advanced geotechnical Engg. II	4	2	-	6	100	50	150	3
MCE 134	Geotechnical exploration and Testing	4	2	-	6	100	50	150	3
MCE 135	Geotechnical Engg Lab -I			6	6	50	50	100	3
	Total	**16**	**8**	**6**	**30**	**450**	**250**	**700**	**15**

II SEMESTER

| Subject Code | Subject | Hrs. / Week | | | | Marks | | | Exam Hrs |
		L	T	P	Total	Theory Exam/ Viva voce	Internal Assessment	Total	
MCE 231	Engineering Geology	4	2	-	6	100	50	150	3
MCE 232	Soil Hydraulics	4	2	-	6	100	50	150	3
	(Any One from 03 and 04 each)								
MCE 233.1 MCE 233.2	Advanced Foundation Engg. Ground Improvement Techniques	4	2	-	6	100	50	150	3
MCE 234.1 MCE 234.2	Earth and rock fill Dams Stability Analysis of Slopes, Dams and Embankments	4	2		6	100	50	150	3
MCE 235	Geotechnical Engg. Lab –II	-	-	6	6	50	50	100	3
	Total	**16**	**8**	**6**	**30**	**450**	**250**	**700**	**15**

III SEMESTER

| Subject Code | Subject | Hrs. / Week | | | | Marks | | | Exam Hrs |
		L	T	P	Total	Theory Exam/ Viva voce	Internal Assessment	Total	
	(Any One from 01 & 02 Each)								
MCE 331.1	Computational methods in Geotechnical engg.								
MCE 331.2	Rock Mechanics	4	2	-	6	100	50	150	3
MCE 331.3	Earthquake Geotechnical Engg								
MCE 331.4	Environmental Geotechnics								
MCE 332.1	Earth pressure and design of retaining structure								
MCE 332.2	Bridge Engineering	4	2	-	6	100	50	150	3
MCE 332.3	Earth Retaining Structures								
MCE 332.4	Reinforced Soil Structures								
MCE 333	Seminar	-	-	6	6	100	-	100	3
	Total	**8**	**4**	**6**	**18**	**300**	**100**	**400**	**9**

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TEACHING/EXAMINATION SCHEME & SYLLABUS

IV SEMESTER

| Subject Code | Subject | Hrs. / Week | | | | Marks | | |
		L	T	P	Total	Theory Practical Exam/Viva voce	Internal Assessment	Total
MCE 431	Dissertation	-	-	-	-	200	-	200
	Total	**-**	**-**	**-**	**-**	**200**	**-**	**200**

Total Marks: 700 + 700 + 400 + 200 = 2000

I SEMESTER

MCE 131   **STRATEGIC MANAGEMENT**   (4-2-0)
Exam Hrs:-3
M.M:-100+50=150

Basics of Management: Scientific management: Fredrick Winslow Taylor; Henry foyal's administrative Management; Managerial Roles; Managerial skills.

. **Managing Change:** Need for change; Paradigm shifts; Organization inertia; Leadership committed to change; Strategy of managing change; case studies highlighting steps needed for managing change successfully.

Crisis Management: Contingencies; contingency planning; Visualizing possible majors problems for the organization in the foreseeable future; Preparing an organization and its staff to deal with such problems; case studies.

. **Innovation and Creativity:** Encouraging creativity at all levels; Innovation; key for future leadership; Innovation for product; process or the organization itself; Increment improvement v/s

Entrepreneurship: Need of the hour: Entrepreneurship; Developing qualities for entrepreneurship; Calculated Risk; Entrepreneurship within an organization.

Work study and Re-engineering: Productivity; Methods of improving productivity by changes in the manufacturing process as well as by better utilization of assts; Re-engineering the product process as well as the organizational set up.

Managing Intangibles: Management at different levels in an organization; Organizational culture; Leadership effective leadership for overall success; Motivation; Developing a diverse workforce; Negotiations within the organization; Attitudes and Behavior.

