Kerala Technological University

Cluster 4: Kottayam

M. Tech Program in Civil Engineering
(Geomechanics & Structures)

Scheme of Instruction & Syllabus: 2015 Admissions

Compiled By

Rajiv Gandhi Institute of Technology, Kottayam

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Kerala Technological University

(Kottayam Cluster)

M. Tech Program in Geomechanics and Structures

Scheme

Credit requirements **:** 66 credits (21+19+14+12)
Normal Duration : Regular: 4 semesters; External Registration: 6 semesters;
Maximum duration : Regular: 6 semesters; External Registration: 7 semesters.
Courses: Core Courses: Either 4 or 3 credit courses; Elective courses: All of 3 credits
Allotment of credits and examination scheme:-

Semester 1 (Credits: 22)

Exam Slot	Course No:	Name	L- T - P	Internal Marks	End Semester Exam		Credits
					Marks	(hrs)	
A	04 CE 6301	Applied Mathematics for Civil Engineers	3-1-0	40	60	3	4
B	04 CE 6303	Theoretical Geomechanics	3-1-0	40	60	3	4
C	04 CE 6305	Advanced Soil Mechanics	3-0-0	40	60	3	3
D	04 CE 6307	Advanced Design of Concrete Structures	3-0-0	40	60	3	3
E	04 CE 6XXX*	Elective - I	3-0-0	40	60	3	3
	04 GN 6001	Research Methodology	0-2-0	100	0	0	2
		Seminar - I	0-0-2	100	0	0	2
	04 CE 6393	Advanced Geotechnical and Structural Lab	0-0-2	100	0	0	1
		Total	23				22

**See List of Electives-I for slot E*

List of Elective - I Courses

Exam Slot	Course No.	Course Name
E	04 CE 6309	Soil Exploration and Field Testing
E	04 CE 6311	Soil- Structure Interaction
E	04 CE 6313	Critical State Soil Mechanics
E	04 CE 6315	Prestressed Concrete Structures

Semester 2 (Credits: 19)

Exam Slot	Course No:	Name	L- T - P	Internal Marks	End Semester Exam		Credits
					Marks	(hrs)	
A	04 CE 6302	Design of Reinforced Concrete Foundations	3-1-0	40	60	3	4
B	04 CE 6304	Foundation Analysis and Design	3-0-0	40	60	3	3
C	04 CE 6306	Dynamics of Soil and Design of Machine Foundations	3-0-0	40	60	3	3
D	04 CE 6XXX*	Elective - II	3-0-0	40	60	3	3
E	04 CE 6XXX^	Elective - III	3-0-0	40	60	3	3
	04 CE 6392	Mini Project	0-0-4	100	0	0	2
	04 CE 6394	Civil Engineering Design Studio	0-0-2	100	0	0	1
		Total	22				19

**See List of Electives -II for slot D* *^See List of Electives -III for slot E*

List of Elective - II Courses

Exam Slot	Course Code	Course Name
D	04 CE 6308	Ground water Engineering
D	04 CE 6312	Ground Improvement Techniques
D	04 CE 6314	Applied Soil Mechanics
D	04 CE 6316	Earthquake Analysis and Design of Structures

List of Elective - III Courses

Exam Slot	Course Code	Course Name
E	04 CE 6318	Environmental Geotechniques
E	04 CE 6122	Advanced Steel Structures
E	04 CE 6322	Analysis and Design of Pavements
E	04 CE 6324	Modern Construction Practices

Summer Break

Exam Slot	Course No:	Name	L- T - P	Internal Marks	End Semester Exam		Credits
					Marks	(hrs)	
NA	04 CE 7390	Industrial Training	0-0-4	NA	NA	NA	Pass /Fail
		Total	4				0

Semester 3 (Credits: 14)

Exam Slot	Course No:	Name	L- T - P	Internal Marks	End Semester Exam		Credits
					Marks	(hrs)	
A	04 CE 7XXX*	Elective - IV	3-0-0	40	60	3	3
B	04 CE 7XXX^	Elective - V	3-0-0	40	60	3	3
	04 CE 7391	Seminar - II	0-0-2	100	0	0	2
	04 CE 7393	Project (Phase - I)	0-0-12	50	0	0	6
		Total	20				14

**See List of Electives-IV for slot A* *^See List of Electives-V for slot B*

List of Elective - IV Courses

Exam Slot	Course Code	Course Name
A	04 CE 7301	Design of Steel-Concrete Composite Structures
A	04 CE 7303	Marine Geotechnical Engineering
A	04 CE 7305	Rock Mechanics

List of Elective - V Courses

Exam Slot	Course Code	Course Name
B	04 CE 7307	Design of Cylindrical Shells and Folded Plates
B	04 CE 7309	Finite Element Analysis
B	04 CE 7311	Slope Stability

Semester 4 (Credits: 12)

Exam Slot	Course No:	Name	L- T - P	Internal Marks	External Evaluation Marks		Credits
NA	04 CE 7394	Project (Phase -II)	0-0-21	70	30	NA	12
		Total	21				12

Total: 67

COURSE CODE	COURSE NAME	L-T-P:C	YEAR
04 CE 6301	APPLIED MATHEMATICS FOR CIVIL ENGINEERS	3-1-0: 4	2015

Pre-requisites:

Course Objectives:

To give the Student:-

- To define some special functions and find the recurrence relations.
- Study integral transforms and apply this to find the solution of differential equations and also its application in integral equations.
- To find the solution of linear and non-linear equations by various numerical methods.

Syllabus

Beta Gamma functions, Integral transforms, Tensor Analysis, Integral Equations, Partial differential equations

Course Outcome:

Familirise with special functions, tensor analysis and solution of certain differential and integral equations and its solutions.

Text Books:

References:

1. Dr. B.S. Grewal, “Higher Engg. Mathematics”, Khanna Publishers, 2008.
2. S.Rajasekharan “Numerical Methods for Initial and Boundary value problems”.
3. Erwin Kreyzig ”Advanced Engineering Mathematics “John Wiley & Sons, 1994
4. SanthiSwaroop, “Integral equations”, Krishna Prakasan Media.
5. M.K. Venkataraman, “Higher Engineering Mathematics”, National Publishers
6. SokolNikof, “Tensor Analysis”, John Wiley, Newyork, 1951
7. Sneddon I.N., “Partial Differential Equations”, McGrawHill, 1957.
8. S.C Chapra , R.P Canale' Numerical Method for Engineers.”

COURSE PLAN

COURSE CODE:	COURSE TITLE	CREDITS	
04 CE 6301	**APPLIED MATHEMATICS FOR CIVIL ENGINEERS**	**3-1-0:4**	
MODULES		**Contact Hours**	**Sem. Exam Marks (%)**
MODULE: 1- Beta Gamma functions Linear differential equations, Applications in vibratory motion. Bessel functions, recurrence relations, generating functions, Legendre's equation and Legendre's polynomials. Recurrence relations and orthogonality property.		10	15
MODULE: 2- Integral transforms Laplace transforms, application to differential equations- Fourier transforms, properties, derivatives, boundary value problems.		9	15
INTERNAL TEST 1 (MODULE 1 & 2)			
MODULE: 3- Tensor Analysis Summation conventions- transformations of coordinates, basic transformations, Contra variant and mixed tensors.		8	15
MODULE: 4- Integral Equations Relation between integral and differential equations- solutions by transforms of derivatives – solutions of initial and boundary value problems.		9	15
INTERNAL TEST 2 (MODULE 3 & 4)			
MODULE: 5- Partial differential equations Non-linear equations of second order, D'Alembert's method. Applications, wave equation ,Laplace equation-solution-application		10	20
MODULE: 6 System of linear algebraic equations- elimination and factorization methods.Gauss-Siedal iteration, solution of non-linear equation-Newton Raphson method. Numerical Integration Gaussian quadrature, Newton – cotes open quadrature Numerical method of solution of partial differential equations in two dimensions-finite differences-explicit and implicit methods-solution for irregular boundaries.		10	20
END SEMESTER EXAM			

COURSE CODE	COURSE NAME	L-T-P:C	YEAR
04 CE 6303	THEORETICAL GEOMECHANICS	3-1-0:4	2015

Pre-requisites: Nil

Course Objectives:

- To analyze plane strain and plane stress problems.
- To understand failure theories and constitutive models in Soil Mechanics

Syllabus

Analysis of stress and strain, Stresses in Soil, Westergaard's analysis, Rheological properties of material.

Course Outcome:

This course provides an introduction to the basic numerical methods and constitutive laws used for the analysis of boundary value problems in geomechanics

Text Books:

References:

1. Sadhu Singh, "Theory of Elasticity", Khanna Publishers, New Delhi, 1988.
2. Harr M.E, "Theoretical Soil Mechanics", 1977
3. Timoshenko, S. and Goodier J.N., "Theory of Elasticity", McGraw Hill Book Co., Newyork, 1988
4. Slater R.A.C, "Engineering Plasticity", John Wiley and Son, New York, 1977.
5. Chou P.C. and Pagano, N.J. "Elasticity Tensor, Dyadic and Engineering Approaches", D.Van Nostrand Co., Inc., London, 1967.
6. Scott R. F. " Principles of Soil Mechanics", Addison & Wesley, 1963
7. Selvadurai A.P.S., "Plasticity & Geomechanics", Cambridge University Press,2002
8. Chen W.F., "Limit Analysis & Soil Plasticity", Elsevier Scientific, 1975
9. Desai C.S. and Christian, J.T. "Numerical Methods in Geotechnical Engineering", McGrew Hill, New York, 1977.

COURSE PLAN

COURSE CODE:	COURSE TITLE	CREDITS	
04 CE 6303	**THEORETICAL GEOMECHANICS**	**3-1-0:4**	
MODULES		**Contact Hours**	**Sem. Exam Marks (%)**
MODULE: 1 Analysis of stress and strain, Equilibrium equations - Compatibility equations – stress strain relationship. Generalized Hooke's law. Octahedral shear ,Stress function .Plane stress and plane strain - Simple two dimensional problems in Cartesian and polar coordinates. Deviator stress		12	15
MODULE: 2 Stresses in Soil: Description of state of stress and strain at a point, stress distribution problems in elastic half pace Boussnesque's analysis for concentrated force. Pressure bulb. Uniformly loaded circular and rectangular areas. Newmark influence diagram. Vertical and horizontal line loads. Uniform vertical load over a strip. Principal stress and maximum shear. Triangular and other loadings.		12	15
INTERNAL TEST 1 (MODULE 1 & 2)			
MODULE: 3 Westergaard's analysis. Burmister's two layer theory. Stress distribution around tunnels and vertical shafts.		8	15
MODULE: 4 Rheological properties of material-equation of state, models, stress deformation behaviour of soil subject to loading, solution of problems of linearly elastic solids. Deformation of Rheological constants. Pore pressure developed, settlement computations		8	15
INTERNAL TEST 2 (MODULE 3 & 4)			
MODULE: 5 Failure theories, Yield criteria , Tresca, Von Mises , Mohr-Coulomb failure conditions. Failure loci in deviatoric plane and principal stress space, influence of intermediate principal stress on failure.		8	20
MODULE: 6 Constitutive Models in Soil Mechanics: Isotropic Elastic, Anisotropic Plasticity and Viscous Models. Representing Soil Behaviour using these Models. ; Advances in Constitutive models		8	20
END SEMESTER EXAM			

COURSE CODE	COURSE NAME	L-T-P:C	YEAR
04 CE 6305	ADVANCED SOIL MECHANICS	3-0-0: 3	2015

Pre-requisites: Nil

Course Objectives:

- To understand clay mineralogy and effective stress principle of soil.
- To compute shear strength parameters and settlement of soil.

Syllabus:

Origin, nature and distribution of soil, Effective stress principle, consolidation, Shear strength, stress history.

