Syllabi Book

For

Post Graduate Course of

Civil-Geotechnical Engineering

Department of Civil Engineering
Faculty of Technology
Dharmsinh Desai University
Nadiad – 387 001, Gujarat, India.
http://www.ddu.ac.in

(w.e.f July- 2021)

M. TECH. SEMESTER – I (CIVIL-GEOTECHNICAL ENGINEERING)
SUBJECT: SOIL ENGINEERING-I [MG110]

Teaching Scheme (Hours/Week)				Credits	Examination Scheme				
Lect	Tut	Prac	Total		Ext	Sess.	TW	Prac	Total
3	1	0	4	4	60	40	25	-	125

A. COURSE OVERVIEW

The course is designed for to establish an understanding of the fundamental concepts of mechanics of different types of soil materials including behavior of materials.

B. COURSE CONTENT

NO	TOPIC	L+T (hrs)	COs
[1]	**Problems in Geotechnical Engineering** Soil, its behaviour, Types of problems in Geo. Engg., Concept of point, line and plane, Effective Stress Principle	2	CO1
[2]	**Preliminary definitions and W-V relationships** Three phase system of soil, Unit Weight, Water content, Specific gravity, Porosity, Void ratio, Degree of Saturation, Relative density	2	CO1
[3]	**Index Properties of Soil** Grain size distribution, Effective size of particle, Stoke's law, Viscosity, Sedimentation analysis, Consistency of soils, Atterberg's Limit: Liquid Limit, Plastic Limit and Shrinkage Limit, Activity of clays, Sensitivity of clays, Thixotropy of clays	4	CO1
[4]	**Classification of Soil** Particle size classification, Textural classification, Highway Research Board classification, Unified Soil Classification System, I.S. classification	2	CO2
[5]	**Soil Water, Soil Structure and Clay Mineralogy** Hygroscopic moisture, Capillary water, Gravitational water, Absorbed water, Adsorbed water, Slaking of clay, Bulking of sand Inter-particle forces, Single grained structure, Honeycomb structure, Flocculent structure, Dispersed structure, Clay Minerals	2	CO2
[6]	**Permeability of soils** Introduction, Darcy's law, Discharge velocity, seepage velocity, Poisseuille's law, Validity of Darcy's law, Factors affecting permeability, Co-efficient of permeability, Constant Head permeability test, Falling Head permeability test, Permeability of stratified soil, Field Permeability tests	4	CO3
[7]	**Seepage Analysis** Introduction to Seepage, Seepage pressure, Laplace equation, Flow net construction, Determination of quantity of seepage and seepage pressure and uplift pressures, Quick sand condition, Phreatic lines of an earth dam	3	CO3
[8]	**Stress Distribution in soils** Introduction, Boussinesq's equation for concentrated load, Westergaard's equation for concentrated loads, Comparison of Boussinesq and Westergaard's equations, Line loads, Strip loads, Stresses beneath the corner of a rectangular foundation, Stresses under uniformly loaded circular footing, vertical stress beneath loaded areas of irregular shape, Pressure isobars, Newmark's Influence chart	6	CO4

[9]	**Compaction in soils** Definition, theory of compaction, Laboratory compaction tests, Factors affecting compaction in the field, Effect of compaction on soil properties, Field compaction, Specifications of field compaction, Equipments for compaction	2	CO5
[10]	**Compressibility of Soils** Compressibility of Soils, Definition and Mechanism of Soil, Consolidation, Spring Analogy, Compression Index, Coefficient of Compressibility, Coefficient of volume change, Derivation of Terazagi's One Dimensional consolidation Equation, Time factor and consolidation ratio, calculation of consolidation settlement for uniform pressure increment in clay layer, one Dimensional consolidation test, Laboratory and theoretical time curves, Concept of sand drain to redue the time of consolidation	9	CO5

C. TEXT BOOKS

1. Verma A.K. *Geotechnical and Foundation Engineering*; Charotar Publishing House Pvt. Ltd.
2. Punmia B. C. *Soil Mechanics and Foundations*; Laxmi Publications

D. REFERENCE BOOKS

1. Murthy V. N. S, *Soil Mechanics and Foundation Engineering;* UBS Publisher
2. Arora K. R. *Soil Mechanics and Foundation Engineering;* Standard Publishers Distributors
3. Das B. M. *Principles of Geotechnical Engineering*; Tata McGraw Hill.
4. Bowles J. E. *Physical and Geotechnical Properties of soils*; McGraw Hill Book Company
5. SP-36 (Part 1) - 1987 : Compendium of Indian Standards on Soil Engineering - Laboratory Testing of Soils for Civil Engineering Purpose
6. SP-36 (Part 2) - 1988 : Compendium of Indian Standards on Soil Engineering - Field Testing of Soils for Civil Engineering Purpose

E. COURSE OUTCOMES

CO Number	Skill	Statement
CO1	Understand	Determine index and engineering properties of soils.
CO2	Understand	Classify soil classification and mineralogy.
CO3	Evaluate	Determine Permeability and Seepage properties of soil
CO4	Evaluate	Determine the effect of stresses in soil
CO5	Evaluate	Evaluate compaction and compressibility parameters of soils

F. COURSE MATRIX

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	3	1	3	1	1	1	2	1	2	-	1	2	0
CO2	2	3	1	2	1	1	1	2	1	2	-	1	3	0
CO3	3	3	1	1	2	1	1	2	2	3	-	2	3	1
CO4	3	3	1	1	2	2	2	2	2	3	-	2	2	2
CO5	1	2	1	3	1	1	1	2	1	2	-	1	2	2

M. TECH. SEMESTER – I (CIVIL-GEOTECHNICAL ENGINEERING)
SUBJECT: ADVANCED FOUNDATION ENGINEERING [MS109]

Teaching Scheme (Hours/Week)				Credits	Examination Scheme				
Lect	Tut	Prac	Total		Ext	Sess.	TW	Prac	Total
3	1	0	4	4	60	40	25	-	125

A. COURSE OVERVIEW

The course is designed for to build the necessary theoretical background for design and construction of foundation systems.

