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Master of Technology (Geotechnical Engineering)

SEMESTER II

COURSE CODE	CATEGORY	COURSE NAME	L	T	P	CREDITS	TEACHING & EVALUATION SCHEME				
							THEORY			PRACTICAL	
							END SEM University Exam	Two Term Exam	Teachers Assessment*	END SEM University Exam	Teachers Assessment*
MTCE 4201	DCS	DYNAMICS OF SOILS AND FOUNDATIONS	2	1	0	3	60	20	20	0	0

Legends: **L** - Lecture; **T** - Tutorial/Teacher Guided Student Activity; **P** – Practical; **C** - Credit;
***Teacher Assessment** shall be based on following components: Quiz/Assignment/ Project/Participation in Class, given that no component shall exceed more than 10 marks.

Course Objectives:

1. Learning the peculiarities of soil response when subjected to dynamic actions, either seismic or not.
2. Understanding the fundamentals of wave propagation and seismology, necessary to characterize the dynamic load.
3. Knowledge of in situ and laboratory tests for soil dynamic characterization.

Course Outcomes:

1. Understands theory of vibration and resonance phenomenon, dynamic amplification.
2. Understand propagation of body waves and surface waves through soil.
3. Exposed to different methods for estimation of dynamic soil properties required for design purpose.
4. Apply theory of vibrations to design machine foundation based on dynamic soil properties and bearing capacity.

Syllabus:

UNIT I

Fundamentals of vibrations: Single, two and multiple degree of freedom systems; Vibration isolation, vibration absorbers, vibration measuring instruments

UNIT II

Wave propagation: Elastic continuum medium; Semi-Infinite elastic continuum medium; Soil behavior under dynamic loading

UNIT III

Liquefaction of soils: Liquefaction mechanism, factors affecting liquefaction, studies by dynamic tri-axial testing, oscillatory shear box, shake table and blast tests, assessment of liquefaction potential

UNIT IV

Bearing capacity of foundations: Introduction to bearing capacity of dynamically loaded foundations for water towers, chimneys and high rise buildings; Response of pile foundations

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UNIT V

Machine foundations: Design criteria for machine foundations; Elastic homogeneous half space and lumped parameter solutions; Analysis and design of foundations for reciprocating and impact type machines, turbines, effect of machine foundation on adjoining structures.

Text Books:

1. Sarana S, Soil Dynamic and Machine Foundations, Galgotia Publications Pvt Ltd-New Delhi, 2016
2. Das B.M., Fundamentals of Soil Dynamics, Elsevier,2005

Reference Books:

1. Steven Kramer, Geotechnical Earthquake Engineering, Pearson, 2008.
2. Prakash, S., Soil Dynamics, McGraw Hill, 1981.
3. Kameswara Rao, N.S.V., Vibration analysis and foundation dynamics, Wheeler Publication Ltd., 1998.

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COURSE CODE	CATEGORY	COURSE NAME	L	T	P	CREDITS	TEACHING & EVALUATION SCHEME				
							THEORY			PRACTICAL	
							END SEM University Exam	Two Term Exam	Teachers Assessment*	END SEM University Exam	Teachers Assessment*
MTCE 4202	**DCS**	**STABILITY ANALYSIS OF SLOPES**	2	1	0	3	60	20	20	0	0

Legends: **L** - Lecture; **T** - Tutorial/Teacher Guided Student Activity; **P** – Practical; **C** - Credit;
*__Teacher Assessment__ shall be based on following components: Quiz/Assignment/ Project/Participation in Class, given that no component shall exceed more than 10 marks.

Course Objectives:

1. Understand the basic concept of slope stability analysis
2. Understand the basic design considerations
3. Be familiar with slope stability analysis and design procedure
4. Be able to perform simple slope stability analysis

Course Outcomes:

Student will be able to

1. Understands types and causes of slope failures
2. Check the stability of earthen dams, and the safety measures to be undertaken to prevent the instability of slopes, earthen dams and embankments.
3. Analyze flow nets in different conditions.
4. Learn about the strengthening measures.