Course Outcome:

This course is designed to give an advanced thorough theoretical background to the different aspects encountered in geotechnical design for example earth pressure analyses, bearing capacity theories, assessments of settlements and displacements and so on.

Text Books:

References:

1. Braja M Das " Advanced soil Mechanics" Taylor and Francis
2. R F Scott, Principles of Soil Mechanics, Addison & Wesley.
3. Lambe T.W, Whitman R.V , " Soil Mechanics" John Wiley & Sons
4. Mitchell, J. K. (1993), “Text book in Fundamentals of Soil Behaviour”, 2Ed, John Wiley &Sons, New York
5. Holtg,R.D and Kovacs W.D.(1981), “An Introduction to Geotechnical Engineering” , Prentice hall CO, N.J.
6. Hough, B. K (1957), “Basic Soil Engineering” The Ronald Press Co, New York.

COURSE PLAN

COURSE CODE:	COURSE TITLE	CREDITS	
04 CE 6305	**ADVANCED SOIL MECHANICS**	**3-0-0:3**	
MODULES		**Contact Hours**	**Sem. Exam Marks (%)**
MODULE: 1 Origin, nature and distribution of soil, classification of soil ,description of individual particle, clay mineralogy, atomic bonds, clay-water electrolytes, soil fabric and structure. Clay mineral identification. X-ray and Differential Thermal Analysis.		7	15
MODULE: 2 Effective stress principle, steady state flow in soil, effect of flow on effective stress, determination of coefficient of permeability,		7	15
INTERNAL TEST 1 (MODULE 1 & 2)			
MODULE: 3 Consolidation ,one, two, three and radial direction, variation of effective stress during consolidation, consolidation tests and determination of consolidation parameters -measurement of swelling pressure- secondary consolidation and its effect on pre-consolidation pressure.		7	15
MODULE: 4 Shear strength- Stress path, Tri-axial ,direct shear, UCC and vane shear tests, shear behaviour of granular soils, factors affecting shear behaviour, determination of shear strength parameters, shear behaviour of fine grained soils, pore pressure parameters, UU,CU,CD tests, total and effective shear strength parameters, total and effective stress paths		7	15
INTERNAL TEST 2 (MODULE 3 & 4)			
MODULE: 5 Stress history, rate of loading, structure and temperature, anisotropy of strength, thixotropy ,creep, determination of in situ undrained strength. Compaction- tests, effect on soil structure, engineering behaviour on preloading		7	20
MODULE: 6 Soil settlement prediction in sand, simplified strain influence factor, Skempton Bjerrum modification- settlement of clays – precompression –stress path for settlement calculation.		7	20
END SEMESTER EXAM			

COURSE CODE	COURSE NAME	L-T-P:C	YEAR
04 CE 6307	ADVANCED DESIGN OF CONCRETE STRUCTURES	3-0-0: 3	2015

Pre-requisites: Nil

Course Objectives:

- To learn the fundamentals of design, analysis, and proportioning of reinforced concrete members and structures.
- Methods for analysis and design of the elements under flexure, shear, and axial loads will be examined.

Syllabus:

Calculation of deflection and crack width - Design of flat slabs and flat plates - Design of RC walls - Inelastic behaviour of concrete beams

Course Outcome:

- The students will be familiar with advanced methods used for concrete structural design.
- Identify underlying concepts in modern concrete design methods

Text Books:

References:

1. Varghese, P.C, “Advanced Reinforced Concrete Design”, Prentice Hall of India, 2005.
2. Varghese P.C, “Limit State Design of Reinforced Concrete, Prentice Hall of India, 2007.
3. Purushothaman, P, “Reinforced Concrete Structural Elements : Behaviour Analysis and Design”, Tata McGraw Hill, 1986
4. Arthur.H.Nilson, David Darwin& Charles W Dolan, "Design of Concrete Structures", Tata Mcgraw Hill, 2004
5. Sinha.N.C. and Roy S.K., “Fundamentals of Reinforced Concrete”, S.Chand and Company Limited, New Delhi, 2003.
6. Park.R & Paulay T "Design of Concrete Structures",John Wiley & Sons, NewYork

COURSE PLAN

COURSE CODE:	COURSE TITLE	CREDITS	
04 CE 6307	**ADVANCED DESIGN OF CONCRETE STRUCTURES**	**3-0-0:3**	
MODULES		**Contact Hours**	**Sem. Exam Marks (%)**
MODULE: 1 Calculation of deflection and crack width Design of columns, slender column, corbels and deep-beams.		7	15
MODULE: 2 Design of flat slabs and flat plates- Design of spandrel beams . method of design of slabs- Yield line theory and Hillerborgs strip method.		7	15
INTERNAL TEST 1 (MODULE 1 & 2)			
MODULE: 3 Design of RC walls - ordinary and shear walls – Design of Grid floors- a) by IS code method-b) by plate theory.		7	15
MODULE: 4 Analysis of Multi-Storey Buildings with Moment resistant Joints for Lateral loads- Modified portal, Cantilever & Factor method- Analysis of Multi-Storey Buildings with Moment resistant Joints for Gravity loads(Vertical Loads)		7	15
INTERNAL TEST 2 (MODULE 3 & 4)			
MODULE: 5 Inelastic behaviour of concrete beams- limit state analysis of concrete beams- moment rotation curves, Moment redistribution in continuous beams.		7	20
MODULE: 6 Baker's method of plastic design - Design of cast-in-situ joints in frames. Detailing for ductility - Fire resistance of structural members – Quality of control of concrete. Strengthening of existing structures		7	20
END SEMESTER EXAM			

COURSE CODE	COURSE NAME	L-T-P:C	YEAR
04 CE 6309	SOIL EXPLORATION AND FIELD TESTING	3-0-0: 3	2015

Pre-requisites: Nil

Course Objectives:

- To understand different methods of sampling and soil explortion.
- To get a knowledge of various field tests and onshore and offshore investigation methods.

Syllabus:

Principles of exploration, Modern methods of sampling, Various types of field tests, Field testing for dynamic properties.

Course Outcome:

Able to plan and design a subsurface exploration program based on anticipated geologic conditions and potential construction problems.

Text Books:

References:

1. N.P. Kurien, Design of Foundation Systems : Principles & Practices, Narosa, New Delhi 1992
2. Bowles J.E., "Foundation Analysis and Design" (4Ed.), Mc.Graw –Hill, NY, 1996
3. M.J Tomlinson (1975) "Foundation Design and construction", Pitman Publishing Limited, London
4. H. F. Winterkorn and H Y Fang, Foundation Engineering Hand Book, Galgotia Booksource
5. G.Ranjan and A S R Rao, Basic and Applied Soil Mechanics, New Age international Publishers
6. Hunt R.E, Geotechnical Engineering investigation Manual, Mc Graw Hill, 1984

COURSE PLAN

COURSE CODE:	COURSE TITLE	CREDITS	
04 CE 6309	**SOIL EXPLORATION AND FIELD TESTING**	**3-0-0: 3**	
MODULES		**Contact Hours**	**Sem. Exam Marks (%)**
MODULE: 1 Principles of exploration; planning of investigation programmes , preliminary investigation-geophysical methods, electrical resistivity and seismic refraction methods, sounding, methods of exploration- open pits, trenches, shafts, tunnels, drifts, auger boring, rotary drilling, depth and spacing of exploration, codal provisions.		7	15
MODULE: 2 Modern methods of sampling, different samplers- open drive sampler, thin walled sampler, piston sampler: disturbed and undisturbed samples in cohesionless and cohesive soils, representative and non-representative samples, Preservation and transportation of samples; Sampling records		7	15
INTERNAL TEST 1 (MODULE 1 & 2)			
MODULE: 3 Various types of field tests; ; standard penetration test, plate load test, cyclic plate load test, static and dynamic cone penetration test, pressure meter tests, dilatometer tests, in-situ permeability tests, in-situ vane shear test, bore hole shear tests. Pile load test – Pullout test, lateral load test.		7	15
MODULE: 4 Field testing for dynamic properties- seismic cross hole test, SPT, Cyclic plate load test, block vibration test, in Situ measurement of K0. SPT correlation, uses of SPT value, Correlation of N value with shear strength and relative density, correlation with SPT and CPT values.		7	15
INTERNAL TEST 2 (MODULE 3 & 4)			
MODULE: 5 Location of water table, soil profiles and bore log, interpretation of exploration data and report preparation-Forensic analysis of geotechnical failures, methodology of back analysis.		7	20
MODULE: 6 Geotechnical instrumentation – settlement, soil pressure, pore water pressure. Investigation below sea/river bed, comparison between onshore and offshore investigation, bathymetry, drillship and sea bed investigations, under water sampling		7	20
END SEMESTER EXAM			

COURSE CODE	COURSE NAME	L-T-P:C	YEAR
04 CE 6311	SOIL STRUCTURE INTERACTION	3-0-0: 3	2015

Pre-requisites: Nil

Course Objectives:

- To understand the theory of soil-structure interaction.
- To learn elastic analysis of pile and theoretical solutions for settlement and load distributions.

Syllabus:

Soil-Foundation Interaction: Beam on Elastic Foundation, Plate on Elastic Medium: Thin and thick plates, Analysis of finite plates, Numerical analysis of finite plates, simple solutions ; Analysis of pile group, Interaction analysis, Load distribution in groups with rigid cap, Laterally Loaded Pile: Load deflection prediction for laterally loaded piles

Course Outcome:

- To understand the fundamental concepts and theory of dynamic soil-structure interaction (SSI), with special focus on the numerical tools currently available to model such problems in earthquake engineering practice.

Text Books:

References:

1. Nainan.P. Kurien, Design of Foundation Sytems:Principles & Practices, Narosa, New Delhi 1992.
2. L.C. Reese, Single piles and pile groups under lateral loading, Taylor & Francis, 2000
3. E.S. Melerski, Design Analysis of Beams, Circular Plates and Cylindrical Tanks on Elastic Foundation, Taylor and Francis, 2006.
4. G. Jones, Analysis of Beams on Elastic foundation, Thomas Telford, 1997.
5. Cakmak,A.S, " Soil Structure Interaction" Elsevier, 1987.

COURSE PLAN

COURSE CODE:	COURSE TITLE	CREDITS	
04 CE 6311	**SOIL STRUCTURE INTERACTION**	**3-0-0: 3**	
MODULES		**Contact Hours**	**Sem. Exam Marks (%)**
MODULE: 1 Soil-Foundation Interaction: Introduction to soil-foundation interaction problems, Soil behaviour, Foundation behaviour, Interface behaviour, Scope of soil foundation interaction analysis, soil response models, Winkler, Elastic continuum, Two parameter elastic models, Elastic plastic behaviour, Time dependent behaviour.		7	15
MODULE: 2 Beam on Elastic Foundation- Soil Models: Infinite beam, Two parameters, Isotropic elastic half space, Analysis of beams of finite length, Classification of finite beams in relation to their stiffness.		7	15
INTERNAL TEST 1 (MODULE 1 & 2)			
MODULE: 3 Plate on Elastic Medium: Thin and thick plates, Analysis of finite plates, Numerical analysis of finite plates, simple solutions.		7	15
MODULE: 4 Elastic Analysis of Pile: Elastic analysis of single pile, Theoretical solutions for settlement and load distributions.		7	15
INTERNAL TEST 2 (MODULE 3 & 4)			
MODULE: 5 Analysis of pile group, Interaction analysis, Load distribution in groups with rigid cap.		7	20
MODULE: 6 Laterally Loaded Pile: Load deflection prediction for laterally loaded piles, Subgrade reaction and elastic analysis, Interaction analysis, Pile-raft system, Solutions through influence charts.		7	20
END SEMESTER EXAM			

COURSE CODE	COURSE NAME	L-T-P:C	YEAR
04 CE 6313	CRITICAL STATE SOIL MECHANICS	3-0-0: 3	2015

Pre-requisites:

Course Objectives:

- To understand the use of models in soil elasticity, plasticity and yielding.
- To understand the behaviour of over consolidated soil.