B. COURSE CONTENT

NO	TOPIC	L+T (hrs)	COs
[1]	**Shallow Foundations** Bearing capacity theories (Shear criteria): Prandtl's, Rankine's, Meyerhof's, Skempton's, Bearing capacity from Plate Load Test.	3	CO1
[2]	**Bearing Capacity of Combined Footings** Rectangular combined footings, trapezoidal combined footings	2	CO1
[3]	**Bearing Capacity of Raft or Mat Foundation** Introduction, Common types of Mat foundation, Bearing Capacity calculation.	2	CO1
[4]	**Pile Foundations** Methods of determining axial load carrying capacity of single pile: Dynamic formulae (Engineering News Formula and Modified Hiley's Formula), Pile Load Test on sand, clay and layered soil, Efficiency of Pile group, Axial load carrying capacity of pile group in clay and sand, Negative skin friction, Ultimate lateral resistance of single pile: Brom's theory, Concept of Free head and Fixed head pile, Lateral load carrying capacity of single pile as per IS-2911 in cohesive and cohesionless soil, Dimensional analysis of elastic pile theory (Reese and Matlock) in cohesionless soil, Reese's approach in cohesive soil, design of pile cap.	11	CO2
[5]	**Under-reamed Pile** Introduction, Installation method, Bearing capacity of under-reamed pile.	3	CO2
[6]	**Well Foundations** Types of wells, components of well foundation, requirement of shape of wells, Forces acting on wells, Lateral stability of well foundation	5	CO3
[7]	**Free and fixed cantilever sheet pile walls, anchored bulkheads** Cantilever sheet pile wall in sand and clay, Anchored sheet pile wall, Free earth support method and Fixed earth support method.	6	CO4
[8]	**Foundations on difficult subsoil** Collapse potential and settlement, Computation of collapse settlement, treatment method, General characteristics of swelling soils, Design of foundation in swelling soils	2	CO5
[9]	**Ground Improvement Techniques** Improvement techniques, Surface compaction, Drainage method, Vibration Method, Pre-compression and consolidation, Grouting, Chemical stabilization	2	CO5

C. TEXT BOOKS

1. Das, B. M. (2020). *Advanced Soil Mechanics*, Fifth Edition. United Kingdom: Taylor & Francis Group.
2. Punmia B. C. *Soil Mechanics and Foundations*; Laxmi Publications

D. REFERENCE BOOKS

1. Murthy V. N. S, *Soil Mechanics and Foundation Engineering;* UBS Publisher
2. Arora K. R. *Soil Mechanics and Foundation Engineering;* Standard Publishers Distributors
3. Das B. M. *Principles of Geotechnical Engineering*; Tata McGraw Hill.
4. Bowles J. E. *Physical and Geotechnical Properties of soils*; McGraw Hill Book Company
5. Saran, S. (2018). *Analysis and Design of Substructures*: Limit State Design. India: CBS Publishers & Distributors.
6. Coduto, D. P. (2001). *Foundation Design: Principles and Practices* (2nd Edition). United Kingdom: Prentice Hall.
7. Kaniraj, S. R., Kaniraj, A. (1988). *Design Aids in Soil Mechanics and Foundation Engineering*. India: Tata McGraw-Hill.

E. COURSE OUTCOMES

CO Number	Skill	Statement
CO1	Apply	Design of shallow footings like isolated and mat footings.
CO2	Apply	Design of Deep foundation like pile and under-reamed pile.
CO3	Understand	Understand types of well and analyse Lateral stability of well foundation.
CO4	Analyze	Analyse anchored and cantilever sheet pile wall.
CO5	Remember	Identify expansive soil and suggest suitable types of ground improvement techniques.

F. COURSE MATRIX

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	3	3	3	3	2	3	2	3	2	3	3	3
CO2	3	3	3	3	3	3	2	3	2	3	2	3	3	3
CO3	3	3	3	3	3	3	2	3	2	3	2	3	3	3
CO4	3	3	3	3	3	3	2	3	2	3	2	3	3	3
CO5	2	2	1	2	1	2	1	3	2	3	1	3	2	1

M. TECH. SEMESTER – I (CIVIL-STRUCTURAL ENGINEERING)
SUBJECT: SOLID MECHANICS WITH FINITE ELEMENT APPLICATIONS

Teaching Scheme (Hours/Week)				Credits	Examination Scheme				
Lect	Tut	Prac	Total		Ext	Sess.	TW	Prac	Total
3	1	0	4	4	60	40	25	0	125

A. COURSE OVERVIEW

To Understand the use of FEM to a range of Engineering Problems and the application of the FEM technique to solve linear 2D structural beams and Continuum problems

B. COURSE CONTENT

NO	TOPIC	L+T (hrs)	COs
[1]	Linear elasticity; stress, strain, constitutive relations; Boundary conditions; Description of an elasticity problem as a boundary value problem, Plane stress, strain, axial symmetrical problems.	[12]	CO1 CO4
[2]	Introduction to plasticity, Yield condition; ideal elasto-plastic material.	[12]	CO2
[3]	Analysis of Continuum and discrete structures, finite element principle and solution for continuum problems, steps in finite element analysis, principles of discretization, formulation of element stiffness matrix based on direct, variation principles, shape functions, numerical integration, convergence, 2-D formulations for plane stress, plane strain, axisymmetric including isoperimetric elements, introduction to 3D brick elements for Continuum problems.	[24]	CO3 CO5

C. TEXT BOOKS

1. Cook R.D; *Concepts and Applications of Finite Element Analysis*, 1st Edition; Wiley, John & Sons 2006

D. REFERENCE BOOKS

1. K J Bathe; Finite Element procedures in engineering analysis, Prentice- Hall India Pvt. Ltd, 1982
2. J. N. Reddy; An Introduction to Finite Element Methods, 3rd edition; John Wiley and sons, 2005
3. Tirupathi K., Chandrapatla, Ashok D. Belagundu, "Introduction to Finite Elements in Engineering", 1st edition, 2013.
4. S. S. Rao, "The Finite Element Methods in Engineering", Elsevier, 4th Edition, 2013
5. Krishnamoorthy C.S; Finite Element Analysis; McGraw-Hill India: New Delhi, 2019

E. COURSE OUTCOMES

CO Number	Skill	Statement
CO1	Evaluate	Understand the Solid mechanics
CO2	Comprehension	Learning the basics of Theory of Elasticity
CO3	Develop	Formulate stiffness matrices for Bar, truss, beam, plane stress problems.
CO4	Analysis	Analyse 1D and 2D problems using Finite element method
CO5	Design	Apply the numerical methods to Continuum problems

F. COURSE MATRIX

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	.
CO1	3	3	3	2	2	2	1	1	3	2	1	2	3	3	
CO2	2	2	3	1	2	2	1	1	3	2	1	3	2	2	
CO3	2	3	2	2	2	-	-	1	2	1	2	2	2	2	
CO4	3	2	3	3	3	2	-	1	3	2	1	2	3	2	
CO5	2	3	2	3	3	1	-	1	3	1	2	3	2	3	
Avg															

M. TECH. SEMESTER – I (CIVIL-GEOTECHNICAL ENGINEERING)

SUBJECT: SUBSURFACE EXPLORATIONS: CONCEPT TO CONCLUSION [MG111]

Teaching Scheme (Hours/Week)				Credits	Examination Scheme				
Lect	Tut	Prac	Total		Ext	Sess.	TW	Prac	Total
2	1	0	3	3	40	0	25	-	65

A. COURSE OVERVIEW

The process of collection soil data for the assessment soil properties at a site through series of laboratory and field investigation is collectively called Sub-soil Exploration Enables the engineers to draw soil profile indicating the sequence of soil strata and the properties of soil and rock involved. Get to know the use of software and manually for Report preparation in subsurface explorations.