Syllabus:

UNIT I

Slopes: Types and causes of slope failures, mechanics of slope failure, failure modes

UNIT II

Stability analysis: Infinite and finite slopes with or without water pressures; Concept of factor of safety, pore pressure coefficients, mass analysis, Wedge methods, friction circle method ; Method of slices, Bishop's method, Janbu's method, Morgenstern and Price, Spencer's method

UNIT III

Stability analysis in the presence of seepage: Two dimensional flow – Laplace equation and solution, graphical method, determination of phreatic line

UNIT IV

Flow nets in homogeneous and zoned earth dams under steady seepage and draw-down conditions; Seepage control in earth dams, influence of seepage on slope stability analysis of dam body during steady seepage

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UNIT V

Strengthening measures: Stabilization of slopes by drainage methods; Surface and subsurface drainage; Use of synthetic filters; Retaining walls, stabilization and strengthening of slopes; Shot-creting; Rock bolting and rock anchoring, Instrumentation and monitoring of slopes, slope movements, warning devices, maintenance of slopes

Text Books:

1. Chowdhary R and Chowdhary I ,Geotechnical Slope Analysis, CRC Press, 2010
2. Y. M. Cheng and C. K. Lau, Slope Stability Analysis and Stabilization: New Methods and Insight, CRC Press; 2008

Reference Books:

1. J. Michael Duncan, Soil Strength and Slope Stability, John Wiley & Sons; 2nd edition, 2014
2. Paul Guyer, An Introduction to Slope Stability Analysis, Independently Published , 2018

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							THEORY			PRACTICAL	
							END SEM University Exam	Two Term Exam	Teachers Assessment*	END SEM University Exam	Teachers Assessment*
MTCE 4203	DCS	GEOTECHNICAL EXPLORATION AND MEASUREMENT TECHNIQUE	3	0	2	4	60	20	20	30	20

Legends: **L** - Lecture; **T** - Tutorial/Teacher Guided Student Activity; **P** – Practical; **C** - Credit;
*__Teacher Assessment__ shall be based on following components: Quiz/Assignment/ Project/Participation in Class, given that no component shall exceed more than 10 marks.

Course Objectives:

1. To impart knowledge about soil investigation techniques.
2. To introduce the boring techniques and assessment of bearing capacity
3. To enable the students to learn various techniques of soil and rock sampling and prepare the soil and rock testing reports.

Course Outcomes:

1. Students can plan subsurface investigation based on the requirement of civil engineering project and site condition. Can finalize depth and number of boreholes
2. Students can execute different subsurface exploration tests, collect disturbed/undisturbed samples for laboratory tests and can suggest design parameters.
3. Student exposed to different methods for estimation of dynamic soil properties required for design purpose.
4. Students can develop instrumentation scheme for monitoring of critical sites

Syllabus:

UNIT I

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

UNIT II

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; Stabilization of bore holes

UNIT III

Extent of boring, factors controlling spacing and depth of bore holes; Different method of stabilization of the bore holes and their relative merits and demerits; Ground water observation; Different method of ground water observation; Time lag in observation

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UNIT IV

Sampling –Introduction, 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

UNIT V

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 penetrometer; Correlation among various test results

Text Books:

1. Dr Mohamed Abdallah El-Reedy, Soil Investigation and Foundations Design, Independently Published, 2020
2. G. Ranjan and A S R Rao, Basic and Applied Soil Mechanics, New Age international Publishers.
3. B. M Das, Principles of Foundation Engineering, Thomson Brooks/Cole

Reference Books:

1. N.P. Kurien, Design of Foundation Systems : Principles & Practices, Narosa, New Delhi 1992
2. H. F. Winterkorn and H Y Fang, Foundation Engineering Hand Book, Galgotia Book source