Communication Skills: Communication Basic: Written and Verbal communication, Presentation skill,
Meetings and their effective; organization; Dealing / Interacting with customers.

Quality and Customer Care: Quality Management; Reliability of product; Defect and Defect Analysis; Total Quality; Economics of Quality; Quality Standards and ISO-9000; Customer care and important outcome of quality and quality relationship.

Safety and Ergonomics: Safety its practice at all levels; Safety training; Importance of safety; Cost of neglecting safety; Environment and need to maintain a clean and healthy environment; Ergonomics-a new term combining nature and its inhabitants.

Suggested Books:
1. Principles of Management by Charles WL Hill and steven L Mcshane; Tata McGrawh-Hill' New Delhi; 2008
2. Principles of Management by PC Tripathi and PN Reddy; Tata McGrawh-Hill' New Delhi; 1991.
3. Organizational Behavior by John W. Newstrom and Keith Danis; Tata McGrawh-Hill' New Delhi; 2002

MCE 132 ADVANCED GEOTECHNICAL ENGINEERING-I   (4-2-0)

Exam Hrs:-3
M.M:-100+50=150

Factors influencing nature and formation of soils. Soil .as a multiphase material. Complexity of soil nature. 1YPical soil deposits with special reference to Indian sOils. Recognition and identification of soils. Soil consistency, significance
Soil Classification, Classification of composite soils; major soil classification systems and their and limitations.
Clay Mineralogy and soil structure; Composition, e1etro-chemical forces. Basic structural units of clay minerals and their characteristics, base exchange capacity. Force fields between soil particles. Guoy-Chapman diffuse double layer theory, soil structures and fabric
Concepts of compaction mechanisms. Field Compaction control and specifications. In place densification of granular soils, shear strength of compacted cohesive soils, Effect of compaction on soil properties
Soil Water : Capillarity in soil, soils water potential, soil water suction. Measurement of soil suction, factors affecting, Equilibrium water content. Frost action Permeability of soils, Darcy's law and its validity, Poiseuille's law of flow through capillary tube. Permeability tests. Factors affecting permeabiHty ".
"Effective stress concept, variation of effective stress-typical cases. Critical cases. Critic~ hydraulic gradient
Consolidation: Consolidation test. Effect of sample disturbance of lab, consolidation curve, field consolidation curve, Terzaghi's theory of one dimensionaJ, consolidation. Estimation of preconsolidation pressure. Solution of consolidation equation. Effect of lateral strain on consolidatio~ Degree of consolidation under .time dependent loading. Consolidation during construction. Layered system. Threedimensional consolidation, Sand drainS and their design. Secondary consolidation-factors affecting Identification and behaviour of expansive soils; Origin, distribution; depth of moisture-fluctuation. Problems posed by expansive soils, mechanics of swelling. Identification of swelling soils. Free swell, shrinkage index and swelling pressure tests
Soil stabilization : Mechanical stabilization. Stabilization with cement, lime bitumen and chemicals Treatment of expansive clay
Flexible pavement design: C.B.K. method using number of vehicles and standard axles for highways and airports. Group index method. AASHO method. Burmister's design method

Suggested Books
1. Soil Mechanics by Prof Alam Singh.
2. Advanced Soil Mechanics by B.M Das, Taylor and Francis
3. Principles of Soil Mechanics by R.F Scott, Addison & Wesley
4. Fundamentals of Soil Behavior by Mitchell, James K, John Wiley and Sons
5. Soil Mechanics in Engineering Practice by Terzaghi , K., and Peck , R.B., John Wiley and Sons .