B. COURSE CONTENT

NO	TOPIC	L+T (hrs)	COs
[1]	For Soil as well as Rock : Problems and phases of foundation investigations, planning of subsurface exploration program, defining no. of boreholes, depth of boreholes, insitu tests and sampling frequency for each borehole, other insitu tests,	4	CO1
[2]	samples to be collected, type and no. of lab. test to be carried out on various samples, tendering and specifications, soundings and drilling, sample requirements, sampling, methods and equipment, Handling, preservation and Transportation of samples, sample preparation, insitu testing, analysis of the results of insitu and lab testing,	4	CO2
[3]	Characteristic strength deformation parameters for geotechnical design, detailed reporting for various geotechnical problems.	4	CO3
[4]	Use of software and manually for Report preparation in subsurface explorations.	4	CO4
[5]	Insitu testing includes SPT, SCPT, DCPT, Static and Cyclic plate load test as well as Pile Load test,	4	CO5
[6]	Block Vibration test, Electrical resistivity test, Seismic refraction tests, Ground penetration radar, high strain and low strain non-destructive testing of pile etc.	4	CO6

C. TEXT BOOKS

1. Principles of Foundation Engg. – B. M. Das

D. REFERENCE BOOKS

1. Foundation Engineering Handbook – Leonards
2. Principles of Foundation Engg. – B. M. Das
3. Analysis and design of foundation– J. E. Bowles
4. Foundation design Manual – N. V. Nayak
5. Handbook of Geotechnical engg. – R. K. Rowe

E. COURSE OUTCOMES

CO Number	Skill	Statement
CO1	Understand	To make students understand concepts of methods of boring,
CO2	Understand	Types of samples & sampling, field tests
CO3	Evaluate	To evaluate strength parameter
CO4	Apply	To prepare soil report manually and use of software
CO5	Understand	To provide brief explanation on pile load test other cone penetration test
CO6	Evaluate	To explain in detail Advanced topics on in-situ soil testing

F. COURSE MATRIX

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	3	3	2	2	2	2	1	2	2	3	1	1
CO2	2	2	1	2	2	3	2	1	2	2	1	2	1	1
CO3	2	1	2	2	1	2	2	1	2	2	1	2	1	1
CO4	2	1	2	2	1	2	2	1	1	2	1	2	3	3
CO5	2	1	1	2	1	2	2	1	2	2	1	2	3	3
CO6	2	1	2	2	1	2	2	1	1	2	1	2	3	3

M. TECH. SEMESTER – I (CIVIL-GEOTECHNICAL ENGINEERING)

SUBJECT: GEOTECH. LAB TESTING PRACTICE [MG112]

Teaching Scheme (Hours/Week)				Credits	Examination Scheme				
Lect	Tut	Prac	Total		Ext	Sess.	TW	Prac	Total
0	0	4	4	2	0	0	50	50	100

A. COURSE OVERVIEW

Geotechnical investigations provide methodology for evaluating soil and rock engineering properties and based on these data soil report. Geotechnical laboratory tests consist of number of tests for the properties of soil. Soil testing is an important function of geotechnical testing and civil engineering in the design of foundations, highway/road pavements, embankments and other earth structures. Geotechnical testing provides valuable information on soil mechanics and materials common to soils such as silt, clay, sand, gravel or rock.

B. COURSE CONTENT

NO	TOPIC	L+T (hrs)	COs
[1]	Laboratory Tests on Soil: sample preparation, testing, analysis	0	**CO1**
[2]	Reporting as per IS Code, uncertainty analysis of test results,	0	**CO2**
[3]	Grain size distribution for coarse grain soil, fine grain soil: dry sieve analysis, wet sieve analysis, hydrometer analysis, liquid limit, plastic limit, shrinkage limit, free swell test	0	**CO3**
[4]	Light compaction test, heavy compaction test, unconfined compressive strength, direct shear test, triaxial compression test, vane shear test	0	**CO4**
[5]	Constant head and falling head permeability test, One dimensional consolidation test, swell pressure test	0	**CO5**
[6]	Rock core sample preparation, rock tests,	0	**CO6**

C. TEXT BOOKS

1. Lab. Soil Testing – Lambe T. W

D. REFERENCE BOOKS

1. Head, H.K Manual of laboratory testing: Vol: 1 to 3,1981
2. Compendium of Indian standards on soil Engineering part I, 1987

E. COURSE OUTCOMES

CO Number	Skill	Statement
CO1	Comprehension	Evaluate various soil characteristics Apply knowledge of soil exploration
CO2	Application	Determination of Index properties
CO3	Evaluate	Evaluate compaction properties of soils
CO4	Evaluation	Determination of engineering property i.e., shear strength of soil
CO5	Evaluate	Obtain engineering properties like permeability of soils
CO6	Evaluate	Gather expertise in Rock samples testing

F. COURSE MATRIX

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	1	1	1	1	2	3	3	2	2	3	2	3	2	2
CO2	-	2	2	3	2	2	1	3	2	3	2	2	1	2
CO3	1	2	3	-	3	2	1	2	1	2	3	2	1	2
CO4	2	3	3	2	2	3	2	3	3	2	2	3	2	2
CO5	2	2	1	3	2	3	2	2	1	3	2	3	1	2
CO6	3	2	1	2	1	2	3	2	1	2	1	2	1	2

M. TECH. SEMESTER – I (CIVIL-GEOTECHNICAL ENGINEERING)
SUBJECT: ENVIRONMENTAL GEOTECHNOLOGY [MG1__]

Teaching Scheme (Hours/Week)				Credits	Examination Scheme				
Lect	Tut	Prac	Total		Ext	Sess.	TW	Prac	Total
2	1	0	0	3	40	0	25	0	65

A. COURSE OVERVIEW

This course is designed to understand environmental effect on soil properties and how to deal with foundation problems on contaminated soils.