List of Practicals:

1. Exploratory borings by different methods including auger boring, wash boring, percussion drilling and rotary drilling.
2. Standard penetration test
3. Dynamic cone penetration test
4. Static cone penetration test
5. Plate load test
6. Pressure meter test
7. Geophysical exploration tests

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COURSE CODE	CATEGORY	COURSE NAME	L	T	P	CREDITS	TEACHING & EVALUATION SCHEME				
							THEORY			PRACTICAL	
							END SEM University Exam	Two Term Exam	Teachers Assessment*	END SEM University Exam	Teachers Assessment*
MTCE 4204	**DCS**	**FEM IN GEOTECHNICAL ENGINEERING**	2	1	0	3	60	20	20	0	0

Legends: **L** - Lecture; **T** - Tutorial/Teacher Guided Student Activity; **P** – Practical; **C** - Credit;
*__Teacher Assessment__ shall be based on following components: Quiz/Assignment/ Project/Participation in Class, given that no component shall exceed more than 10 marks.

Course Objectives:

1. To learn basic principles of finite element analysis procedure
2. To learn the theory and characteristics of finite elements that represent engineering structures
3. Learn to model complex geometry problems and solution techniques
4. To learn and apply finite element solutions to Structural Engineering problem

Course Outcomes:

Upon successful completion of the course, the students will be able to

1. Understand the concepts various approaches in FEM.
2. Identify the application and characteristics of FEA elements such as bars, beams, plane and isoparametric elements, and 3-D element
3. Apply FEM in different fields like, seepage problem, heat transfer etc.
4. Develop element level equation and generate global stiffness equation for the engineering problem

Syllabus:

UNIT I

Stress-deformation analysis – Introduction; One dimensional, two dimensional and three-dimensional formulations

UNIT II

Discretization of a Continuum; Elements, strains, stresses, constitutive relations, Hooke's law; Formulation of Stiffness Matrix, boundary conditions, solution algorithms

UNIT III

Principles of discretization, element stiffness and mass formulation based on direct; Variation and weighted residual techniques and displacements approach; Shape functions and numerical integrations, convergence

UNIT IV

Displacement formulation for rectangular, triangular and iso-parametric elements for two dimensional and asymmetric stress analyses

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UNIT V

Settlement Analysis; 2-D elastic solutions for homogeneous, isotropic medium; Steady Seepage Analysis; Finite element solutions of Laplace's equation; Consolidation Analysis; Terzaghi's consolidation problem; Choice of soil properties for finite element analysis

Text Books:

1. David M. Potts, Finite Element Analysis in Geotechnical Engineering: Application, Thomas Telford, 2001
2. Chandrupatla, Introduction to Finite Elements in Engineering, Pearson Education India, 2015

Reference Books:

1. O.C. Zienkiewicz and R.L. Taylor, Finite element methods Vol. I & Vol. II, McGraw Hill,2010
2. K.J. Bathe, Finite element procedures, PHI Ltd., 1996.

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COURSE CODE	CATEGORY	COURSE NAME	L	T	P	CREDITS	TEACHING & EVALUATION SCHEME				
							THEORY			PRACTICAL	
							END SEM University Exam	Two Term Exam	Teachers Assessment*	END SEM University Exam	Teachers Assessment*
MTCE 4205(1)	DCS	DESIGN OF UNDERGROUND EXCAVATIONS	2	1	0	3	60	20	20	0	0

Legends: **L** - Lecture; **T** - Tutorial/Teacher Guided Student Activity; **P** – Practical; **C** - Credit;
*__Teacher Assessment__ shall be based on following components: Quiz/Assignment/ Project/Participation in Class, given that no component shall exceed more than 10 marks.