Syllabus:

Critical state concept, Constitutive relationships of soil, Stress and strain path and invariant, models and soil mechanics; Consolidation, drained and undrained triaxial test; Critical State Line and Roscoe surface- Drained and undrained loading, ; behaviour of over consolidated soil, Hvorslev Surface, complete state boundary surface; Yield Surfaces: Modified Cam-clay and Original Cam-clay, Special Topics: hypoelasticity-plasticity, disturbed state concept; Failure theorems for soils.

Course Outcome:

- Able to understand the conceptual models that represent the mechanical behaviour of saturated remoulded soil.

Text Books:

References:

1. B M Das, Advanced Soil Mechanics, Taylor and Francis
2. R F Scott, Principles of Soil Mechanics, Addison & Wesley
3. D.M. Wood, Soil Behaviour and Critical State Soil Mechanics, University of Glasgow
4. A.N, Schofield, C.P Wroth Critical State Soil Mechanics, Mc Graw Hill, London
5. R.O. Davis and A.P.S. Selvadurai, Elasticity and Geomechanics, Cambridge University Press, New York.
6. Mitchell, J. K. (1993), “Text book in Fundamentals of Soil Behaviour”, 2Ed, John Wiley &Sons, New York
7. J.H Atkinson & P.L Bransby , The Mechanics of soil –an introduction to critical state soil mechanics, Mc Graw Hill, London 1978

COURSE PLAN

COURSE CODE:	COURSE TITLE	CREDITS	
04 CE 6313	**CRITICAL STATE SOIL MECHANICS**	**3-0-0:3**	
MODULES		**Contact Hours**	**Sem. Exam Marks (%)**
MODULE: 1 Critical state concept, Constitutive relationships of soil, Stress and strain path and invariant, models and soil mechanics, use of models in engineering, elasticity, soil elasticity, plasticity and yielding, yielding in combined tension and torsion, elastic volumetric strains,		8	15
MODULE: 2 Consolidation, drained and undrained triaxial test- Stress-dilatancy theory; Work hardening plasticity theory: formulation and implementation.		7	15
INTERNAL TEST 1 (MODULE 1 & 2)			
MODULE: 3 Critical State Line and Roscoe surface- Drained and undrained loading		6	15
MODULE: 4 The behaviour of over consolidated soil, Hvorslev Surface, complete state boundary surface ,elastic-plastic model for soil, a particular elastic-plastic model cam-clay models, simulation of single element test using cam-clay		8	15
INTERNAL TEST 2 (MODULE 3 & 4)			
MODULE: 5 Yield Surfaces: Modified Cam-clay and Original Cam-clay, Special Topics: hypoelasticity-plasticity, disturbed state concept.		6	20
MODULE: 6 Failure theorems for soils; Failure and plastic flow at critical state Applications of elasto-plastic models		7	20
END SEMESTER EXAM			

COURSE CODE	COURSE NAME	L-T-P:C	YEAR
04 CE 6315	PRESTRESSED CONCRETE STRUCTURES	3-0-0:3	2015

Pre-requisites: Nil

Course Objectives:

To give the Student:-

- To Explain the effects of prestress on the behaviour of concrete beams and identify situations when prestress is needed
- To determine the combined stresses induced by prestress and applied loads
- To define and determine the different types of losses of pre-stressed concrete

Syllabus

Analysis and design of simply supported (post and pre tensioned, Short term deflections and long term deflections as per IS Code, Design of tension members.

Course Outcome:

- To introduce you the concepts of pre-stressed concrete, dealing with load analysis.
- You will also be introduced to types pre stressed concrete structures.

Text Books:

References:

- Krishna Raju N, “Prestressed Concrete” , 4th Edition TMH New Delhi , 2000
- Rajagopalan N, “Prestressed Concrete”, Narora Publishing house, 2002
- Sinha N.C. & Roy, “Fundamentals of Prestressed Concrete”, S.Chand & Co, 1985
- Lin T.Y, “Design of Prestressed Concrete Structures”, John Wiley & Sons , 1960
- Pandit and Gupta, “Prestressed concrete”, CBS, 2002
- F K Kong and R H Evans, “ reinforced and prestressed concrete”, TMH, 1999

COURSE PLAN

COURSE CODE:	COURSE TITLE	CREDITS	
04 CE 6315	**PRESTRESSED CONCRETE STRUCTURES**	**3-0-0:3**	
MODULES		**Contact Hours**	**Sem. Exam Marks (%)**
MODULE : 1 - **Analysis and design of simply supported (post and pre tensioned)** PSC flexural members – Basic concepts – Stresses at transfer and service loads, ultimate strength in flexure.		8	15
MODULE : 2 - **Short term deflections and long term deflections** Deflection as per IS Code – Design and analysis of post and pre tensioned PSC slabs.		6	15
INTERNAL TEST 1 (MODULE 1 & 2)			
MODULE : 3 - Design for shear, bond and torsion Design of end blocks (IS code method)– Design of prestressed concrete cylindrical water tanks – Design of prestressed concrete pipes.		8	15
MODULE : 4 - Design of tension members Design of compression members – compression members with and without flexure – Design of piles.		7	15
INTERNAL TEST 2 (MODULE 3 & 4)			
MODULE : 5 - Composite construction with precast RC beams Analysis and design – Ultimate strength – Partial prestressing – Definitions – principles and design approaches.		6	20
MODULE : 6 - Statically indeterminate structures Analysis and design – Continuous beams – concept linear transformation – concordant cable profile and cap cables.		7	20
END SEMESTER EXAM			

COURSE CODE	COURSE NAME	L-T-P-C	YEAR
04 GN 6001	RESEARCH METHODOLOGY	0-2-0:2	2015

Pre-requisites:

Course Objectives:

To enable the students:

- To get introduced to research philosophy and processes in general.
- To formulate the research problem and prepare research plan
- To apply various numerical /quantitative techniques for data analysis
- To communicate the research findings effectively

Syllabus

Introduction to the Concepts of Research Methodology, Research Proposals, Research Design, Data Collection and Analysis, Quantitative Techniques and Mathematical Modeling, Report Writing.

Course Outcome:

Students who successfully complete this course would learn the fundamental concepts of Research Methodology, apply the basic aspects of the Research methodology to formulate a research problem and its plan. They would also be able to deploy numerical/quantitative techniques for data analysis. They would be equipped with good technical writing and presentation skills.

Text Books:

1. Research Methodology: Methods and Techniques', by Dr. C. R. Kothari, New Age International Publisher, 2004
2. Research Methodology: A Step by Step Guide for Beginners' by Ranjit Kumar, SAGE Publications Ltd; Third Edition

References:

1. Research Methodology: An Introduction for Science & Engineering Students', by Stuart Melville and Wayne Goddard, Juta and Company Ltd, 2004
2. Research Methodology: An Introduction' by Wayne Goddard and Stuart Melville, Juta and Company Ltd, 2004
3. Research Methodology, G.C. Ramamurthy, Dream Tech Press, New Delhi
4. Management Research Methodology' by K. N. Krishnaswamy et al, Pearson Education

COURSE CODE:	COURSE TITLE	CREDITS	
04 GN 6001	RESEARCH METHODOLOGY	0-2-0: 2	
MODULES		Contact Hours	
MODULE : 1 Introduction to Research Methodology: Concepts of Research, Meaning and 2 Objectives of Research, Research Process, Types of Research, Type of research: Descriptive vs. Analytical, Applied vs. Fundamental, Quantitative vs. Qualitative, and Conceptual vs. Empirical		5	
MODULE :2 Criteria of Good Research, Research Problem, Selection of a problem, Techniques involved in definition of a problem, Research Proposals – Types, contents, Ethical aspects, IPR issues like patenting, copyrights.		4	
INTERNAL TEST 1 (MODULE 1 & 2)			
MODULE: 3 **Research Design :** Meaning, Need and Types of research design, Literature Survey and Review, Identifying gap areas from literature review, Research Design Process, Sampling fundamentals, Measurement and scaling techniques, Data Collection – concept, types and methods, Design of Experiments.		5	
MODULE 4: **Quantitative Techniques:** Probability distributions, Fundamentals of Statistical analysis, Data Analysis with Statistical Packages, Multivariate methods, Concepts of correlation and regression - Fundamentals of time series analysis and spectral analysis.		5	
INTERNAL TEST 2 (MODULE 3 & 4)			
MODULE: 5 **Report Writing:** Principles of Thesis Writing, Guidelines for writing reports & papers, Methods of giving references and appendices, Reproduction of published material, Plagiarism, Citation and acknowledgement.		5	
MODULE: 6 Documentation and presentation tools – LaTeX, Office with basic presentations skills, Use of Internet and advanced search techniques.		4	

COURSE CODE	COURSE NAME	L-T-P-C	YEAR
04 CE 6393	ADVANCED GEOTECHNICAL & STRUCTURAL LABORATORY	0-0-2:1	2015

Geotechnical lab

Modified Proctor Compaction Test
Permeability of fine grained soil
Atterberg Limits
Soil Classification as per IS
Direct Shear Test
Triaxial Shear Test (CU, CD, UU)
Consolidation Test
Relative Density
Field Study of SPT/ Field vane shear test

Structural Lab

Mix Design of Concrete with Admixtures
Testing of Simply Supported RCC beam for Flexural failure
Testing of Simply Supported RCC beam for Shear Failure
Testing of RCC Column

SEMESTER II

COURSE CODE	COURSE NAME	L-T-P: C	YEAR
04 CE 6302	DESIGN OF REINFORCED CONCRETE FOUNDATIONS	3-0-0:3	2015

Pre-requisites: Nil

Course Objectives:

- To familiarise knowledge and understanding of soil behaviour, pertaining to different types of foundations.
- To introduce detailed design issues related to both deep and shallow foundations.
- Develop the understanding of the role of modern soil mechanics.

Syllabus:

Introduction to Limit State Design of reinforced concrete in foundations, Combined footings subjected to vertical loads, Structural design of mat foundation, Analysis of flexible beams and grids on elastic foundations, Structural design of piles including pile caps, Special foundations.

Course Outcome:

- To build the knowledge on soil behaviour and introduce to design issues pertaining to different types of foundations
- An ability to identify & design various types of foundations according to field conditions

Text Books:

References:

1. Varghese P.C, “Foundation Engineering” Prentice Hall of India,2005
2. Nainan P Kurien,Design of Foundation Sytems:Principles & Practices, Narosa, New Delhi 1992.
3. Bowles J.E., “Foundation Analysis and Design” (4Ed.), Mc.Graw –Hill, NY, 1996
4. Askok K Jain , “Reinforced Concrete Limit State Design”Nem Chand & Bros ,Roorkee
5. Shamsher prakash, Gopal Ranjan, & Swami Saran (1979), “Analysis and design of foundations and retaining structures”, Sarita Prakashan New Delhi
6. Jain G.S & Dinesh Mohan “ Hand Book on Under reamed and Bored compaction pile foundation “, CBRI Roorkee.