B. COURSE CONTENT

NO	TOPIC	L+T (hrs)	COs
[1]	Introduction to environmental geotechnique, source, production and classification of wastes	4	CO1
[2]	Soil-pollution interaction, effects of pollutant on soil properties, foundation problems on contaminated clays	5	CO2
[3]	Hazardous waste management, criteria for selection of sites for waste disposal facilities, subsurface disposal techniques	8	CO3, CO4
[4]	Passive containment systems, monitoring and performance of waste facilities.	7	CO5

C. TEXT BOOKS

1. Criteria for Hazardous Waste Landfills: CPCB Publication, Feb. 2001.
2. Geotechnology of Waste Management - Oweis I, S. and Khera R.P.

D. REFERENCE BOOKS

Proceeding of the Workshop on Geotechnical Hazardous Waste Management at DDU Nadiad

E. COURSE OUTCOMES

(Minimum 5 Cos are required)

CO Number	Skill	Statement
CO1	Understand	Understand the basics of Environmental Geotechnology.
CO2	Evaluate	Determine the efffects of pollutant on soil properties
CO3	Remember	Criteria for selection of site for waste disposal facilities
CO4	Understand	Understand Subsurface disposal technique
CO5	Analyse	Analyse passive containment system

F. COURSE MATRIX

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	3	1	3	1	1	1	2	1	2	-	1	2	1
CO2	2	3	1	2	1	1	1	2	1	2	-	1	2	1
CO3	3	3	1	1	2	1	1	2	2	3	-	2	2	1
CO4	3	3	1	1	2	2	2	2	2	3	-	2	2	1
CO5	1	2	1	3	1	1	1	2	1	2	-	1	2	1

M. TECH. SEMESTER –I (CIVIL_GEOTECHNICAL ENGINEERING)

SUBJECT: ROCK MECHANICS [MG2__]

Teaching Scheme (Hours/Week)				Credits	Examination Scheme				
Lect	Tut	Prac	Total		Ext	Sess.	TW	Prac	Total
2	1	0	3	3	40	0	25	0	65

A. COURSE OVERVIEW

The process of collection soil data for the assessment soil properties at a site through series of laboratory and field investigation is collectively called Sub-soil Exploration. Enables the engineers to draw soil profile indicating the sequence of soil strata and the properties of soil and rock involved.

B. COURSE CONTENT

NO	TOPIC	L+T (hrs)	COs
[1]	Physical and structural geology of rocks, classification of rocks	4	CO1
[2]	mapping of joins, Classification of inferential testing,	4	CO2
[3]	transitional materials, engineering property evaluation;	4	CO3
[4]	laboratory methods and insitu tests, friction in rocks, elasticity and strength of rocks,	4	CO4
[5]	insitu stress determination, application of rock mechanics in engineering and underground openings,	4	CO5
[6]	slope stability and foundation problems.	4	CO6

C. TEXT BOOKS

1. Rock Mechanics – Goodman, F. E.

D. REFERENCE BOOKS

1. Rock Engineering– Ohn, A. Franklin and Maurice B. Dusseault,
2. Rock Mechanics in Engineering Practical – Stagg K G & Zienkiewicz 0 C
3. Rock Mechanics – Muller
4. Engineering in Rocks for Slopes, Foundation and tunnels – Ramamurthy T.
5. Engineering Rock Mechanics – An Introduction to the Principles – Hudson J A and Harrison J P

E. COURSE OUTCOMES

CO Number	Skill	Statement
CO1	Understand	Classify the Rock mass and rate the quality of rock.
CO2	Evaluation	mapping of joins, Classification of inferential testing,
CO3	Application	Apply the knowledge of engineering and assess the influence of in situ stress in the stability of various underground excavations and also acquire the knowledge of design of opening in rocks.

CO4	Evaluation	design the foundations resting on rocks. Able to carry out suitable foundation for the structure resting on rock.
CO5	Understand	Apply the knowledge of engineering and understand the stress – strain characteristics and geological structures.
CO6	Application	Apply the knowledge on rock mechanics and analyse the stability of rock slopes and arrive at the bearing capacity of shallow and deep foundations resting on rocks considering the presence of joints.

F. COURSE MATRIX

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	2	2	3	2	2	1	3	2	2	3	3	2	-
CO2	1	3	2	2	3	3	1	2	2	3	3	3	2	-
CO3	1	2	2	3	3	3	2	3	2	3	3	3	2	2
CO4	2	2	2	2	3	3	2	2	2	1	1	1	2	2
CO5	2	3	2	3	3	3	2	3	2	1	1	1	2	1
CO6	2	2	2	3	3	3	2	2	2	1	1	1	2	1

M. TECH. SEMESTER – I (CIVIL-GEOTECHNICAL ENGINEERING)
SUBJECT: NUM. METHODS & APPLICATION TO GEOTECHNICAL ENGG. [MG113]

Teaching Scheme (Hours/Week)				Credits	Examination Scheme				
Lect	Tut	Prac	Total		Ext	Sess.	TW	Prac	Total
2	1	0	0	3	40	0	25	0	65

A. COURSE OVERVIEW

The course aims at learning various numerical methods and understanding and applying the applications of these methods in Geotechnical Engineering.

B. COURSE CONTENT

NO	TOPIC	L+T (hrs)	COs
[1]	Advanced Matlab Applications for: Solution of non – linear algebraic equations, , numerical solutions of ordinary differential equations and partial differential equations, its applications to structural engineering problems. Solution of Eigen value problems, iterative methods & transformation methods. Use of software for transformation methods. Computer oriented algorithms	4	CO1
[2]	Correlation and regression, Principles of least squares Euler's equation -Functional dependent on first and higher order derivatives	5	CO2
[3]	Laplace transform methods, Laplace equation -Properties of harmonic functions -Fourier transform methods for Laplace equation.	6	CO3
[4]	Application : Excel spread sheets for the design of shallow foundations, laboratory testing applications, settlement calculations, pile foundations etc.	4	CO4
[5]	Constitutive modeling of soil, Software Usage: Applications of Geo4, Z-soil, Plaxis, STAAD, STRAP etc. for Soil Structure Interaction and geotechnical design problems.	5	CO5

C. TEXT BOOKS

1. Salvadori, M. G., Baron, M. L. (1964). *Numerical Methods in Engineering*. United States: Prentice-Hall.
2. Wilson, E. L., Bathe, K. (1976). *Numerical methods in finite element analysis*. United Kingdom: Prentice-Hall.
3. Scarborough, J. B. (1930). *Numerical Mathematical Analysis*, By James B. Scarborough.
4. *Numerical Methods in Geomechanics*: Proceedings of the NATO Advanced Study Institute, University of Minho, Braga, Portugal, Held at Vimeiro, August 24 – September 4, 1981. (2012). Netherlands: Springer Netherlands.