MCE 133   ADVANCED GEOTECHNICAL ENGINEERING-II   (4-2-0)

Exam Hrs:-3

M.M:-100+50=150

Shear strength: Characteristics of Mohr circle. Measurement of shear strength. Shear strength criteria. Pore pressure coefficients and their determination. Stress paths and applications. Stress-Strain and strength characteristics of cohesion less and cohesive soils, factors affecting. Horsley's Shear strength parameters, Sensitivity and Thixotrophy. Shear strength of partially saturated soils, factors affecting

Failure envelopes. Concept of yield surface. Theories of failure; Mohr coulomb, Von Mises and Tresca. Yield surfaces. Elements of . elasticity, Concept of stress, Equilibrium equations, compatibility equations. Boundary conditions. Principal stresses and strains. Two dimensional cases, Stress function

Elastic theories of stress distribution in soils-Boussinesq,. Westergard, burmister and Mindlin theories. Different conditions of loading. Contact pressure

Limiting equilibrium in soil. Equations of limiting equilibrium in two dimensions and their solution. Sokolovsky's numerical procedure, Slip lines.

Stability of slopes : Stability of finite and infinite slopes. Effective versus total stress analysis. Method of slices. Friction circle method. Bishop's simplified method. Janbu method. Effect of seepage and submergence   .

Rheology-helogical elements. Introduction to Theological models

Suggested Books:

1.   Soil Mechanics by Prof Alam Singh.
2.   Advanced Soil Mechanics by B.M Das, Taylor and Francis
3   Principles of Soil Mechanics by R.F Scott, Addison & Wesley
4   Fundamentals of Soil Behavior by   Mitchell, James K, John Wiley and Sons
5. Soil Mecchanics by Lambe, T.W. and Whitman, John Wiley & Sons

MCE 134   GEOTECHNICAL EXPLORATION AND TESTING   (4-2-0)

Introduction : Necessity and importance of soil exploration and testing
Field test-Methods of subsurface exploration. Test pits, trenches, boreholes. Methods of boring-Wash boring, percussion drilling, rotary drilling, stabilization of boreholes. Factors affecting the selection of a suitable method of boring. Extent of boring, factors controlling spacing and depth of boreholes. Spacing and depth for various Civil Engineering structures
Indirect methods of exploration, seismic method, electrical resistivity, resistivity-sounding and profiling, interpretation of test

Suggested Books :

1. Principles of Foundation Engineering by B. M.Das, Thomson Brooks /Cole
2. Basic and Applied Soil Mechanics by G.Ranjan and A.S.R Rao, New Age International Publishers
3. Foundation Analysis and Design by   J.E Bowles , McGraw-Hill Book Company
4. Engineering Principles of Ground Modification by Hausmann M.R., McGraw-Hill Book Company
5. Foundation Engineering Hand Book by H.F. Winterkorn and H Y Fang , Galgotia Booksource

MCE 135   GEOTECHNICAL ENGINEERING Lab -I   (0-0-6)

Exam Hrs:-3
M.M:-50+50=100

1. Standard and Modified Compaction Test
2. C.B.R (Unsoaked& Soaked)
3. Consolidation Test
4. Direct Shear Test
5. Triaxial Shear Test (CU, CD, UU)
6. Permeability of Fine grained soil
7. Nuclear devices for moisture and density measurement.

II SEMESTER

MCE 231   **ENGINEERING GEOLOGY**   **(4-2-0)**
Exam Hrs:-3
M.M:-100+50=150

Subsurface exploration; geophysical methods, Interpretation and correlation of field data. General principles of boring and drilling methods. Cleaning the bore holes. Sampling and sample handling. Core boring. Diamond and calyx. Depth of core boring. Bore hole logs and their interpretation. Exploratory drifts and tunnels. Rocks as construction materials, their source: Brief ideas of gradation. Surface texture and physical and engineering properties of aggregates. Cement aggregate reaction. Rock defects, identification and treatment Tunnel Rock and soft ground tunnels. Geological factors on **tunnel alignment** and design. Influence of rock stratification. Tunnels in folded and faulted zones Bridging capacity of. rocks. General principles of tunnel excavation. Rock and soft ground tunneling. Rock bolting. Requirement for tunnel lining. Pressure problems in water tunnels **Geological problems** in building and bridge foundation, highways, share lines and harbors .Dam geology-Problems in dam foundation and their treatment. Reservoir problems. **Seepage and leakage,** grouting material and method .Slope movements. **Classification of land slides.** Pore pressure. Land subsidence and settlements **Earthquakes,** kinds of earthquakes, Causes, intensity and magnitude. Seismic zoning of India, effect on engineering structures