COURSE PLAN

COURSE CODE:	COURSE TITLE	CREDITS	
04 CE 6302	DESIGN OF REINFORCED CONCRETE FOUNDATIONS	3-0-0:3	
MODULES		**Contact Hours**	**Sem. Exam Marks (%)**
MODULE: 1 Introduction to Limit State Design of reinforced concrete in foundations; Soil pressure for structural design; Conventional structural design of Spread footings, isolated footings, column Pedestals		7	15
MODULE: 2 Combined footings subjected to vertical loads, lateral loads and moments, Combined Footing, Strap footing, strip footings under several columns,		7	15
INTERNAL TEST 1 (MODULE 1 & 2)			
MODULE: 3 Structural design of mat foundation of various types subjected to vertical and lateral loads and moments; Design of circular rafts; Annular rafts. Soil structure interaction and 'flexible' approach to the design of foundations; Structural design of retaining walls.		7	15
MODULE: 4 Analysis of flexible beams and grids on elastic foundations, Analysis of flexible plates on elastic foundations, ACI method of analysis of beams on elastic foundation.		7	15
INTERNAL TEST 2 (MODULE 3 & 4)			
MODULE: 5 Structural design of piles including pile caps, under-reamed piles, piers and caissons; infilled virendal frame foundation- steel column basis , structural design of well foundation.		7	20
MODULE: 6 Special foundations; Foundations For Towers-steel towers- foundation to water tank, chimneys- shells for foundations- hyperbolic paraboloid foundations, design of conical shell foundation.		7	20
END SEMESTER EXAM			

COURSE CODE	COURSE NAME	L-T-P:C	YEAR
04 CE 6304	FOUNDATION ANALYSIS AND DESIGN	3-0-0: 3	2015

Pre-requisites: Nil

Course Objectives:

- To analyze and estimate bearing capacity, settlement and lateral resistance of deep foundation systems
- To study the effect of soil structure interaction on foundation design.
- To understand the various methods used for the determination of bearing capacity of shallow foundations.

Syllabus:

Shallow Foundation, Bearing capacity of foundation based on in-situ tests; Pile Foundations , Pile Groups – Consideration regarding spacing – Efficiency of pile groups – Stresses on underlying soil strata – Approximate analysis of pile groups; Laterally loaded piles – Modulus of sub grade reaction method – ultimate lateral resistance of piles; Soil -Structure Interaction

Course Outcome:

- Able to comprehend the knowledge of foundation engineering and to establish the framework for foundation design.

Text Books:

References:

1. Fleming,W.G.K , Weltman A.J, Randolph M.F, Elson W.K, " Piling Engineering", Blackie Academic & Professional.
2. N.P. Kurien, Design of Foundation Sytems : Principles & Practices, Narosa.
3. Winterkorn H.F. and Fang H.Y. Ed., “Foundation Engineering Hand Book”, Van-Nostrand Reinhold, 1975.
4. Poulose H.G. and Davis E.H., “Pile foundation Analysis and Design”, John-Wiley & Sons, NY, 1980.
5. Lambe and Whitman, “Soil Mechanics”, Wiley Eastern., 1976.
6. Leonards G. Ed., “Foundation Engineering”, Mc.Graw-Hill,NY, 1962.
7. Bowles J.E., “Foundation Analysis and Design” (4Ed.), Mc.Graw –Hill, NY, 1996

COURSE PLAN

COURSE CODE:	COURSE TITLE	CREDITS	
04 CE 6304	FOUNDATION ANALYSIS AND DESIGN	3-0-0:3	
MODULES		Contact Hours	Sem. Exam Marks (%)
MODULE: 1 Shallow Foundation-Bearing capacity- Mayerhoff, Hansen and Vesic – bearing capacity factors, effect of water table, shape of foundation, inclination. Settlement immediate and consolidation –pressure bulb distribution.		10	15
MODULE: 2 Bearing capacity of foundation based on in-situ tests. Design of spread footing, column footing , combined footing. Mat foundations on cohesive and cohesion less soil- rigid beam analysis- Winkler model		8	15
INTERNAL TEST 1 (MODULE 1 & 2)			
MODULE: 3 Pile Foundations Introduction – Estimation of pile capacity by static and dynamic formulae – Wave equation method of analysis of pile resistance – Load -Transfer method of estimating pile capacity – Settlement of single pile – Elastic methods.		10	15
MODULE: 4 Pile Groups – Consideration regarding spacing – Efficiency of pile groups – Stresses on underlying soil strata – Approximate analysis of pile groups –Settlement of pile groups- Pile caps –Pile load tests – Negative skin friction, Under reamed piles		10	15
INTERNAL TEST 2 (MODULE 3 & 4)			
MODULE: 5 Laterally loaded piles – Modulus of sub grade reaction method – ultimate lateral resistance of piles. Well foundation- Design and construction. Bearing capacity, settlement and lateral resistance. Tilts and shifts		8	20
MODULE: 6 Soil -Structure Interaction Introduction to Soil -Structure interaction problems -Contact pressure distribution – factors influencing Contact pressure distribution beneath rigid and flexible footings contact pressure distribution beneath rafts – concentrically and eccentrically loaded cases –Modulus of Sub grade reaction – Determination of modulus of sub grade reaction – Factors influencing modulus of subgrade reaction		10	20
END SEMESTER EXAM			

COURSE CODE	COURSE NAME	L-T-P:C	YEAR
04 CE 6306	DYNAMICS OF SOIL AND DESIGN OF MACHINE FOUNDATION	3-0-0:3	2015

Pre-requisites: Nil

Course Objectives:

- To analyze SDOF system and MDOF system under dynamic loading.
- To familiarize different methods of analysis of machine foundation.
- To design machine foundation such that it neither endanger the satisfactory operation of the machine nor disturb people working in the immediate vicinity

Syllabus:

Introduction to Soil Dynamics; Bearing capacity of dynamically loaded foundations; Design of Machine Foundations; foundation of reciprocating machines -design criteria -calculation of induced forces and moments -multi-cylinder engines; Foundations subjected to impact loads; vibration isolation – active and passive isolation -transmissibility -methods of isolation in machine foundations.

Course Outcome:

- Able to understand the behaviour of soil and foundations under dynamic loads.

Text Books:

References:

1. Bowles J.E., “Foundation Analysis and Design” (4Ed.), Mc.Graw Hill, NY,19962. Shamsher Prakash, “Soil Dynamics”, McGraw Hill, 1981.
2. Das B M, “Principles of Soil Dynamics”, Thomsons Engineering, 1992.4. Saran S., “ Soil Dynamics and Machine Foundations”, Galgotia Publications Private Ltd.,1999.
3. Sreenivasalu & Varadarajan, “Handbook of Machine Foundations”, Tata McGraw Hill ,2002
4. A Major, “Vibration Analysis and Design of Foundations for Machines
5. and Turbines: Dynamical Problems in Civil Engineering”, Akademiai Kiado Budapest Collets Holding Ltd, 1962
6. IS 2974 -Part I and II, “Design Considerations for Machine Foundations”
7. IS 5249: “Method of Test for Determination of Dynamic Properties Of Soils

COURSE PLAN

COURSE CODE:	COURSE TITLE	CREDITS	
04 CE 6306	DYNAMICS OF SOIL AND DESIGN OF MACHINE FOUNDATION	3-0-0:3	
MODULES		**Contact Hours**	**Sem. Exam Marks (%)**
MODULE: 1- Introduction to Soil Dynamics Vibration of elementary systems- free and forced vibration with and without damping, Analysis of systems with Single degree and multi-degree of freedom. Natural frequencies of continuous systems, resonance . Effect of vibration on soil properties.		7	15
MODULE: 2 Bearing capacity of dynamically loaded foundations .Nature of dynamic loads –stress conditions on soil elements under earthquake loading -methods of analysis of machine foundations -methods based on linear elastic weightless springs methods based on linear theory of elasticity (elastic half space theory) -nature of damping -geometric and internal - Elastic Constants of soil and their experimental determination.		7	15
INTERNAL TEST 1 (MODULE 1 & 2)			
MODULE: 3- Design of Machine Foundations Type of machine foundations special considerations for design of machine .Vertical, sliding, rocking and yawing vibrations of a block foundation –simultaneous rocking, sliding and vertical vibrations of a block foundation		7	15
MODULE: 4 Foundation of reciprocating machines -design criteria -calculation of induced forces and moments -multi-cylinder engines -numerical example (IS code method)		7	15
INTERNAL TEST 2 (MODULE 3 & 4)			
MODULE: 5 Foundations subjected to impact loads - design criteria - analysis of vertical vibrations computation of dynamic forces - design of hammer foundations (IS code method)		7	20
MODULE: 6 Vibration isolation – active and passive isolation -transmissibility - methods of isolation in machine foundations		7	20
END SEMESTER EXAM			

COURSE CODE	COURSE NAME	L-T-P:C	YEAR
04 CE 6308	ADVANCED STEEL STRUCTURES	3-0-0: 3	2015

Pre-requisites: Nil

Course Objectives:

- To study and design members subjected to lateral loads and axial loads
- To focus on the study and design of various steel towers and steel chimneys
- To study the design concepts and design Light gauge steel structures

Syllabus:

Review of loads on structures, Types of connections, Design of self supporting chimney, Theory of plastic bending, Behaviour of Compression Elements

Course Outcome:

- The student will also gain knowledge of designing different types of steel members
- The student will have an exposure to design of steel tower and chimneys
- The student will also gain the knowledge of designing light gauge steel structures

Text Books:

References:

1. Subramanian.N, “Design of Steel Structures”, Oxford University Press, 2008.
2. Dayaratnam.P, “Design of Steel Structures”, A.H.Wheeler, India, 2007.
3. Linton E. Grinter, “Design of Modern Steel Structures”, Eurasia Publishing House, New Delhi, 1996.
4. John E. Lothers, “Design in Structural Steel”, Prentice Hall of India, New Delhi, 1990.
5. Lynn S. Beedle, “Plastic Design of Steel Frames”, John Wiley and Sons, New York, 1990.
6. Wie Wen Yu, “Design of Cold Formed Steel Structures”, Mc Graw Hill Book Company, New York, 1996.
7. S.S Bhavikatti “ Design of steel structures” I.K International Publishing house Pvt Ltd
8. S.K Duggal “ Limit State Design of steel structures’ TMH publications

COURSE PLAN

COURSE CODE:	COURSE TITLE	CREDITS	
04 CE 6308	ADVANCED STEEL STRUCTURES	**3-0-0:3**	
MODULES		**Contact Hours**	**Sem. Exam Marks (%)**
MODULE: 1- Review of loads on structures Dead, live, wind and seismic loads as per IS 800-2007 , Design of purlins, Louver rails, gable column and gable wind girder – Analysis and design of gable frames – design of moment resisting base plates.		7	15
MODULE: 2- Types of connections Design requirement of bolted and welded connections– Seated Connections – Unstiffened and Stiffened seated Connections – Moment Resistant Connections – Semi rigid Connections – Split beam Connections – Framed Connections		7	15
INTERNAL TEST 1 (MODULE 1 & 2)			
MODULE: 3- Design of self supporting chimney Design of base plates, foundations and anchor bolts- Guyed steel chimney – guy ropes – stresses due to wind . Along with load calculation – gust factor method.		7	15
MODULE: 4- Theory of plastic bending Plastic hinge concept- mechanism method- Application to continuous beam and portal frames – plastic moment distribution.		7	15
INTERNAL TEST 2 (MODULE 3 & 4)			
MODULE: 5- Limit State Design –Ultimate and serviceability limit states Limit state design of axially loaded members- Design of beams.		7	20
MODULE: 6- Behaviour of Compression Elements Effective width for load and deflection determination – Behaviour of Unstiffened and Stiffened Elements – Design of webs of beams – Flexural members – Lateral buckling of beams – Shear Lag – Flange Curling – Design of Compression Members – Wall Studs		7	20
END SEMESTER EXAM			

COURSE CODE	COURSE NAME	L-T-P:C	YEAR
04 CE 6312	APPLIED SOIL MECHANICS	3-0-0: 3	2015

Pre-requisites:

Course Objectives:

- To design reinforced earth retaining structures.
- To study bulkheads, cofferdams and stability analysis of natural slopes.