D. REFERENCE BOOKS

1. Bowles, J. E. (1997). Foundation Analysis and Design. Singapore: McGraw-Hill.

E. COURSE OUTCOMES

CO Number	Skill	Statement
CO1	Apply	Applications of Matlab in solutions of various equations
CO2	Understand	Understand Correlation and regression
CO3	Understand	Understand Laplace transform methods
CO4	Apply	Apply Excel spread-sheets of design of foundation system
CO5	Analyze	Analyze the soil behaviour in softwares under various conditions

F. COURSE MATRIX

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	3	1	3	1	1	1	2	1	2	-	1	2	3
CO2	2	3	1	2	1	1	1	2	1	2	-	1	2	3
CO3	3	3	1	1	2	1	1	2	2	3	-	2	2	3
CO4	3	3	1	1	2	2	2	2	2	3	-	2	3	3
CO5	1	2	1	3	1	1	1	2	1	2	-	1	3	3

M. TECH. SEMESTER – I (CIVIL-GEOTECHNICAL ENGINEERING)
SUBJECT: SOIL ENGINEERING-II [MG207]

Teaching Scheme (Hours/Week)				Credits	Examination Scheme				
Lect	Tut	Prac	Total		Ext	Sess.	TW	Prac	Total
3	0	2	5	4	60	40	25	-	65

A. COURSE OVERVIEW

The course is designed for to establish an understanding of the fundamental concepts of mechanics of different types of soil materials including shear strength behavior of materials and its applications in various elements of Geotechnical Engineering.

B. COURSE CONTENT

NO	TOPIC	L+T (hrs)	COs
[1]	**Shear Strength of Soils** Mohr's strength theory, Mohr-Coulomb theory, Types of shear tests: Direct shear test, Unconfined compression test, triaxial compression test, Drainage conditions – UU, CU, CD, Vane shear Test, Effective Stress principle, Skemptom's pore pressure parameters, Stress Path method, Stress path – field cases	6	CO1
[2]	**Critical State Soil Mechanics** Introduction, CSSM representation, soil yielding, Cam Clay model, Modified Cam Clay model, Peak state, Prediction of soil behaviour from MCCM, CSSM problems	4	CO1
[3]	**Earth Pressure Theory** Active and passive earth pressure due to backfill, Earth Pressure at rest, Rankine's earth pressure theory, Coulomb theory of earth pressure	5	CO2
[4]	**Design of Retaining Wall** Introduction, Type of Retaining wall, Principles of design of retaining wall, Gravity retaining wall, Cantilever retaining wall	4	CO2
[5]	**Stability of Slopes** Idealized Condition used in the analysis, factor of safety, Infinite and finite slopes, Stability of Infinite slopes, Introduction to Swedish Circle Method of Analysis, Fellenius method, Taylor's Stability Number, Friction Circle Method, Bishop's Method	5	CO3
[6]	**Sheet Pile Wall** Classification, Cantilever sheet pile wall in cohesive and cohesionless soil, Design of anchored bulk head: Free & Fixed Earth support method, Soil pressure on Braced excavation	8	CO4
[7]	**Introduction to Rock Mechanics** Geological classification of rock, basic terminologies, Index Properties of rock, Classification of rock for engineering purposes, Strength classification of intact rocks, Laboratory tests of rocks, modes of failure of rocks	4	CO5

C. TEXT BOOKS

1. Verma A.K. *Geotechnical and Foundation Engineering*; Charotar Publishing House Pvt. Ltd.
2. Punmia B. C. *Soil Mechanics and Foundations*; Laxmi Publications

D. REFERENCE BOOKS

1. Murthy V. N. S, *Soil Mechanics and Foundation Engineering;* UBS Publisher
2. Arora K. R. *Soil Mechanics and Foundation Engineering;* Standard Publishers Distributors
3. Das B. M. *Principles of Geotechnical Engineering*; Tata McGraw Hill.
4. Bowles J. E. *Physical and Geotechnical Properties of soils*; McGraw Hill Book Company
5. SP-36 (Part 1) - 1987 : Compendium of Indian Standards on Soil Engineering - Laboratory Testing of Soils for Civil Engineering Purpose
6. SP-36 (Part 2) - 1988 : Compendium of Indian Standards on Soil Engineering - Field Testing of Soils for Civil Engineering Purpose

E. COURSE OUTCOMES

CO Number	Skill	Statement
CO1	Evaluate	Determine shear strength properties of soils
CO2	Evaluate	Determine earth pressure values and its application in Retaining wall
CO3	Analyse	Analyse the stability of slope
CO4	Apply	Design and analyse sheet pile wall
CO5	Understand	Determine basic properties of rock and understand its behaviour

F. COURSE MATRIX

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	3	1	3	1	1	1	2	1	2	-	1	3	2
CO2	2	3	1	2	1	1	1	2	1	2	-	1	3	3
CO3	3	3	1	1	2	1	1	2	2	3	-	2	3	3
CO4	3	3	1	1	2	2	2	2	2	3	-	2	3	3
CO5	1	2	1	3	1	1	1	2	1	2	-	1	1	0

M. TECH. SEMESTER – II (CIVIL-GEOTECHNICAL ENGINEERING)
SUBJECT: SOIL STRUCTURE INTERACTION

Teaching Scheme (Hours/Week)				Credits	Examination Scheme				
Lect	Tut	Prac	Total		Ext	Sess.	TW	Prac	Total
3	1	0	4	4	60	40	25	0	125

A. COURSE OVERVIEW

The objective of this course is to make student understand about the importance of Soil Structure Interaction in design of structures. Application of Soil structure Interaction to various structural elements will be shown.

B. COURSE CONTENT

NO	TOPIC	L+T (hrs)	COs
[1]	Critical study of conventional methods of foundation design; Nature of complexities of soil structure interaction; Application of advanced techniques of analysis such as the finite element method, finite differences, relaxation and interaction for the evaluation of soil-structure interaction for different types of structures under various conditions of loading and subsoil characteristics;	12	CO1
[2]	Preparation of comprehensive design-oriented computer programs for specific problems.	04	CO2
[3]	Interaction problems based on the theory of sub-grade reaction such as beams, footings, rafts bulkheads etc, Analysis of different types of framed structures founded on stratified natural deposits with linear and non-linear stress-strain characteristics.	10	CO4
[4]	Determination of axial and lateral pile capacities; group action of piles considering stress-strain characteristics of real soils.	10	CO3

C. TEXT BOOKS

1. Analysis and design of foundation - J. Bowles
2. Numerical Methods in Geotechnical Engg. - Desai & Christian

D. REFERENCE BOOKS

1. Elastic Analysis of Soil Foundation Interaction - A P S Selvadurai
2. Advanced Geotechnical Engineering - C S Desai, M. Zaman

E. COURSE OUTCOMES

On the successful completion of this course
CO1: Students will have basic understanding of Soil Structure Interaction.
CO2: Students will solve beams on elastic foundation problem and its application.
CO3: Students will be able to understand effect of Soil structure interaction to deep foundation.
CO4: Students will be able to analyse raft foundation resting on soil using soil springs.