Course Objectives:

1. Make theoretical calculations and engineering assessments of in situ and induced stresses before and after opening formation
2. Understand the practical approaches in designing support system for underground openings Analyze the tunnel face stability
3. Learn about the design procedures for dealing with structurally controlled instabilities in underground openings

Course Outcomes:

1. Students can understand the use of elastic and plastic analysis in the design of underground support system.
2. Students will have idea about the field tests generally conducted during and after construction of under structures.
3. Learn the methods to make assessment of the properties of rock and rock masses
4. Learn the design of underground openings in varying ground conditions

Syllabus:

UNIT I

Introduction, planning of land exploration for various underground construction projects; Stereographic projection method, principle and its application in underground excavation design

UNIT II

Elastic stress distribution around tunnels; Stress distribution for different shapes and under different in-situ stress conditions; Greenspan method, design principles, multiple openings and openings in laminated rocks; elasto-plastic analysis of tunnels, Daemen's theory

UNIT III

Application of rock mass classification systems, ground conditions in tunneling, analysis of underground openings in squeezing and swelling ground; Empirical methods; Estimation of elastic modulus and modulus of deformation of rocks; Uniaxial jacking / plate jacking tests, radial jacking and Goodman jacking tests; Long term behaviour of tunnels and caverns; New Austrian Tunnelling Method (NATM), Norwegian Tunnelling Method (NTM), Construction dewatering

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UNIT IV

Rock mass-tunnel support interaction analysis; Ground response and support reaction curves; Ladanyi's elasto-plastic analysis of tunnels; Design of various support systems including concrete and shotcrete linings, steel sets, rock bolting and rock anchoring, combined support systems; Estimation of load carrying capacity of rock bolts

UNIT V

In-situ stress, flat jack, hydraulic fracturing and over coring techniques and USBM type drill hole deformation gauge, single and multi-point bore hole extensometers, load cells, pressure cells, etc.; Instrumentation and monitoring of underground excavations; During and after construction; Various case studies

Text Books:

1. Singh, B. and Goel, R.K., Tunnelling in Weak Rocks, Elsevier Science, 2006
2. Singh, B. and Goel, R.K., Rock Mass Classification- A Practical Engineering Approach, Elsevier Science, 1999

References:

1. Hoek, E and Brown, E. T., Underground Excavations in Rocks, Institute of Mining Engineering.
2. Obert, L. and Duvall, W.I., Rock Mechanics and Design of Structures in Rocks, John Wiley.

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COURSE CODE	CATEGORY	COURSE NAME	L	T	P	CREDITS	TEACHING & EVALUATION SCHEME				
							THEORY			PRACTICAL	
							END SEM University Exam	Two Term Exam	Teachers Assessment*	END SEM University Exam	Teachers Assessment*
MTCE 4205(2)	DCS	DESIGN OF ROAD PAVEMENTS	2	1	0	3	60	20	20	0	0

Legends: **L** - Lecture; **T** - Tutorial/Teacher Guided Student Activity; **P** – Practical; **C** - Credit;
***Teacher Assessment** shall be based on following components: Quiz/Assignment/ Project/Participation in Class, given that no component shall exceed more than 10 marks.

Course Objectives:

1. To learn about various factors affecting pavement design.
2. To learn about stress analysis of the pavement.
3. To learn about various methods of flexible pavement design.
4. To learn about various methods of rigid pavement design.

Course Outcomes:

1. To understand the philosophy of design of flexible and rigid pavements.
2. To analysis pavements using different analytical methods.
3. To design of flexible and rigid pavements using different methods.
4. To compare performances of different types of pavements.

Syllabus:

UNIT I

General Consideration: Components of road pavement such as sub grade, sub base, base course and wearing course and their functions; Comparison of flexible and rigid pavements highway and air port pavements

Pavements Materials: Stabilizing base viz., Mechanical, stabilized with admixture like cements, bitumen lime and other chemicals

UNIT II

Factor Affecting the Pavements Design: Traffic factor, moisture and climate factors, soil factor and stress distribution factor

Design of Flexible Pavements: General classification of various methods and their approach; Empirical methods using soil classification; Theoretical and semi theoretical methods; General observation and limitation of various methods.