Syllabus:

Earth Pressure, Design of retaining wall, Theory of arching in soils and its applications in tunnel, conduits, silos; Bulkheads; Cellular Cofferdams; Slope stability.

Course Outcome:

- This inspiring course encourages students to solve geotechnical engineering problems using traditional engineering solutions.

Text Books:

References:

1. Das B. M., “Principles of Foundation Engineering”, Thomson, Indian Edition, 2003.
2. Bowles J.E., “Foundation Analysis and Design” (4Ed.), Mc.Graw Hill, NY, 1996
3. Nainan P Kurian, “Design of foundation systems: principles and practices” ,Narosa publish House New Delhi, 1992
4. Gregory. P. Tschebotarioff ,“Foundations, Retaining and Earth Structures”, McGraw Hill , 1978.
5. Shamsher prakash, Gopal Ranjan, & Swami Saran, “Analysis and design of foundations and retaining structures”, Sarita Prakashan New Delhi, 1979
6. Craig R F, “Soil Mechanics”, Chapman and Hall(ELBS) ,2004.

COURSE PLAN

COURSE CODE:	COURSE TITLE	CREDITS	
04 CE 6312	**APPLIED SOIL MECHANICS**	**3-0-0:3**	
MODULES		**Contact Hours**	**Sem. Exam Marks (%)**
MODULE: 1- Earth Pressure Fundamental relationships between the lateral pressures and the strain with a back fill. Rankine and Coulomb theories. Assumption and conditions. Point of application of passive earth pressures		7	15
MODULE: 2- Design of retaining wall Gravity wall, stability criteria. External stability, and internal stability. Reinforced earth retaining structures- Recent advances in Earth retaining structures		7	15
INTERNAL TEST 1 (MODULE 1 & 2)			
MODULE: 3 Theory of arching in soils and its applications in tunnel, conduits, silos. Braced excavation: Types, Construction methods, Pressure distribution in sands and clays, stability, bottom heave, seepage. Braced excavations, Earth pressure against bracings in cuts, Heave of the bottom of cut in soft clays.		7	15
MODULE: 4 Bulkheads: Definition and assumptions, conditions of end supports and distribution of active earth pressure and bulkheads, bulkheads with free and fixed earth supports, equivalent beam method, Improvements suggested by Rowe, Tschebotarioff's method, Anchorage of bulkheads and resistance of anchor walls. Diaphragm walls, Bored pile walls		7	15
INTERNAL TEST 2 (MODULE 3 & 4)			
MODULE: 5- Cellular Cofferdams Stability and design of cellular cofferdams. TVA method,The Cummings Method, Reinforced Soil walls, elements, construction methods.		7	20
MODULE: 6- Slope stability Stability analysis of natural slopes. stability analysis models .Stability analysis of finite and Infinite slopes: concept of factor of safety. Culman friction circle, Swedish, modified Bishop, Janbu's method and limit state analysis of slopes. Design of earth embankments and slopes ,Prestressed ground anchors, soil nailing		7	20
END SEMESTER EXAM			

COURSE CODE	COURSE NAME	L-T-P:C	YEAR
04 CE 6314	GROUND IMPROVEMENT TECHNIQUES	3-0-0:3	2015

Pre-requisites: Nil

Course Objectives:

- To study various methods of insitu densification and ground improvement by grouting techniques.
- To understand various soil stabilization methods and familiarise different types of geosynthetics.

Syllabus:

Introduction to ground improvement techniques: Soil Stabilization; Soil Reinforcement; Soil fracturing techniques for terminating settlements and restoring levels of buildings and structures, injection technology and its effects; Geosynthetics.

Course Outcome:

- Delegates will gain an understanding of the concepts behind a range of Ground Improvement Techniques, and be able to identify appropriate techniques for a range of ground and site conditions.

Text Books:

References:

1. Raj, P. Purushothama, (2005) “Ground Improvement Techniques”, Laxmi Publications, New Delhi
2. N. V. Nayak, Foundation Design Manual, Dhanpat Rai and Sons, Delhi
3. Moscly, M.P. (1994) “Ground Improvement”, Blackie Academic and Professional,Glasgow
4. Van Impe, W.F " Soil Improvement Techniques & their Evolution", AA Balkema
5. T.S Ingold (1982), “Reinforced Earth”,Thomas Telford Ltd, London
6. J.N Mandal (1988) “Reinforced Soil and Geotextiles”, Oxford and IBH Publishers Co. Pvt. Ltd, New Delhi.
7. Robert M. Koerner (1990), “Designing with Geosynthetics”, Prentice Hall, Englewood Cliffs
8. G Venkatappa Rao, GVS Surry Narayana Raju, (1990) “Engineering with Geosynthetics”,Tata Mc Graw Hill Publishing Company Ltd, New Delhi

COURSE PLAN

COURSE CODE:	COURSE TITLE	CREDITS	
04 CE 6314	**GROUND IMPROVEMENT TECHNIQUES**	**3-0-0:3**	
MODULES		**Contact Hours**	**Sem. Exam Marks (%)**
MODULE: 1-Introduction to ground improvement techniques Economic considerations- Engineering properties of soil, weak and compressible deposits. In situ densification – Vibrofloatation, Compaction pile , Vibro Compaction Piles Dynamic Compaction, Blasting Preloading with and without vertical drains. Compressibility, vertical and radial consolidation, preloading methods. Types of Drains, Design of vertical Drains, construction techniques. Stone Column: Function Design principles, load carrying capacity, construction techniques, settlement of stone column		7	15
MODULE: 2 Ground Improvement by Grouting techniques, types of grout, desirable characteristics, grouting pressure, grouting methods. chemical grouting, principles of injection, grout systems, grouting operations, applications, design methods, jet grouting, the jet grouting process, geometry and properties of soil used, properties of treated ground, application of jet grouting.		7	15
INTERNAL TEST 1 (MODULE 1 & 2)			
MODULE: 3- Soil Stabilization Lime stabilization-Base exchange mechanism, Pozzolanic reaction, lime-soil interaction, lime columns. Cement stabilization: Mechanism, amount, age and curing. Fly-ash – Lime Stabilization, Soil Bitumen Stabilization. deleterious effects of organic substances and sulphates on inorganic stabilization lime-sand columns, stone columns		7	15
MODULE: 4- Soil Reinforcement Mechanism, Types of reinforcing elements, reinforcement-soil interaction, Reinforcement of soil beneath the roads, foundation.		7	15
INTERNAL TEST 2 (MODULE 3 & 4)			
MODULE: 5 Soil fracturing techniques for terminating settlements and restoring levels of buildings and structures, injection technology and its effects, typical examples, in situ soil mixing techniques, construction techniques, testing procedures		7	20
MODULE 6: Geosynthetics Types and functions, Materials and manufacturing process, Testing and valuations Design and construction of geosynthetics , reinforced soil retaining structures, walls and slopes. Geosynthetics in		7	20

pavements, Embankments on soft soils, Geosynthetics in roads and railways, separators, drainage and filtering in road pavements, railway tracks, overlay design and constructions, trench drains. Geosynthetics in Environmental control, liners for ponds and canals, covers and liners for landfills, material aspects and stability considerations, landfills, occurrences and methods of mitigation, Erosion causes and techniques for control		
END SEMESTER EXAM		

COURSE CODE	COURSE NAME	L-T-P:C	YEAR
04 CE 6316	GROUND WATER ENGINEERING	3-0-0: 3	2015

Pre-requisites: Nil

Course Objectives:

- To study groundwater flow in detail.
- To study the design and construction methods of various types of wells.

Syllabus:

Occurrence of ground water: origin -rock properties affecting ground water vertical distribution -geologic formations as aquifers; ground water flow -Darcy's law -laplace equation –potential flow lines; Ground water and well hydraulics; Tube wells, Quality of ground water: ground water samples, ground water investigation

Course Outcome:

This course will give students a quantitative understanding of the hydraulics of subsurface fluid flow and engineering applications and design.

Text Books:

References:

1. Todd D.K., " Ground Water Hydrology", John Wiley
2. H.M. Raghunath, Ground Water, New Age International Pvt. Ltd.
3. Garg S.P., "Ground Water & Tube wells", Oxford & IBH
4. F. W. Schwartz & H. Zhang, Fundamental of Ground Water, John Willey & Sons

COURSE PLAN

COURSE CODE:	COURSE TITLE	CREDITS	
04 CE 6316	**GROUND WATER ENGINEERING**	**3-0-0:3**	
MODULES		**Contact Hours**	**Sem. Exam Marks (%)**
MODULE: 1-Occurrence Of Ground Water Origin -rock properties affecting ground water vertical distribution -geologic formations as aquifers -types of aquifers -aquifer parameters-ground water basins -springs -ground water in permeable regions -ground water balance.		7	15
MODULE: 2 Ground water flow -Darcy's law -laplace equation -potential flow lines -flow net -steady radial flow into a well -well in uniform flow -steady flow in leaky aquifer -aquifer with percolation-seepage under a dam -unsteady flow -general equation -confined and unconfined aquifers		7	15
INTERNAL TEST 1 (MODULE 1 & 2)			
MODULE: 3- Ground water and well hydraulics Steady unidirectional flow -steady radial flow in to a well -well in uniform flow -steady flow with uniform discharge -unsteady radial flow in to a well -confined, unconfined and leaky aquifers -well near aquifer boundaries -multiple well system -partially penetrating wells -characteristics well losses -pumping tests -non equilibrium equation for pumping tests -Thies' method -Jacob method -Chow's method		7	15
MODULE: 4-Tube wells Design -screened wells -gravel packed wells -well loss-selection of screen size yield of a well -test holes -well logs -methods of construction -dug wells - shallow tube wells - deep wells - gravity wells - drilling in rocks -screen installation -well completion well development -testing wells for yield -collector -or radial wells – infiltration galleries well point system -failure of tube wells		7	15
INTERNAL TEST 2 (MODULE 3 & 4)			
MODULE: 5- Quality of ground water Ground water samples – measurement of water quality- chemical, physical and bacterial analysis - quality for domestic use - quality for agricultural use pumps - shallow well pumps.		7	20

MODULE: 6 Ground water investigation - geographical investigation electrical resistivity method - seismic refraction method - gravity and magnetic method - test drilling – resistivity logging – potential logging – artificial recharge - recharge by water spreading -sewage recharge - recharge through pits, shafts and wells	7	20
END SEMESTER EXAM		

COURSE CODE	COURSE NAME	L-T-P:C	YEAR
04 CE 6318	ANALYSIS AND DESIGN OF PAVEMENTS	3-0-0:3	2015

Pre-requisites: Nil

Course Objectives:

- To get a knowledge of various factors affecting design and performance of pavements.
- To understand types of stresses in rigid pavements and its design.

Syllabus:

Introduction: Types and component parts of pavements, Materials for cement concrete and semi-rigid pavements, Stresses and strains in an infinite elastic half space , use of Boussinesq's equations**,** Flexible pavement design methods for highways and airports, Stresses in rigid pavements, Rigid pavement design.