F. COURSE MATRIX

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	1	2	2	3	3	1	2	1	2	2	1	3	1
CO2	1	3	1	3	1	3	3	1	3	2	2	3	1	3
CO3	3	2	1	2	1	2	3	2	1	1	1	2	3	1
CO4	2	2	3	3	2	1	1	3	2	3	3	1	2	3

M. TECH. SEMESTER – II (CIVIL-GEOTECHNICAL ENGINEERING)
SUBJECT: GEOPHYSICAL EXPLORATIONS [MG2__]

Teaching Scheme (Hours/Week)				Credits	Examination Scheme				
Lect	Tut	Prac	Total		Ext	Sess.	TW	Prac	Total
2	1	0	0	3	40	0	25	0	65

A. COURSE OVERVIEW

This course aims at learning various geophysical methods of exploring the ground to understand the various physical and engineering properties of soil and rock.

B. COURSE CONTENT

NO	TOPIC	L+T (hrs)	COs
[1]	**Introduction** An overview of geophysical methods of exploration; classification – major /minor; artificial / natural; applications and limitations, need for integrated surveys. Physical properties, rocks-density, susceptibility, resistivity and elastic wave velocities, factors controlling the properties, numerical values for important rock types, concept of physical property contrast. Role of geophysics in understanding the internal structure of the earth and plate tectonics.	6	CO1
[2]	**Gravity Methods** Earth's gravity field, origin, variation with elevation and depth, temporal and transient variations, international gravity formula, geoid, spheroid. Principle of gravity exploration, concept of gravity anomaly; gravimeters, gravity surveys, reduction of data, free air, Bougrer and topographic correlations; concepts of regional and residuals; contamination and derivative maps. Quantitative interpretation of anomaly maps, identification of faults, folds and contacts, principles of quantitative interpretation with reference to spheres, cylinders and thin horizontal sheets; concepts of modeling and inversion.	4	CO2
[3]	**Magnetic Methods** Earth's magnetic field, origin; magnetic elements, interrelationships, transient and temporal variations; IGRF; principle of magnetic method, origin of anomalies, induced and remanant magnetizations; magnetometers, proton precession and fluxgate; plan of magnetic surveys, reduction of data; anomaly maps, identification of structures; familiarization of magnetic anomalies over spheres, sheets and dykes; interpretation of magnetic anomalies of sheets and dykes. Airborne magnetometry, plan of surveying and presentation of results.	5	CO3
[4]	**Electrical and Electromagnetic Methods** Self-potential method, origin of SP; resistivity method, concept of apparent resistivity, Werner, Schlumberger and Dipole-dipole configurations; electrical sounding, interpretation through curve matching, electrical profiling; elements of electromagnetic methods, in phase, out of phase components, identification of conductors from EM anomalies.Telluric and magneto methods, application in oil exploration.	4	CO4
[5]	**Seismic Methods** Elastic propagation in rocks, Hooke's Law, acoustic impedance; Snell's	5	CO5

	Law, principles of seismic refraction method, travel time curves over horizontal interfaces and faults, interpretation of results; principles of seismic reflection method, travel time curves, over horizontal and dipping layers, interpretation; concept of RMS interval and average velocities; seismic data acquisition on land and sea, sub-bottom profilers, seismic sources, air gun, etc., processing of seismic reflection data, single channel and multi channel seismic data interpretation methods, pitfalls, seismic stratigraphy, velocity pull ups, bright spots etc., Technological advances in seismic data processing, modern survey techniques; GPS; reservoir characterization.		

C. TEXT BOOKS

1. Radhakrishna Murthy, I.V., (1998). *Gravity and magnetic interpretation in exploration geophysics*. Geol. Soc. India, Bangalore.
2. Jhon, Milsom (2003). *Field Geophysics*, 3rd Edn. John Wiley, London.
3. Dobrin, M.B. and Savit, C.H. (1988). *Introduction to geophysical prospecting*, 4th Edn., McGraw Hill, New York.
4. Saha, J. G. *Seismic data processing manual*, ONGC Pub. Dehradun.
5. Coffeen, J.A. 1986. *Seismic exploration fundamentals and seismic techniques for finding oil*, 2nd Edn. Pennwell Pub. Co., Tulsa, Oklahoma.
6. Domenico, S.N. 1983. *Modern Seismic Exploration concepts*. Tulsa, Oklahoma.
7. Macquillin, R. Bacon, M.(eds). 1984. *An introduction to seismic interpretation, reflection seismics in petroleum exploration*, Grahmam, Trot.

D. REFERENCE BOOKS

1. M.B.R.Rao, (1993). *Outlines of geophysical prospecting*, English Book Depo, Dehradun.

E. COURSE OUTCOMES

CO Number	Skill	Statement
CO1	Understand	Understand the need of Geophysical methods and classify it.
CO2	Apply	Gravity methods: uses, application and interpretation of results
CO3	Apply	Magnetic methods: uses, application and interpretation of results
CO4	Apply	Electrical and electromagnetic methods: uses, application and interpretation of results
CO5	Apply	Seismic methods: uses, application and interpretation of results

F. COURSE MATRIX

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	3	1	3	1	1	1	2	1	2	-	1	2	1
CO2	2	3	1	2	1	1	1	2	1	2	-	1	2	2
CO3	3	3	1	1	2	1	1	2	2	3	-	2	2	2
CO4	3	3	1	1	2	2	2	2	2	3	-	2	2	2
CO5	1	2	1	3	1	1	1	2	1	2	-	1	2	2

M. TECH. SEMESTER – II (CIVIL-GEOTECHNICAL ENGINEERING)

SUBJECT: EARTHDAM ENGINEERING [MG208]

Teaching Scheme (Hours/Week)				Credits	Examination Scheme				
Lect	Tut	Prac	Total		Ext	Sess.	TW	Prac	Total
2	1	0	3	3	40	0	25	0	65

A. COURSE OVERVIEW

The course will provide knowledge on effective stress analysis; Stability of earth and rock fill dams; Steady state seepage and rapid draw down cases. Design of earth dams, Pore pressure during construction stage, Methods of seepage control in earth dams. Seismic analysis of embankment and measuring instruments.