Suggested Books :
1. Engineering Behavior of Rocks by W.Farmer , Chapman and Hall Ltd.
2. Introduction to Rock Mechanics by R.E. Goodman
3. Hand book on Mechanical Properties of Rocks by V.S. Vutukuri and R.D. Lama,
4. Rock Mechanics for Engineers by B.P. Verma
5. Principles of Foundation Engineering by B.M. Das , Thomosn Brooks/Cole
6. Soil Dynamics and Machine Foundation by S.Saran , Galgotia Publications Pvt.Ltd., New Delhi
7. Geotechnical Earthquake Engineeringby .S.L. Kramer , Pentice Hall, International Series, Pearson Education (Singapore) Pvt.Ltd

MCE 232   **Soil Hydraulics**   **(4-2-0)**
                                                    Exam Hrs:-3
                                                    M.M:-100+50=150

Flow of water through porous medium, Darc's Law and its limitations. Reynold's number, General hydrodynamic equations for two dimensional flow, stream function, Streams lines and equipotential lines, Anisotropy, Seepage force and critical gradient flow into wells and galleries. Confined and unconfined aquifers, partially peneterating wells. Interference of wells. Artificial recharge of a well. Test pumping analysis.**Methods of solving the basic equations.** Exact solutions, conformal methods and method of images. Approximate solutions finite differences and graphical methods. Zhukovsky function. Schwartz-Charistoffel transformation. Seepage from canals, experimental and semitheoretical methods. **Ground water** prospecting-construction and design of wells, well casing. Well screens gravel packs, dug, brored, driven, jetted and drilled wsells, radial collector wells confined flwo. Weir on a base of infinite depth. Khosla solution. **Depressed weirs** on permeable bases with sheet piles, Approximate solutions.

Suggested Books:
1. Ground Water by H.M. Raghunath , Willy Eastern Ltd
2. Ground Water Hydrology by D.K.Todd, John Wiley and Sons
3. Ground Water Science by C.Fitts , Elsevier Publications, U.S.A
4. Soil Mechanics by A. Jumikis , East West Pvt.Ltd
5. Fundamental of Ground Water by F.W.Schwartz & H.Zhang , John Wiley and Sons
6. Ground Water Manuals , A water resources technical Publications , Scientific Publisher, Jodhpur

MCE 233.1   ADVANCED FOUNDATION ENGINEERING   (4-2-0)

Exam Hrs:-3
M.M:-100+50=150

Shallow foundation : Requirements for satisfactory action of foundations. Methods of estimating bearing capacity, Terzaghi's theory and its limitations. Meyerhofs analysis. Bearing capacity under eccentric and inclined loads. Bearing capacity of stratified soils. Settlement of footings, limits of settlements for various 'structures. Interference between footings. Influence of water table

Raft foundations. General considerations. Conventional methods of design. Finite difference method. Beam on elastic foundations

Pile foundation : Use of piles, Mechanical and vibro pile drivers. Construction of piles. Methods of estimating load transfer of piles; settlement of piles group. Negative skin friction and influence on pile design. Laterally loaded pile-various approaches Pile group under inclined loads

Foundations under uplifting loads, difference in behaviour, methods of analysis, design provisions of IS code

Foundations in expansive soils.

Well foundations: IS and IRC Codes and their provisions, Design and construction, Tilts and shifts in wells and their rectifications Soil-structure interaction

Dynamics of soils : Theory of vibration, Machine foundations, behaviour and design of foundation for reciprocating and rotary machines I.S. Code

Suggested Books:

1. Soil Mechanics by Prof Alam Singh.
2. Soil and Foundations Engineering by Dr. B.C. Punmia
3. B.M. Das, *Principles of Foundation Engineering,* Thomson, Indian Edition, 2003.