UNIT III

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; Thickness design methods such as P.C. A.

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UNIT IV

Pavement Evaluation and Strengthening: Method of pavement evaluation including LCN method for airport; Design of various types of overlays for flexible and rigid pavements; Mechanics of pumping and blowing; Factor affecting pumping, preventive measures.

UNIT V

Pavements Performance: Pavements performance; Road Mechanic and their applications; The AASTHO road test; Evaluation of performance of the flexible and rigid pavements; Analysis of results from flexible and rigid pavements.

Text Books:

1. S.K.Sharma, Principles, Practice and Design of Highway Engineering, S Chand & Company, 2014.
2. L R Kadyali, Principles and Practices of Highway Engineering, Khanna Publisher, 2004

Reference Books:

1. E.J.Yodar and M.W.Witczac, Principles of Pavement Design, 2nd Edition, John Wiley and Sons, New York,2000
2. Khanna and Justo, Highway Engineering Nem Chand & Sons, Roorkee, 2014

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COURSE CODE	CATEGORY	COURSE NAME	L	T	P	CREDITS	TEACHING & EVALUATION SCHEME				
							THEORY			PRACTICAL	
							END SEM University Exam	Two Term Exam	Teachers Assessment*	END SEM University Exam	Teachers Assessment*
MTCE 4205(3)	**DCS**	**GEOTECHNICAL EARTHQUAKE ENGINEERING**	2	1	0	3	60	20	20	0	0

Legends: **L** - Lecture; **T** - Tutorial/Teacher Guided Student Activity; **P** – Practical; **C** - Credit;
*__Teacher Assessment__ shall be based on following components: Quiz/Assignment/ Project/Participation in Class, given that no component shall exceed more than 10 marks.

Course Objectives:

Student will able to

1. Understand the behavior of civil engineering structures during earthquake loading.
2. Estimate the earthquake induced ground deformations, such as liquefaction effects, settlement, and lateral spreading, given the characteristics of the earthquake.
3. Design geotechnical structures, such as, shallow and deep foundations, retaining walls, and slope stability.

Course Outcomes:

1. Students will know the causes and quantification of earthquake.
2. Student will be exposed to the effect of earthquake and the design criterions to be followed for the design different geotechnical structures

Syllabus:

UNIT I

Earthquake Seismology: Causes of earthquake; Plate tectonics, earthquake fault sources, seismic waves; Elastic rebound theory; Quantification of earthquake; Intensity and magnitudes; Earthquake source models.

UNIT II

Earthquake Ground Motion: Seismograph; Characteristics of ground motion; Effect of local site conditions on ground motions; Design earthquake, design spectra; Development of site specification and code-based design.

UNIT III

Ground response analysis: One-dimensional ground response analysis: Linear approaches, equivalent linear approximation of non-linear approaches; Computer code "SHAKE".

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UNIT IV

Liquefaction and Lateral Spreading: Liquefaction related phenomena; Liquefaction susceptibility; Historical, geological, compositional and state criteria; Evaluation of liquefaction by cyclic stress and cyclic strain approaches; Lateral deformation and spreading; Criteria for mapping liquefaction hazard zones

UNIT V

Seismic design of foundations; Seismic slope stability analysis, internal stability and weakening instability and seismic design of retaining walls

Text Books:

1. Steven Kramer, Geotechnical Earthquake Engineering, Pearson Education India, 2008
2. Kumar Kamalesh, Basic Geotechnical Earthquake Engineering, New Age International Private Limited, 2017

Reference Books:

1. Seco e Pinto, P., Seismic behavior of ground and Geotechnical structure, A. A.
2. Ferrito, J.M, Seismic design criteria for soil liquefaction, Tech. Report of Naval Facilities service centre, Port Hueneme, 1997

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