B. COURSE CONTENT

NO	TOPIC	L+T (hrs)	COs
[1]	Factors influencing design of earthdams, types of earthdams, Control of pore pressure within the dam and foundation,	4	**CO1**
[2]	critical study of earthdam failures, embankment settlement during and after construction, differential settlement and cracks,	4	**CO2**
[3]	construction pore pressures and control, seepage analysis, various methods of construction of flownets, methods of foundation treatment,	4	**CO3**
[4]	critical evaluation of methods of stability analysis, dams with impervious membranes of manufactured materials like reinforced concrete, steel plates and asphaltic conctrete,	4	**CO4**
[5]	embankment construction procedures,	4	**CO5**
[6]	equipment, methods of quality control, measuring instruments, performance observations, aseismic design, slope protection, rockfill construction.	4	**CO6**

C. TEXT BOOKS

1. Sherrared - Earth Dam Engg.

D. REFERENCE BOOKS

2. Creager W. P. - Engineering for dams, Wiley, 1967.
3. Singh, B. - Earth and Rockfill dam, Sarita Prakashan, 1973.
4. Sowers G. I. - Earth and Rockfill dam engineering,
5. Earth Manual, - USBR Publication.
6. Arcold - Volume on earth and rockfill dams.

E. COURSE OUTCOMES

CO Number	Skill	Statement
CO1	Understand	Recognize potential failure modes or deformation types for soil slopes and embankments
CO2	Application	Distinguish the common causes/triggering mechanisms for landslides/slope instabilities
CO3	Design	Determine the stability of a slope using slope stability manually
CO4	Evaluation	Design proper slope and stable earthen structure as per requirement
CO5	Decision Making	Construction of earth dam work
CO6	Understand	Instrumentation in Earthen Dam

F. COURSE MATRIX

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	1	3	2	3	1	3	1	2	2	2	3	2	2	-
CO2	1	2	2	2	3	2	2	2	3	2	2	2	2	-
CO3	2	2	3	2	2	2	2	1	1	2	2	1	3	1
CO4	2	1	1	2	2	1	1	2	2	2	3	2	3	1
CO5	1	2	2	2	3	2	2	1	1	2	2	1	2	-
CO6	3	3	2	2	1	1	1	2	2	2	3	2	2	-

M. TECH. SEMESTER – II (CIVIL-GEOTECHNICAL ENGINEERING)

SUBJECT: GROUND IMPROVEMENT TECHNIQUES [MG2__]

Teaching Scheme (Hours/Week)				Credits	Examination Scheme				
Lect	Tut	Prac	Total		Ext	Sess.	TW	Prac	Total
2	1	0	3	3	40	0	25	0	65

A. COURSE OVERVIEW

Various processes of ground improvements are available to increase the strength, reduce compressibility, reduce permeability of weak soils, or improve groundwater conditions. Further, if there is any foundation distress in the existing structures, in-place foundation treatment can be applied to rehabilitate the structure.

B. COURSE CONTENT

NO	TOPIC	L+T (hrs)	COs
[1]	Weak deposts- identification, problems associated with weak deposits, Mitchel chart for applicability of treatment methods	4	CO1
[2]	Insitu compaction of cohesionless soil, injection grouting, soil stabilization, vibroflotation, reloading, sand drains	4	CO2
[3]	prefabricated vertical drains, stone columns, dynamic consolidation, blasting, compaction piles	4	CO3
[4]	Ground water control methods, diaphragm walls, well point system	4	CO4
[5]	Geo-reinforcement applications	4	CO5
[6]	Techniques for expansive soils, loess	4	CO6

C. TEXT BOOKS

1. An Intro. To Ground Improvement Engg. – Satyendra mittal

D. REFERENCE BOOKS

1. Construction and Geotechnical Methods in Foundation Engg. – Koerner R. M.
2. Foundation Engineering in Difficult Subsoil Conditions - Zeevart L.
3. Foundation Engineering in Difficult Ground – Bell F. G.
4. Engg. Principles of Ground Modifications – Haussman M. R.
5. Earth Reinforcement and Soil Structure – Jones J E P.

E. COURSE OUTCOMES

CO Number	Skill	Statement
CO1	Understand	The different ground improvement techniques.
CO2	Understand	The methods of stabilisation

CO3	Apply	The basic concept of consolidation of soil
CO4	Understand	Understand the basic concept of water control methods
CO5	Understand	Understand the basic concepts of geosynthetics
CO6	Evaluate	The concept of shear strength in difficult soils

F. COURSE MATRIX

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	1	2	3	2	-	3	3	1	2	3	2	1
CO2	3	3	3	3	1	2	3	3	3	2	-	3	2	2
CO3	3	3	3	3	2	2	3	3	3	1	3	3	2	1
CO4	3	3	3	3	1	3	3	-	3	1	-	3	3	3
CO5	3	3	3	3	1	1	3	3	2	3	1	3	3	2
CO6	3	2	3	2	3	1	-	3	3	1	-	3	2	2

M. TECH. SEMESTER – II (CIVIL-GEOTECHNICAL ENGINEERING)
SUBJECT: REINFORCED EARTH AND GEOTEXTILES

Teaching Scheme (Hours/Week)				Credits	Examination Scheme				
Lect	Tut	Prac	Total		Ext	Sess.	TW	Prac	Total
3	0	0	3	3.0	60	0	0	0	60

A. COURSE OVERVIEW

This section may include motivation, objectives, scope etc. of the subject. It is preferred to describe all in less than 7 lines.

B. COURSE CONTENT

NO	TOPIC	L+T (hrs)	COs
[1]	Basic introduction to the elements of ground engineering characteristics of reinforcing materials, definition of reinforced and advantage of RE.	5	CO1
[2]	Soil reinforcement interaction, behaviour of reinforced earth walls, basis of wall design, the coulomb force method, the Rankine force method, internal and external stability condition,	9	CO2, CO3
[3]	Field application of RE, randomly reinforced earth and analysis of reinforced soils, testing of soil reinforcements.	6	CO4
[4]	Definitions, functions, properties and application of geotextiles, design of geotextile applications,	5	CO1, CO2, CO3
[5]	definitions, functions, properties and application of geo membranes, design of geo membranes	5	CO1, CO2, CO3
[6]	applications, geo textiles associated with geo membranes, testing on geo Textiles, environmental efforts, ageing and weathering.	6	CO1, CO4

C. TEXT BOOKS

1. Koerner R.M. . *Designing with Geosynthetics*; 3rd ed.; Prentice Hall. University of Michigan, 1994.

D. REFERENCE BOOKS

1. Rao G.V., *Geosynthetics- New Horizons;* 5th ed.; Asian Books Private Ltd.: New Delhi, 2012.
2. Swami Saran,. *Reinforced soil and its engineering applications,*; McWiley, Hoboken, New Jersey, 2019.
3. G L Sivakumar Babu, *An Intro. To Soil reinf. And Geosymthetics*, 1st ed. Universities Press (India) Pvt. Ltd.2013.