MCE 233.2   GROUND IMPROVEMENT TECHNIQUES   (4-2-0)

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Exam Hrs:-3
M.M:-100+50=150

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Introduction: Engineering properties of soft, week and compressible deposits, Natural onland, off-shore and Man-made deposits. **Role of ground improvement** in foundationengineering, methods of ground improvement, Selection of suitable ground improvementtechniques ; In-situ treatments methods: In-situ densification soils, **Dynamic compaction andconsolidation**, Vibrofloation ,Sand pile compaction, Preloading with sand drains and fabricdrains, Granular columns, Micro piles, Soil nailing, Ground Anchors, Lime piles, Injections,Thermal, Electrical and Chemical methods, Electro osmosis, Soil freezing ; Reinforced Soil:The Mechanism, Reinforcement materials, Reinforcement -Soil Interactions, Geosynthetics,Principles, Analysis and Design of Reinforced Retaining Structures, Embankments and
Slopes ; **Ground Improvement Techniques** for Geotechnical Earthquake Engineering, Casestudies on ground improvement techniques.

Suggested Books**:**
1. R. M. Korner, *Design with Geosynthetics*, Prentice Hall, New Jersy, 3rd Edn. 2002
2. P. Purushothama Raj, *Ground Improvement Techniques*, Tata McGrawHill, New
   Delhi, 1995.
3. B. M. Das, *Principles of Foundation Engineering,* Thomson, Indian Edition, 2003.
4. G. V. Rao and G. V. S. Rao, *Text Book On Engineering with Geotextiles*, Tata
   McGraw Hill
5. T. S. Ingold and K. S. Miller, *Geotextile Hand Book*, Thomas Telfrod, London
6. N. V. Nayak, *Foundation Design Manual*, Dhanpat Rai and Sons, Delhi.

MCE 234.1   EARTH AND ROCKFILL DAMS   (4-2-0)
Exam Hrs:-3
M.M:-100+50=150

Earth Dams-Types, selection, requirements of foundations and material of construction, causes of failure and criteria for safe design, zoning and design details

Seepage through dams, Casagrende's solution. Komey's parabolal entrance and exist corrections. Flow nets for homogeneous and zoned earth dams and earth dams on previous foundations under steady seepage conditions, flow nets for homogeneous section under sudden drawdown situations Control of seepage, methods which reduce seepage, Coretypes, selection and material, cut off trenches, grout curtains sheet pile walls, upstream blanket, Method which control seepage. Filter-type, errection and design, relief wells .

Stability analysis-shear strength of soils and rockfis, pore pressures, role in stability analysis, Construction, steady seepage and.

drawdown pore pressures, factors. affecting and control of construction and drawdown pore pressures, Instrumentation for pore pressure measurements, Stability analysis under steady seepage and drawdown pore pressures, factors affecting and control of construction and drawdown pore pressures, Instrumentation for pore pressure measurements, Stability analysis under steady seepage and sudden drawdown conditions, seismic-stability, special problems-cracking and its control. Dam in fault zones, conduits through earth dams

Embankment construction-methods, compaction of cohesive and cohesionless materials, placement of rockfill, qualiy-control, borrow area, moisture and compaction control, supervision. Foundation and abutment treatment

Emhankment movement-embankment compressibility and swelling. Foundation settlement, foundation spreading, compression of rock, fill, crest movement, measurement of movement

Case histories-Design details, performance and cases of fallure of major dams, case studies in foundation investigation, foundation. treatment, control of seepage and instrumentation

Suggested Books:

1. L. W Abramson, T. S Lee, S Sharma and G M Boyce, *Slope Stability and Stabilization Methods*, Willey Interscience publications
2. V N S Murthy, *Principles of Soil Mechanics and Foundation Engineering*, UBS Publishers Private Ltd.
3. R.F.Craig " Soil Mechanics Chapman & Hall (ELBS)