Course Outcome:

- The purpose of this course is to introduce the concepts of design, performance, and analysis of rigid and flexible pavements

Text Books:

References:

1. Atkins & Harold, Highway Materials, Soils, and Concretes, Prentice Hall –Pearson, 2003.
2. Richard Kim Y., “Modeling of Asphalt Concrete”, Mc Graw Hill Professional.,2008.
3. Relevant IRC, ASTM, AASHTO and other Codes, Manuals and Specifications
4. Lavin P.G., “Asphalt Pavements”1stEd, Taylor and Francis, 2007

COURSE PLAN

COURSE CODE:	COURSE TITLE	CREDITS	
04 CE 6318	**ANALYSIS AND DESIGN OF PAVEMENTS**	**3-0-0:3**	
MODULES		**Contact Hours**	**Sem. Exam Marks (%)**
MODULE: 1 Introduction: Types and component parts of pavements, Factors affecting design and performance of pavements. Highway and airport pavements. Conventional aggregates and their evaluation, Bituminous binders-Properties, testing and applications; Bituminous mixes-Design, testing and evaluation.		7	15
MODULE: 2 Materials for cement concrete and semi-rigid pavements, Design of mixes for stabilized roads ; Non-conventional and new pavement materials-their application and limitations		7	15
INTERNAL TEST 1 (MODULE 1 & 2)			
MODULE: 3 Stresses and strains in an infinite elastic half space , use of Boussinesq's equations, Burmister's two layer and three layer theories; Wheel load stresses, various factors in traffic wheel loads; Equivalent single wheel load of multiple wheels.Repeated loads and EWL factors		7	15
MODULE: 4 Flexible pavement design methods for highways and airports: Empirical, semi-empirical and theoretical approaches; Development, principle, design steps of the different pavement design methods including AASHTO, Asphalt Institute, Shell Methods.		7	15
INTERNAL TEST 2 (MODULE 3 & 4)			
MODULE: 5 Stresses in rigid pavements: Types of stresses and causes; Introduction to Westergaard's equations for calculation of stresses in rigid pavement due to the influence of traffic and temperature; Considerations in rigid pavement analysis, EWL; wheel load stresses, warping stresses, frictional stresses, combined stresses		7	20
MODULE: 6 Rigid pavement design: Design of cement concrete pavement for highways and runways; Design of joints, reinforcements, tie bars, dowel bars. IRC method of design; Design of continuously reinforced concrete pavements.		7	20
END SEMESTER EXAM			

COURSE CODE	COURSE NAME	L-T-P:C	YEAR
04 CE 6322	EARTHQUAKE ANALYSIS AND DESIGN OF STRUCTURES	3-0-0: 3	2015

Pre-requisites: Nil

Course Objectives:

- To assists analysing the interaction between civil infrastructure and the ground, including the consequences of earthquakes on structures.
- For the proper design and construction of buildings in accordance with building codes, so as to minimize damage due to earthquakes.

Syllabus:

Engineering Seismology, Dynamics of Structures, Structural Systems, Earthquake Resistant Design of R.C.C. Buildings.

Course Outcome:

- Ensure proper design of buildings so they will resist damage due to earthquakes, but at the same time not be unnecessarily expensive

Text Books:

References:

1. S K Duggal, “Earthquake Resistant Design of Structures”, Oxford UniversityPress, 2007.49
2. Pankaj Agarwal and Manish Shrikhande, “Earthquake Resistant Design of Structures”, Prentice Hall of India, 2006
3. Course Notes "Design of Reinforced Concrete Buildings", IIT Kanpur, June 1999.
4. Paulay,T and Priestly, M.N.J., “A seismic Design of Reinforced Concrete and Masonry buildings”, John Wiley and Sons, 1991.
5. Bruce A Bolt, “Earthquakes” W H Freeman and Company, New York, 2004
6. Bungale S.Taranath,"Structural Analysis and Design of Tall Buildings”, Mc Graw Hill Book Company, New York, 1999.
7. StevenC. Kramer, “A text Book on Geotechnical Earthquake Engineering”,Prentice hall International series,2004
8. Das B . M.,“A text Book on principles of soil Dynamics”, Brooks, Code,1993.

COURSE PLAN

COURSE CODE:	COURSE TITLE	CREDITS	
04 CE 6322	EARTHQUAKE ANALYSIS AND DESIGN OF STRUCTURES	3-0-0:3	
MODULES		**Contact Hours**	**Sem. Exam Marks (%)**
MODULE: 1- Engineering Seismology Engineering Seismology (Definitions,Introduction to Seismic hazard, Earthquake Phenomenon), Seismotectonics and Seismic Zoning of India, Earthquake Monitoring and Seismic Instrumentation, Characteristics of Strong Earthquake Motion, Estimation of Earthquake Parameters, Microzonation		7	15
MODULE: 2-Dynamics of Structures Dynamics of Structures (SDOFS/ MDOFS), Response Spectra -Average Response Spectra -Design Response Spectra, Evaluation of Earthquake Forces as per codal provisions, Effect of Earthquake on Different Types of Structures, Lessons Learnt From Past Earthquakes		7	15
INTERNAL TEST 1 (MODULE 1 & 2)			
MODULE: 3- Structural Systems Structural Systems -Types of Buildings, Causes of damage, Planning Considerations, Philosophy and Principle of Earthquake Resistant Design, Guidelines for Earthquake Resistant Design, Earthquake Resistant Earthen Buildings, Earthquake Resistant Masonry Buildings -Design consideration –Guidelines.		7	15
MODULE: 4- Earthquake Resistant Design of R.C.C. Earthquake Resistant Design of R.C.C. Buildings - Material properties - Lateral load analysis -Design and detailing –Rigid Frames –Shear wall –Coupled Shear wall		7	15
INTERNAL TEST 2 (MODULE 3 & 4)			
MODULE: 5- Mathematical modeling of multistoried RC Buildings Mathematical modeling of multistoried RC Buildings –Capacity based design. Vibration Control -Tuned Mass Dampers –Principles and application		7	20
MODULE: 6- Basic Concept of Seismic Base Isolation Basic Concept of Seismic Base Isolation –various Systems-Case Studies, Important structures.		7	20
END SEMESTER EXAM			

COURSE CODE	COURSE NAME	L-T-P:C	YEAR
04 CE 6324	ENVIRONMENTAL GEOTECHINICS	3-0-0: 3	2015

Pre-requisites: Nil

Course Objectives:

- To understand various methods of waste disposal.
- To understand geotechnical reuse of waste materials.

Syllabus:

Introduction: Forms of waste, engineering properties; Design of ash containment system; Subsurface contamination and Contaminant transport through porous media; Design- clay liners, geosynthetic clay liners for waste containment, cover and gas collection system; Geotechnical Reuse of Waste materials; Contaminants of Slurry wastes.

Course Outcome:

- This course will focus on geotechnical aspects in the disposal of waste materials and the remediation of environmentally contaminated sites.

Text Books:

References:

1. Reddy K. R. and H D Sharma, " Geoenvironmental Engineering: Site Remediation, waste containment, and emerging waste management technologies", John Willey, 2004.
2. Yong R N., "Geo Environmental Engineering: Contaminated Ground: Fate of pollutions and Remediation", Thomson Telford, 2000.
3. Reddy L N and Inyang H.I., "Geoenvironmental Engineering: Principles and Applications", Marcel Dek, 2000
4. Hsai yang Fang "Introduction to Environmental Geotechenology", CRC press Newyork , 1997
5. Cairmey .T. "Contaminated land problems and solutions", Blackie Academic & Professional, 1993
6. Ayyar ,R.S.R "Soil Engineering in relation to Environment", LBS ,Thiruvananthapuram, 2000
7. Sivapullaiah ,P.V, " Environmental Geotechnics", IISC ,Bangalore, 1985.

COURSE PLAN

COURSE CODE:	COURSE TITLE	CREDITS	
04 CE 6324	**ENVIRONMENTAL GEOTECHINICS**	**3-0-0:3**	
MODULES		**Contact Hours**	**Sem. Exam Marks (%)**
MODULE: 1 Introduction: Forms of waste, engineering properties (determination and typical values). Selection of waste disposal sites: Site selection – selection criteria and rating; Solid waste disposal: Ash Disposal facilities- Dry disposal, waste disposal.		7	15
MODULE: 2 Design of ash containment system, Stability of ash dykes; Reclaiming potentially combustible sites , combustion process, combustion tests , use of combustion potential tests, Land fill gases , principal gases and their properties, Gas monitoring ,Data assessment and remedial solutions.		7	15
INTERNAL TEST 1 (MODULE 1 & 2)			
MODULE: 3 Subsurface contamination and Contaminant transport through porous media: mechanisms- advection and dispersion. Contaminants of Solid Waste in Land fills: Types- Dry cell, wet cell, bioreactor		7	15
MODULE: 4 Design- clay liners, geosynthetic clay liners for waste containment, cover and gas collection system. Stability of land fills. Land fill Instruction & operation, sustainable waste management. Remediation: Principle- planning, source control, soil washing, bioremediation.		7	15
INTERNAL TEST 2 (MODULE 3 & 4)			
MODULE: 5 Geotechnical Reuse of Waste materials: Waste reduction, use in geotechnical construction, waste characteristics, transportation consideration, Engineering properties of Wastes, Waste material in Embankment and Fills		7	20
MODULE: 6 Contaminants of Slurry wastes: Slurry transported wastes, slurry ponds, operation,Embankment construction and raising, Design aspects, Environmental Impact and control.Vertical Barriers for Contaminant: Contaminated sites, Types of barriers, Soil-Bentonite slurry trench walls, Cement-Bentonite slurry trench walls, construction, material and design aspects		7	20
END SEMESTER EXAM			

COURSE CODE	COURSE NAME	L-T-P:C	YEAR
04 CE 6326	MODERN CONSTRUCTION PRACTICES	3-0-0: 3	2015

Pre-requisites: Nil

Course Objectives:

- To study the substructure construction techniques like box jacking, sheet piling etc
- To study and understand the various types of equipments used for earthwork, tunneling, drilling, blasting, dewatering, material handling conveyors and its applications in construction projects

Syllabus:

Fundamentals of Earth Work Operations; Equipment for Compaction - Erection Equipment; Forklifts and related equipment; Sub structure construction-Box jacking - pipe jacking - Under water construction of diaphragm walls and basement - Tunneling techniques; Super Structure construction-Vacuum dewatering of concrete flooring – concrete paving technology; erection techniques of tall structures, large span structures.

Course Outcome:

- At the end of this course students will be able to know various types of equipments to be used in the constructions projects

Text Books:

References:

1. Peurifoy, R.L., Ledbetter, W.B. and Schexnayder, C., Construction Planning, Equipment and Methods, 5th Edition, McGraw-Hill, Singapore, 1995
2. Sharma S.C. Construction Equipment and Management, Khanna Publishers, New Delhi, 1988.
3. Deodhar, S.V. Construction Equipment and Job Planning, Khanna Publishers, New Delhi, 1988.
4. Dr.Mahesh Varma, Construction Equipment and its planning and Application, Metropolitan Book Company, New Delhi. 1983.
5. Robertwade Brown, Practical foundation engineering hand book, McGraw-Hill Publications, 1995
6. Patrick Powers. J., Construction Dewatering: New Methods and Applications, John Wiley & Sons, 1992
7. Jerry Irvine, Advanced Construction Techniques, CA Rocketr, 1984

COURSE PLAN

COURSE CODE:	COURSE TITLE	CREDITS	
04 CE 6326	**MODERN CONSTRUCTION PRACTICES**	**3-0-0:3**	
MODULES		**Contact Hours**	**Sem. Exam Marks (%)**
MODULE: 1 Fundamentals of Earth Work Operations - Earth Moving Operations - Types of Earth Work Equipment - Tractors, Motor Graders, Scrapers, Front end Waders, Earth Movers, Equipment for Dredging, Trenching, Tunneling, Drilling, Blasting .		7	15
MODULE: 2 Equipment for Compaction - Erection Equipment - Types of pumps used in Construction - Equipment for Dewatering and Grouting – Foundation and Pile Driving Equipment		7	15
INTERNAL TEST 1 (MODULE 1 & 2)			
MODULE: 3 Forklifts and related equipment - Portable Material Bins – Conveyors - Hauling Equipment, Crushers – Feeders - Screening Equipment - Handling Equipment - Batching and Mixing Equipment - Hauling, Pouring and Pumping Equipment – Transporters		7	15
MODULE: 4 Sub structure construction-Box jacking - pipe jacking - Under water construction of diaphragm walls and basement - Tunneling techniques - piling techniques- auger, DMC, drilling - driving well and caisson - sinking cofferdam - cable achoring and grouting - driving diaphragm walls, sheet piles - laying operations for built up offshore system - shoring for deep cutting - large reservoir construction with membrances and earth system - well points - dewatering and stand by plant equipment for underground open excavation		7	15
INTERNAL TEST 2 (MODULE 3 & 4)			
MODULE: 5 Super Structure construction- Vacuum dewatering of concrete flooring – concrete paving technology – techniques of construction for continuous concreting operation in tall buildings of various shapes and varying sections – launching techniques – suspended form work		7	20
MODULE: 6 Erection techniques of tall structures, large span structures – launching techniques for heavy decks – insitu prestressing in high rise structures, aerial transporting handling erecting lightweight components on tall structures		7	20
END SEMESTER EXAM			