E. COURSE OUTCOMES

CO Number	Skill	Statement
CO1	Evaluate	Prepare and Understand the Reinforced Earth & Geotextile.
CO2	Comprehension	Identify the various methods of analysis and failure modes.
CO3	Analysis	Application of methods to analyse and design reinforced earth walls.
CO4	Application	Application of geotextile for various functions performed by geotextiles.

F. COURSE MATRIX

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	1	1	1	1	1	1	1	1	1	1	1
CO2	3	3	3	3	3	3	3	3	3	3	3	3
CO3	2	2	2	2	2	2	2	2	2	2	2	2
CO4	1	-	-	1	1	-	2	-	1	1	-	1
Avg												

M. TECH. SEMESTER – II (CIVIL-STRUCTURAL ENGINEERING)
SUBJECT: RESEARCH METHODOLOGY [SG202]

Teaching Scheme (Hours/Week)				Credits	Examination Scheme				
Lect	Tut	Prac	Total		Ext	Sess.	TW	Prac	Total
2	2	2	2	2	2	2	2	2	2

A. COURSE OVERVIEW

The objective of this course is to understand the basic concepts of research and its methodologies, identify appropriate research topics, select and define appropriate research problem and parameters, prepare a research proposal and research documentation.

B. COURSE CONTENT

NO	TOPIC	L+T (hrs)	COs
[1]	Meaning of research problem, Sources of research problem, Criteria Characteristics of a good research problem, Errors in selecting a research problem, Scope and objectives of research problem. Approaches of investigation of solutions for research problem, data collection, analysis, interpretation, Necessary instrumentations	7	CO1
[2]	Effective literature studies approaches, analysis Plagiarism, Research ethics	4	CO2
[3]	Effective technical writing, how to write report, Paper Developing a Research Proposal, Format of research proposal, a presentation and assessment by a review committee	4	CO3
[4]	Nature of Intellectual Property - Patents, Designs, Trademark and Copyright. Process of Patenting and Development: technological research, innovation, patenting, development. International Scenario: International cooperation on Intellectual Property. Procedure for grants of patents, Patenting under PCT.	4	CO5
[5]	Patent Rights - Scope of Patent Rights. Licensing and transfer of technology. Patent information and databases. Geographical Indications.	4	CO4
[6]	New Developments in IPR - Administration of Patent System. New developments in IPR; IPR of Biological Systems, Computer Software etc. Traditional knowledge Case Studies, IPR and IITs.	4	CO5

C. TEXT BOOKS

1. Ranjit Kumar, “Research Methodology: A Step-by-Step Guide for beginners”

D. REFERENCE BOOKS

1. Stuart Melville and Wayne Goddard, “Research methodology: an introduction for science & engineering students”
2. Wayne Goddard and Stuart Melville, “Research Methodology: An Introduction”
3. Halbert, “Resisting Intellectual Property”, Taylor & Francis Ltd ,2007.
4. Mayall, “Industrial Design”, McGraw Hill, 1992.
5. Niebel, “Product Design”, McGraw Hill, 1974.
6. Asimov, “Introduction to Design”, Prentice Hall, 1962.

7. Robert P. Merges, Peter S. Menell, Mark A. Lemley, “Intellectual Property in New Technological Age”, 2016.
8. T. Ramappa, “Intellectual Property Rights Under WTO”, S. Chand, 2008

E. COURSE OUTCOMES

CO Number	Skill	Statement
CO1	Create	Students will be able to understand the concept of research and its methodologies and formulate research problem.
CO2	Evaluate	Students will be able to review existing literature in a given research area.
CO3	Application	Students will be able to document research findings effectively.
CO4	Understand	Students will be able to understand importance of research ethics law of patents and copy right
CO5	Understand	Students will be able to explore on various IPR components and process of filing.

F. COURSE MATRIX

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	3	1	3	2	1	2	3	3	1	3	1	-
CO2	2	3	2	1	2	1	1	2	3	2	1	3	1	-
CO3	1	1	-	1	2	1	-	2	3	3	-	3	-	-
CO4	1	1	-	-	1	2	-	3	2	2	1	3	-	-
CO5	1	1	-	-	1	1	-	1	2	2	1	3	-	-

M. TECH. SEMESTER –II (CIVIL- STRUCTURAL ENGINEERING)

SUBJECT: AUDIT COURSE – II: PEDAGOGIC STUDIES

Teaching Scheme (Hours/Week)				Credits	Examination Scheme				
Lect	Tut	Prac	Total		Ext	Sess.	TW	Prac	Total
2	0	0	0	0	0	0	0	0	0

A. DETAILED SYLLABUS

1. Introduction and Methodology:
   Aims and rationale, Policy background, Conceptual framework and terminology, Theories of learning, Curriculum, Teacher education. Conceptual framework, Research questions**.** Overview of methodology and Searching.
2. Thematic overview: Pedagogical practices are being used by teachers in formal and informal classrooms in developing countries. Curriculum, Teacher education.
3. Evidence on the effectiveness of pedagogical practices, Methodology for the in depth stage: quality assessment of included studies. How can teacher education (curriculum and practicum) and the school curriculum and guidance materials best support effective pedagogy? Theory of change. Strength and nature of the body of evidence for effective pedagogical practices. Pedagogic theory and pedagogical approaches. Teachers' attitudes and beliefs and Pedagogic strategies.
4. Professional development: alignment with classroom practices and followup support Peer support, Support from the head teacher and the community, Curriculum and assessment, Barriers to learning: limited resources and large class sizes
5. Research gaps and future directions, Research design, Contexts, Pedagogy, Teacher education, Curriculum and assessment, Dissemination and research impact.

B. RECOMMENDED TEXT / REFERENCE BOOKS

1. Culture and pedagogy: International comparisons in primary education. - Alexander RJ
2. Read India: A mass scale, rapid, 'learning to read' campaign - Chavan M