MCE 234.2 STABILITY ANALYSIS OF SLOPES, DAMS   (4-2-0)
AND EMBANKMENTS   Exam Hrs:-3

Landslide phenomenon: Types and causes of slope failures, Practical applications ; Stabilityanalysis of infinite slopes with or without water pressures ; **Stability analysis** of finite andInfinite slopes: concept of factor of safety, pore pressure coefficients, Mass analysis, Wedgemethods, friction circle method ; Method of slices, Bishop's method, Janbu's method ; Effectof seepage, submerged and sudden draw down conditions ; **Design of slopes** in cutting,Embankments and Earth dams ; Site Investigation: Reconnaissance, **Preliminary anddetailed investigation**, Investigation for foundations ; Advances in stability analysis of slopes

Suggested Books**:**
1. L. W Abramson, T. S Lee, S Sharma and G M Boyce, *Slope Stability and Stabilization Methods*, Willey Interscience publications
2. B M Das, *Principles of Geotechnical Engineering*, Thomson Brooks/Cole
3. T W. Lambe and R V Whitman, *Soil Mechanics*, John Wiley & sons
4. V N S Murthy, *Principles of Soil Mechanics and Foundation Engineering*, UBS Publishers Private Ltd.

MCE 235 GEO TECHNICAL ENGINEERING LAB-II   (0-0-6)

1. Plate Load Test
2. Standard Penetration Test
3. Cone Penetration Tests
4. Mechanical Properties of Geosynthetics/Geogrid
5.Geophysical Exploration

III SEMESTER

MCE 331.1   COMPUTATIONAL METHODS IN GEOTECHNICAL ENGINEERING

(4-2-0)
Exam Hrs:-3
M.M:-100+50=150

Solution of linear differential equations of first and second order solution of Terzaghi's consolidations equation. Solution of this equation for unsteady flow. Governing equation for three dimensional consolidation and numerical formation for time integration .

Complex variables. Functions of a complex variable. Exponential trigonometric hyperbolic and logarithmic functions. Analytic function Cauchy-rimanu equation. Cauchy's integral formula residues. Schwartz-christoffel transformation and conformal mapping. Conjugate function and their applications to two dimensional seepage problems.

Methods of solving basic equation. Exact solutions, conformal methods and method of images. Approximate solution**. Form factor method**. Finite difference method for solving foundation problems and seepage problems.

Sokolovsky's numerical procedure. **Finite difference approach**, slip lines Finite element method. Introduction.,. applications to foundation problems and problems of seepage through soil.

Suggested Books :

1. Swami Sara, " Analysis and Design of Sub Structures oxford and IBH Publishing Co. Pvt. Ltd. New Delhi.
2. Gupta, S.P., "Statistical Methods," S. Chand & Sons
3. Sastry, S.S. , " Introductory Methods of Numerical Analysis," Prentice Hall of India (P) Ltd. New Delhi

MCE 331.2   **ROCK MECHANICS**   **(4-2-0)**
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Exam Hrs:-3
M.M:-100+50=150
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Rock: Formation of rocks, Physical properties, Classification of rocks and rock masses**,** Static Elastic constants of rock ; **Rock Testing**: Laboratory andFieldtests;Discontinuities in RockMasses:Discontinuity orientation, Effect of discontinuities on strength of rock ;**Strength Behavior**: Compression, Tension and Shear, Stress-Strain relationships,Rheological behavior ; Strength/ Failure Criterion: Coulomb, Mohr, Griffith theory of brittle strength and other strength criteria. Stresses in rock near underground openings; **Application of rock mechanics** in Civil Engineering: Rock tunneling, rock slope stability, bolting, blasting, grouting and rock foundation design.