COURSE CODE	COURSE NAME	L-T-P:C	YEAR
04 CE 6392	**Civil Engineering Design Studio**	0-0-2:1	2015

COURSE OBJECTIVES:

To visualize, model and analyze civil engineering problems using finite element softwares and arrive at suitable solution

Application of software packages like PLAXIS, ANSYS, SAP, STRUDS, etc in modeling, simulation, analysis , design and drafting of structural components for raft foundation, retaining wall, pile foundation, beams, columns , slopes and embankments using the concepts given in theory papers. The student has to practice the packages by working out different types of problems. The student has to carry out a mini project work which will be evaluated for internal assessment

SEMESTER III

COURSE CODE	COURSE NAME	L-T-P: C	YEAR
04 CE 7301	DESIGN OF STEEL-CONCRETE COMPOSITE STRUCTURES	3-0-0: 3	2015

Pre-requisites: Nil

Course Objectives:

- To get introduced to various connections and connection design of composite structures
- To get introduced to composite construction and composite behaviour of steel concrete composite structures.
- To obtain the knowledge to conceptualise and design the composite structures

Syllabus:

Introduction to steel-concrete composite construction, Introduction to steel, Design of composite member.

Course Outcome:

- The student can gain the knowledge of connection behaviour and design.
- The student will possess knowledge of the composite behaviour of structures.
- The student will have the ability to design various composite structural elements

Text Books:

References:

1. Teaching Resource material for Structural Steel Design', Volume 2/3 prepared by IIT, Anna University, SERC and Institute for Steel Development and Growth'Calcutta, 2009.
2. Owens and Knowels," Steel design manual", Steel Concrete Institute (UK)-Oxford Blackwell Scientific Publications, 1992.
3. Johnson.R.P., "Composite structures of steel and concrete-Beams, slabs, columns and frames of buildings",(3rd edition),Blackwell Publishing, U.K, 2004.
4. Bungale S. Taranath, "Steel concrete and composite design of tall buildings", McGrawhill, 1998.
5. David Collings, "Steel Concrete Composite Bridges", Thomas Tefford, 2005.
6. Johnson.R.P., "Composite structures of steel and concrete-Beams, slabs, columns and frames of buildings",(3rd edition),Blackwell Publishing, U.K, 2004.

COURSE PLAN

COURSE CODE:	COURSE TITLE	CREDITS	
04 CE 7301	**DESIGN OF STEEL-CONCRETE COMPOSITE STRUCTURES**	**3-0-0:3**	
MODULES		**Contact Hours**	**Sem. Exam Marks (%)**
MODULE: 1 Introduction to steel-concrete composite construction- Theory of composite structures.		7	15
MODULE: 2 Introduction to steel-concrete steel sand witch construction.		7	15
INTERNAL TEST 1 (MODULE 1 & 2)			
MODULE: 3 Design of composite member-Behaviour of composite beams-Design of composite beams		7	15
MODULE: 4 Behaviour of composite columns-Design of steel-concrete composite columns.		7	15
INTERNAL TEST 2 (MODULE 3 & 4)			
MODULE: 5 Design of composite trusses-Types of connections in composite structures-Shear connections-Design of connections in composite trusses.		7	20
MODULE: 6 Composite girder bridges-Behaviour of girder bridges-Design concepts Seismic behaviour of composite structures.		7	20
END SEMESTER EXAM			

COURSE CODE	COURSE NAME	L-T-P:C	YEAR
04 CE 7303	MARINE GEOTECHNICAL ENGINEERING	3-0-0: 3	2015

Pre-requisites: Nil

Course Objectives:

- To understand engineering behaviour of marine soils.
- To get a knowledge about foundations for jacket type structures.

Syllabus:

Introduction to Marine Geotechnical Engineering, Offshore Soil Investigation, Foundations for Gravity Structures, Foundations for jack up platforms, Foundations for jacket type structures Sea bed anchors, submarine pipe lines.

Course Outcome:

- The candidate should have a knowledge of various equipments used and standard soil investigation methods in offshore engineering.

Text Books:

References:

1. Poulos, H. G & Davis, E. H., “Pile Foundation Analysis and Design”, John
2. Wiley, 1980.
3. “Numerical Methods in offshore Piling, Proc. Conf. Inst. of Civil Engineers”, London 1980.
4. Chaney,F., “Marine geotechnology and nearshore/offshore structures”, ASTM, STP, 1986.
5. Chaney, R. C & Demars, K. R., “Strength Testing of Marine Sediments - Laboratory and In-situ Measurements”, ASTM, STP -883, 1985.
6. George, P & Wood, D., “Offshore Soil Mechanics”, Cambridge University Press., 1985
7. Le Tirant, “ Sea Bed Reconnaissance and Offshore Soil Mechanics for the Installation of Petroleum Structures”, Gulf Publ. Co., 1979.

COURSE PLAN

COURSE CODE:	COURSE TITLE	CREDITS	
04 CE 7303	MARINE GEOTECHNICAL ENGINEERING	3-0-0: 3	
MODULES		Contact Hours	Sem. Exam Marks (%)
MODULE: 1 **Introduction to Marine Geotechnical Engineering**: Scope of marine geotechnical engineering - Marine classification, properties of marine sediments - Structure of marine soils - Cementation bonding - Morphology and genesis of marine and submarine sediments - Post-depositional changes - Effect of calcium carbonate in marine deposits. **Engineering behaviour of marine soils**: Fineand coarse-grained deposits - Strength and deformation behaviour of fine - and coarse-grained marine deposits - Effect of cementation - Strength and deformation behaviour under static and cyclic loading		7	15
MODULE: 2 Offshore Soil Investigation: Planning and site exploration. Offshore-drilling. Sampling techniques. Laboratory testing, In situ testing methods and geophysical methods. In-situ determination of strength of submarine soils - Penetrometer, piezocone, vane and pressure meter techniques -		7	15
INTERNAL TEST 1 (MODULE 1 & 2)			
MODULE: 3 Foundations for Gravity Structures: Types of gravity structures - Installation techniques - Movement of gravity structures - Settlement of soil beneath gravity structures - Stress distribution beneath gravity structures - Stability of gravity structures understatic and cyclic loads		7	15
MODULE: 4 Foundations for jack up platforms: Types of jack up platforms - Piles and mat supported - Spud cans - Different types - Techniques for installation and removal of jack up - Stability of jack up platforms - Determination of penetration of supports - Stability under lateral loads - Stability under static and cyclic load effects.		7	15

INTERNAL TEST 2 (MODULE 3 & 4)		
MODULE: 5 Foundations for jacket type structures: Types - Installation techniques - Design considerations - Axial and lateral load capacity of piles - Lateral load deformation behaviour of piles - Calculation of bearing capacity of piles - Design of piles subjected to lateral loads - Reese-Matlock method & p-y curves method.	7	20
MODULE: 6 Sea bed anchors, submarine pipe lines: General introduction tosea bed anchors, moorings, submarine pipe line etc. - general design considerations (brief outline only) - geotechnical aspects in the design and installation of sea bed anchors, moorings, submarine pipelines etc.	7	20
END SEMESTER EXAM		

COURSE CODE	COURSE NAME	L-T-P: C	YEAR
04 CE 7305	ROCK MECHANICS	3-0-0: 3	2015

Pre-requisites: Nil

Course Objectives:

- To understand rock exploration methods.
- To study bearing capacity of homogeneous as well as discontinuous rocks.

Syllabus:

Introduction , objective, scope and problems of Rock Mechanics, Discontinuities in Rock Masses, Rheological behaviour, Openings in rock mass and stresses around openings, Bearing capacity of homogeneous as well as discontinuous rocks, Rock slopes, Rock bolting, Plastic mechanics.

Course Outcome:

- The aim of this course is to learn about the mechanical behaviour or rock and rock masses, the engineering properties of rock and techniques for the analysis of stress and the measurement of deformation under load.

Text Books:

References:

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

COURSE PLAN

COURSE CODE:	COURSE TITLE	CREDITS	
04 CE 7305	**ROCK MECHANICS**	**3-0-0:3**	
MODULES		**Contact Hours**	**Sem. Exam Marks (%)**
MODULE: 1 Introduction , objective, scope and problems of Rock Mechanics Formation of rocks, Physical properties, Classification of rocks and rock masses, Static Elastic constants of rock. Rock exploration – Rock coring, geophysical methods. Rock testing- laboratory and field tests.		7	15
MODULE: 2 Discontinuities in Rock Masses: Discontinuity orientation, Effect of discontinuities on strength of rock , Strength Behaviour: Compression, Tension and Shear, Stress-Strain relationships,		7	15
INTERNAL TEST 1 (MODULE 1 & 2)			
MODULE: 3 Rheological behaviour ; Strength/ Failure Criterion: Coulomb, Mohr, Griffith theory of brittle strength and other strength criteria		7	15
MODULE: 4 Openings in rock mass and stresses around openings. Pressure tunnels, development of plastic zone. Rock support needed to avoid plastic deformation. Lined and unlined tunnels. Underground excavation and subsidence. Rock mechanics applications.		7	15
INTERNAL TEST 2 (MODULE 3 & 4)			
MODULE: 5 Bearing capacity of homogeneous as well as discontinuous rocks. Support pressure and slip of the joint. Delineation of types of rock failure. Unsupported span of underground openings, pillars		7	20
MODULE: 6 Rock slopes. Rock bolting. Plastic mechanics. Tunnels, shapes, usages, Methods of Construction, Problems associated with tunnels, Tunneling		7	20
END SEMESTER EXAM			

COURSE CODE	COURSE NAME	L-T-P: C	YEAR
04 CE 7307	DESIGN OF CYLINDRICAL SHELLS AND FOLDED PLATES	3-0-0: 3	2015

Pre-requisites: Nil

Course Objectives:

- To classify and analyse the different type of shell structures
- To classify and analyse the different type of folded plates

Syllabus:

General classification of shells, Design of cylindrical shell based on membrane theory, Design of shells with double curvature, Design of spherical domes, Design of conical shells, Types of Hyperbolic paraboloids, Folded plate – introduction- methods of analysis – complete analysis of folded plates.

Course Outcome:

- At the end of this course, the students will be able to analyse various shell understand the behaviour of folded plates.