Suggested Books**:**

1. W. Farmer, *Engineering Behavior of Rocks*, Chapman and Hall Ltd.
2. R. E. Goodman, *Introduction to Rock Mechanics*
3. P.R. Sheorey, *Empirical Rock Failure Criteria*, Balkema, Rotterdam, 1997
4. V.S. Vutukuri and R D Lama, *Hand Book on Mechanical Properties of Rocks*
5. B.P Verma, *Rock Mechanics for Engineers*

MCE 331.3   EARTHQUKE GEOTECHNICAL ENGINEERING   (4-2-0)
Exam Hrs:-3
M.M:-100+50=150

Earthquakes: Causes and characteristics (magnitude, intensity, accelarograms), responsespectra, attenuation of ground motion. Estimation of seismic hazards (deterministic andprobabilistic) ; Introduction to vibratory motion: Waves in Elastic Medium**;** Dynamics ofDiscrete: Systems , Vibration of single and multiple degree of freedom systems. Free andforced vibrations (regular and irregular excitation) ; **Dynamic properties of soils**:Determination of site characteristics, local geology and soil condition, site investigation andsoil test, Laboratory and in-situ tests; Site response to earthquake. Seismic Microzonation ;Liquefaction of soils: Fundamental concept of **liquefaction,** assessment of liquefactionsusceptibly from SPT and CPT ; **Seismic response** of soil structure system, seismic bearing
capacity of shallow foundation, design of pile foundation in liquefiable ground. Pseudo-staticanalysis and **design of earth retaining structures** and soil slopes. Estimation of earthquake induced deformation.

Suggested Books**:**
1. S.L. Kramer, *Geotechnical Earthquake Engineering*, Pentice Hall, international
    series, Pearson Education (Singapore) Pvt. Ltd., 2004.
2. S.Saran, *Soil Dynamics and Machine Foundation*, Galgotia publications Pvt. Ltd.,
    New Delhi 1999.
3. A. Ansal, *Recent Advances in Earthquake Geotechnical Engineering and*
    Microzonation, Springer, 2006.
4. I. Towhata, *Geotechnical Earthquake Engineering*, Springer , 2008.

MCE 331.4   ENVIRONMENTAL GEOTECHNICS   (4-2-0)

Exam Hrs:-3
M.M:-100+50=150

Introduction: Forms of waste, engineering properties (determination and typical values),subsurface contamination. ; **Selection of waste disposal** sites: Site selection – selectioncriteria and rating; Solid waste disposal: Ash Disposal facilities- Dry disposal, wastedisposal, **Design of ash containment system**, Stability of ash dykes; Contaminant transportthrough porous media: mechanisms- addective and dispersion; **Municipal and hazardouswaste landfill**: Types- Dry cell, wet cell, bioreactor, Design- clay liners, geosynthetic clayliners for waste containment, cover and gas
planning, source control, soil washing, bioremediation.

Suggested Books**:**

1.K. R. Reddy and H D Sharma, *"Geoenvironmental Engineering: Site Remediation, waste containment, and emerging waste management technologies"*, John Willey,2004.
2. R N. Yong, *"Geo Environmental Engineering: Contaminated Ground: Fate of Pollutions and Remediation"*, Thomson Telford, 2000.
1. L N Reddy and H.I. Inyang, *"Geoenvironmental Engineering: Principles and Applications"*, Marcel   Dek, 2000

MCE 332.1   EARTH PRESSURE AND DESIGN OF RETAINING STRUCTURE   (4-2-0)

Theories of earth pressure-Rankine, coulomb. Trial wedge earth pressure at rest, and active and passive states. Soil properties and lateral Earth pressure. Earth pressure on walls, various types of back fill and condition of loading: Soil tension effects and rup'ure zones. Effect of flexibility of structure on lateral pressures. Earth pressures due to earthquakes.

Pressures in soils, grain elevators and coal bunkers. Types of retaining walls. Gravity, cantilever-fort and crib type, basement or foundation retaining walls: allowable bearing capacity, settlements, tilting. Safety against general slip failure, wall joints and drainage Bulk head cantilevered and anchored, different types, Earth pressure behind bulk heads due to cohesive and non-cohesive soils free and fixed earth support. Rowe's modifications to moments **Modern trends** in retaining walls-Reinforced Earth retaining walls; Tsagaraeli's relieving plateforms.