Text Books:

References:

1. P.C Varghese , " Design of reinforced concrete shells and folded plates" PHI New Delhi- 2010
2. Krishna Raju .N., "Advanced Reinforced concrete Design". - CBS Publishers and distributor – New Delhi-2003
3. Ramaswamy G.S., "Design and construction of concrete shell roofs" – CBS Publishers
4. Chatterjee B.K., "Theory and Design of concrete shell"- Chapman & Hall
5. Bandhopadhyay., "Thin shell structures"- New age International Publishers – New Delhi
6. Chandrasekhar., " Analysis of thin concrete shells" - New age International Publishers– New Delhi

COURSE PLAN

COURSE CODE:	COURSE TITLE	CREDITS	
04 CE 7307	**DESIGN OF CYLINDRICAL SHELLS AND FOLDED PLATES**	**3-0-0:3**	
MODULES		**Contact Hours**	**Sem. Exam Marks (%)**
MODULE : 1 General classification of shells - shells of revolution - translational shells - ruled surfaces - folded plates (hipped plates).Gausian curvature – thin – thick shells – long shells – short shells – Design of cylindrical shell based on membrane theory		7	15
MODULE : 2 Design of cylindrical shell with edge beams-Design of transverse stiffners of long shells. Design of shells with double curvature – Design of spherical domes		7	15
INTERNAL TEST 1 (MODULE 1 & 2)			
MODULE : 3 Membrane analysis-Analysis of domes with skylight – Design of ring beams (edge member)- Design of conical shells - conical dome roof with ring beams.		7	15
MODULE : 4 Design of paraboloid shells-(shells formed from two parabolas). Types of Hyperbolic paraboloids – Types of hyper shells with straight rectangular edges – shallow and deep H.P shells		7	15
INTERNAL TEST 2 (MODULE 3 & 4)			
MODULE : 5 Analysis of shell part of shallow hyper shells with straight edges-Analysis of the edge members. Folded plate – introduction- methods of analysis – complete analysis of folded plates.		7	20
MODULE : 6 Design of reinforcements in folded plates and supporting diaphragms – Design of steel for transverse moments- Design of longitudinal steel.		7	20
END SEMESTER EXAM			

COURSE CODE	COURSE NAME	L-T-P:C	YEAR
04 CE 7309	FINITE ELEMENT ANALYSIS	3-0-0- 3	2015

Pre-requisites: Nil

Course Objectives:

- Understand the general plate bending theories
- Obtain an understanding of the fundamental theory of FEA
- Develop the ability to generate the governing differential equations

Syllabus:

Introduction to FEM -General procedure of FEA - Displacement approach-Variational principles-Derivation of Shape functions-Convergence criteria - Conforming & nonconforming elements-Derivation of Stiffness matrix-axisymmetric problems Isoparametric elements - Numerical Integration.- Gauss-Quadrature General plate bending elements-Plate bending theory – Kirchhoff's theory – Mindlin's theory – locking problems - -spurious modes.

Course Outcome:

- Students who successfully complete this course will have demonstrated an ability to understand the fundamental concepts of theory of FEA and will be able use the basic finite elements for structural applications using truss, beam, frame and plane elements

Text Books:

References:

1. Desai, C.S and Abel J.F, "Introduction to Finite Element Method", CBS Publishers and Distributors, Delhi. 1987
2. Cook R. D. "Concepts and Applications of Finite Element Analysis", John Wiley, New York, 2004.
3. Zienkiewicz O. C. and Taylor R. L., "Finite Element Method, Butterworth Heinemann publication", 2000.
4. Reddy J. N., " An introduction to Linear Finite Element Method, Oxford University Press", Oxford, 2004. 5. Smith I.M , "Programming the FEM with applications to Geomechanics", John
5. Wiley&Sons , 1982
6. Chandupatla T. R. & Belegundu A. D, "Introduction to Finite Elements in Engineering", Prentice Hall of India Pvt. Ltd., New Delhi, 5th Reprint, 1999 7. Krishnamoorty C.S. "Finite element methods", Tata-Mc Graw Hill, Second Edition, Delhi, 2002.
7. Gudehus.G, "Finite Elements in Geomechanics", John Wiley & Sons , 1977

COURSE PLAN

COURSE CODE:	COURSE TITLE	CREDITS	
04 CE 7309	**FINITE ELEMENT ANALYSIS**	**3-0-0:3**	
MODULES		**Contact Hours**	**Sem. Exam Marks (%)**
MODULE: 1- Introduction to FEM Historical development - Idealization of structures-Mathematical model - General procedure of FEA - Displacement approach		7	15
MODULE: 2- Variational Approaches to FEM Variational principles weighted residual approach and method of virtual work. Derivation of equilibrium equations.		7	15
INTERNAL TEST 1 (MODULE 1 & 2)			
MODULE: 3- Shape Functions Introduction to Shape Functions-characteristics-Derivation of Shape functions using different methods- -Lagrangian and Hermition Interpolation–Generalised coordinates–Natural coordinates		7	15
MODULE: 4- Stiffness matrix Derivation of Stiffness matrix of Bar element - Beam element - Plane stress and plane strain and axisymmetric problems -Triangular elements - Constant Strain Triangle - Linear Strain Triangle – using generalized coordinates-natural coordinates etc. – Fellipas method		7	15
INTERNAL TEST 2 (MODULE 3 & 4)			
MODULE: 5- Convergence Criteria & Numerical Integration Compatibility-$C^{\circ}$and C^{1} elements - Convergence criteria - Conforming & nonconforming elements – Patch test. Legrangian and Serendipity elements, static condensation - Isoparametric elements - Numerical Integration.- Gauss- Quadrature – Computer implementation of finite element method.		7	20
MODULE: 6- General Plate Bending Elements Plate bending theory – Kirchhoff's theory – Mindlin's theory – locking problems - preventive measures – reduced integration – selective integration-spurious modes.		7	20
END SEMESTER EXAM			

COURSE CODE	COURSE NAME	L-T-P:C	YEAR
04 CE 7311	SLOPE STABILITY	3-0-0: 3	2015

Pre-requisites: Nil

Course Objectives:

- To understand various factors contributing slope failures.
- To study various methods of stabilizing slopes.

Syllabus:

Introduction, Natural slopes and Engineered slopes .Factors contributing slope failures, Types of failures Basic concept of slope stability, Infinite slope analysis: In dry sand, c-ϕ soil with seepage. Planar surface analysis, Circular surface analysis- Friction circle method. Method of slice, Methods of stabilizing slopes, Surface slope protection, Landslides, Landfill slopes.

Course Outcome:

- Able to inspect, understand and assess slope instability.

Text Books:

References:

1. Das B M,"Principles of Geotechnical Engineering", Thomson Books, 2004
2. Murthy V. N. S , "Principles of Soil Mechanics and Foundation Engineering", UBS Publishers Private Ltd. , 2002.
3. Abramson L. W, Lee T. S , Sharma S and Boyce G M , " Slope Stability and Stabilization Methods", Willey Interscience publications, 1996
4. Lambe T W. and Whitman R V, "Soil Mechanics", John Wiley & sons ,2008

COURSE PLAN

COURSE CODE:	COURSE TITLE	CREDITS	
04 CE 7311	**SLOPE STABILITY**	**3-0-0:3**	
MODULES		**Contact Hours**	**Sem. Exam Marks (%)**
MODULE: 1 Introduction, Natural slopes and Engineered slopes .Factors contributing slope failures, Types of failures Basic concept of slope stability. Factors considered for analysis: Site topography, Ground water, Shear strength, seismicity. Effect of ground water: Design, Wetting band approach, Developing of groundwater model, ground water effect on slope stability, ground water in rock. monitoring of groundwater - Piezometer, observation wells. Site investigation: Planning of exploration program for slope stability. Concept of factor of safety. Pore water pressure.		7	15
MODULE: 2 Infinite slope analysis: In dry sand, c-ϕ soil with seepage. Planar surface analysis, Circular surface analysis- Friction circle method. Method of slices: Ordinary method of slices, Bishop method, Janbu's method. Limit equilibrium method. Selection of Analysis method. Use of design charts. Effect of tension crack, vegetation, foundation load etc. on slope stability analysis. Earthquake loading considerations: Pseudostatic method, Newmark's displacement method.		7	15
INTERNAL TEST 1 (MODULE 1 & 2)			
MODULE: 3 Methods of stabilizing slopes: Unloading – excavation, lightweight fill vegetation, Buttressing- Counter berms, shear keys, mechanically stabilized embankments. Drainage – Surface drainage, subsurface drainage, Reinforcement- Soil nailing, Stone columns, micropiles, Geosynthetically reinforced slopes, Retaining walls- driven piles,gravity and cantilever retaining walls,tie back walls. soil hardening. Vegetation – general design, Species, biotechnical stabilization.		7	15
MODULE: 4 Surface slope protection: Shotcrete, chunam plaster, masonry, Rip-Rap, Soil hardening- Compacted soil - cement fill, electro osmosis, grouting, lime injection, pre consolidation; Alternate methods – Complete removal of slide zone, Facility relocation, Bridging. Selection of		7	15

stabilization methods. Rock slope stabilization methods.		
INTERNAL TEST 2 (MODULE 3 & 4)		
MODULE: 5 Landslides: Identification, Types and mechanism, Features and dimensions, Land slide rates and type of movements, Seepage flow mechanism due to infiltration, Mechanism of rainfall induced landslides, field loading conditions, correlation between landslide and rainfall.mitigation.	7	20
MODULE: 6 Landfill slopes: Typical configurations, landfill waste engineering properties, Geosynthetics in landfill , Geosynthetic Clay Liners, Anchor trenches. Construction of landfills. Stability: Excavation slope stability, waste fill stability, Cover system stability. Recent advances in slope stability analysis	7	20
END SEMESTER EXAM		

COURSE CODE	COURSE NAME	L-T-P:C	YEAR
04 CE 6391/7391	SEMINAR – I/II	0-0-2: 2	2015

Course Objectives:

1. Improve the technical presentation skills of the students.
2. To train the students to do literature review.
3. To impart critical thinking abilities.

Methodology

Individual students are required to choose a topic of their interest from related topics to the stream of specialization, preferably from outside the M. Tech syllabus. The students are required to do a moderate literature review on the topic and give seminar. A committee consisting of at least three faculty members (preferably specialized in the respective stream) shall assess the presentation of the seminar and award marks to the students based on merits of topic of presentation. Each student shall submit two copies of a write up of his seminar topic. The seminar report shall not have any plagiarised content (all sources shall be properly cited or acknowledged). One copy shall be returned to the student after duly certifying it by the chairman of the assessing committee and the other shall be kept in the departmental library. Internal continuous assessment marks are awarded based on the relevance of the topic, presentation skill, quality of the report and participation. It is encouraged to do simulations related to the chosen topic and present the results at the end of the semester.

COURSE CODE	COURSE NAME	L-T-P:C	YEAR
04 CE 7393	PROJECT PHASE - I	0-0-12: 6	2015

Course Objectives:

The project work aims to develop the work practice in students to apply theoretical and practical tools/techniques to solve real-life problems related to industry and current research.

The project work can be a design project/experimental project and/or computer simulation project on any of the topics related to the stream of specialisation. The project work is chosen/allotted individually on different topics. Work of each student shall be supervised by one or more faculty members of the department. The students shall be encouraged to do their project work in the parent institute itself. If found essential, they may be permitted to carry out their main project outside the parent institute, subject to the conditions specified in the M. Tech regulations of the Kerala Technological University. Students are encouraged to take up industry problems in consultation with the respective supervisors.

The student is required to undertake the main project phase-1 during the third semester and the same is continued in the 4th semester (Phase 2). Phase-1 consist of preliminary work, two reviews of the work and the submission of a preliminary report. First review would highlight the topic, objectives, methodology and expected results. Second review evaluates the progress of the work, preliminary report and scope of the work which is to be completed in the 4th semester.

COURSE CODE	COURSE NAME	L-T-P: C	YEAR
04 CE 7394	PROJECT PHASE - II	0-0-21: 12	2015

Main project phase II is a continuation of project phase-I started in the third semester. There would be two reviews in the fourth semester, first in the middle of the semester and the second at the end of the semester. First review is to evaluate the progress of the work, presentation and discussion. Second review would be a pre -submission presentation before the evaluation committee to assess the quality and quantum of the work done. It is encouraged to prepare at least one technical paper for possible publication in journals or conferences. The project report (and the technical paper(s)) shall be prepared without any plagiarised content and with adequate citations, in the standard format specified by the Department /Cluster/University.