Open cuts sheeting and bracing systems in shallow and deep open cuts in different types of soils, failure modes of braching cuts, pressure distribution behind cuts, field measurements.

Coffer dams-types, design data for cellular coffer dams, stability analysis, interlock stresses, methods of design of cellular coffer dams. Tunnels-arching in soils, pressure computation around tunnels, application of arching to shallow and deep tunnels, stress distribution around vertical shafts.

Suggested Books :

1. B. M. Das, *Principles of Foundation Engineering,* Thomson, Indian Edition, 2003.

2. J. Bowel, *Foundation Engineering* , Analysis and Design. McGrwHill
3. P. Raj, *Geotechnical Engineering*, Tata McGraw Hill
4. R F Craig, *Soil Mechanics,* Chapman and Hall(ELBS)

MCE 332.2   BRIDGE ENGINEERING   (4-2-0)

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Exam Hrs:-3
M.M:-100+50=150

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Introduction, historical review, engineering and aesthetic requirements in bridge design.Introduction to bridge codes. Economic evaluation of a bridge project. Site investigation andplanning;. Scour - factors affecting and evaluation. **Bridge foundations** - open, pile, well andcaisson. Piers, abutments and approach structures; **Superstructure** - analysis and design ofright, skew and curved slabs. Girder bridges - types, load distribution, design. Orthotropicplate analysis of bridge decks. Introduction to long span bridges - cantilever, arch, cablestayed and suspension bridges. **Methods of construction** of R.C Bridges, **Prestressedconcrete bridges** and steel bridges Fabrication, Lounching & creation. Design and
construction of construction joints (use of relevant codes of practice are permitted in the examination).

Suggested Books :

1. V. K. Raina, *Concrete Bridges Practice – Analysis, Design and Economics*, Shroff
 Publications, New Delhi 2nd Ed. 2005.
2. Vazirani, Ratwani and Aswani, *Design of Concrete Bridges*, Khanna Publishers , 2nd
 Ed. 2008.
3. *IRC codes for Road bridges- IRS Sec –I , II, III*
4. *IRS Codes of Practice for Railway bridges.*
5. B. M. Das, *Principles of Foundation Engineering,* Thomson, Indian Edition, 2003.

MCE 332.3   REINFORCED SOIL STRUCTURES   (4-2-0)

Historical background; Principles, concepts and mechanism of reinforced earth;**Design consideration** for reinforced earth and reinforced soil structures;**Geosynthetics-**their composition, manufacture, properties, functions, testing andapplications in reinforced earth structures; **Design of reinforced soil structures** like retaining walls, embankments, foundation beds etc.; Designing for Separation,Filtration, Drainage and Roadway Applications; Designing for Landfill Liners andBarrier Applications; Case histories of applications.

Suggested Books :

1. Clayton, C. R. I., Milititsky, J. and Woods, R. I., Earth Pressure and Earth Retaining Structures, Blackie Academic & Professional, 1993.
2. Ingold, T, Reinforced Earth, Thomas Telford Ltd., 1982.
3. Jones, C. J. F. P, Earth Reinforcement and Soil Structures, Butterworth, 1985.
4. Koerner, R. M, Designing with Geosynthetics, Prentice Hall, 1993.

MCE 333 SEMINARS (ON ANY CONTEMPORARY TOPIC)

(0– 0–6)
M.M.:- 100

In this course, the concepts on specific contemporary topic will be studied and tools for preparing reports will be used by students to prepare report. Reporting, writing and presentation skill development in engineering and technology is the main objective.

Seminar shall consist of term work submitted in the form of technical report of research, analysis and design on any current topic in the concerned or allied field.

MCE 431   DISSERTATIONS

<div align="right">

M.M. :- 200

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