Annexure-1 Curriculum
M. Tech (Geo-Technical Engineering)

First Semester

S.No.	Core/Elective	Course Name	L	T	P	IM	EM	CR
1	Core 1	Advanced Soil Mechanics	3	0	0	40	60	3
2	Core 2	Advanced Foundation Engineering	3	0	0	40	60	3
3	PE 1	1. Soil Structure Interaction 2. Ground Improvement Techniques 3. Pavement Analysis and Design	3	0	0	40	60	3
4	PE 2	1. FEM in Geo-Mechanics 2. Environmental Geo-Technology 3. Critical Soil Mechanics	3	0	0	40	60	3
5		Research Methodology & IPR	2	0	0	40	60	2
6	Audit Course	Audit Course						
7	Lab 1	Soil Mechanics – 1 Laboratory	0	0	4	50	50	2
8	Lab 2	Soil Mechanics – 2 Laboratory	0	0	4	50	50	2
		Total	14	0	8	300	400	18

Second Semester

S.No.	Core/Elective	Course Name	L	T	P	IM	EM	CR
1	Core 3	Dynamics of Soil and Foundations	3	0	0	40	60	3
2	Core 4	Subsurface Investigations and Instrumentation	3	0	0	40	60	3
3	PE 3	1. Offshore Geo-Technical Engineering 2. Computational Geo-Mechanics 3. Engineering Rock Mechanics	3	0	0	40	60	3
4	PE 4	1. Earth Retaining Structures 2. Design of Underground Excavations 3. Physical and Constitutive Modeling on Geo-Mechanics	3	0	0	40	60	3
5		Mini-Project	0	0	4	40	60	2
6	Audit Course	Audit Course						
7	Lab 3	Sub Soil Exploration Laboratory	0	0	4	50	50	2
8	Lab 4	Geo-Technical Engineering Modeling Laboratory	0	0	4	50	50	2
		Total	12	0	12	300	400	18

Third Semester

S.No.	Core/Elective	Course Name	L	T	P	IM	EM	CR
1	PE 5	1. Stability Analysis of Slopes 2. Foundation on Weak Rocks 3. Geo-Technical Earthquake Engineering	3	0	0	40	60	3
2	OE	1. Business Analytics 2. Industrial Safety 3. Operations Research 4. Cost Management of Engineering Projects 5. Composite Materials 6. Waste to Energy	3	0	0	40	60	3
3	Major Project	Dissertation Stage – 1 (to be continued next semester)	0	0	20	100	--	10
		Total	6	0	20	180	120	16

Fourth Semester

S.No.	Core/Elective	Course Name	L	T	P	IM	EM	CR
1	Major Project	Dissertation Final Stage (continued from 3rd semester)	0	0	32	50	50	16
		Total	0	0	32	50	50	16

Subject Code	Subject Category	Subject Title	L	T	P	IM	EM	Credits
1851101		Advanced Soil Mechanics	03	00	00	40	60	03

COURSE OBJECTIVES

- To explain about the consolidation theory
- To explain about the strength behaviour of soil under various conditions
- To analyse the stress paths for different practical situations
- To study the critical parameters in soils
- To study the elastic and plastic deformations in soils

COURSE OUTCOME

- The students obtain the complete knowledge on strength of soil mass
- The students are able to develop mathematical models for solving different problems in soil mechanics

Unit – 1

Compressibility of Soils: Consolidation Theory (One, Two, and Three Dimensional Consolidation Theories), Consolidation in Layered Soil and Consolidation for Time Dependent Loading, Determination of Coefficient of Consolidation (Casagrande Method and Taylors Method)

Unit – 2

Strength Behavior of Soils; Mohr Circle of Stress; UU, CU, CD Tests, Drained and UndrainedBehavior of Sand and Clay, Significance of Pore Pressure Parameters; Determination of Shear Strength of Soil; Interpretation of Triaxial Test Results.

Unit – 3

Stress Path; Drained and Undrained Stress Path; Stress Path With Respect to Different Initial State of the Soil; Stress Path for Different Practical Situations.

Unit – 4

Critical State Soil Mechanics; Critical State Parameters; Critical State for Normally Consolidated and Over Consolidated Soil; Significance of Roscoe and Hvorslev State Boundary Surface; Drained and Undrained Plane. Critical Void Ratio; Effect of Dilation in Sands; Different Dilation Models.

Unit – 5

Elastic And Plastic Deformations: Elastic Wall; Introduction to Yielding and Hardening; Yield Curve and Yield Surface, Associated and Non-Associated Flow Rule.

Text Books:

1. Atkinson, J.H. and Bransby, P.L, The Mechanics of Soils: An introduction to Critical soil mechanics, McGraw Hill, 1978.
2. Das, B.M., Advanced Soil Mechanics, Taylor and Francis, 2nd Edition, 1997.
3. Wood, D.M., Soil Behavior and Critical State Soil Mechanics, Cambridge University Press, 1990.

Reference Books:

1. Craig, R.F., Soil Mechanics, Van Nostrand Reinhold Co. Ltd., 1987.
2. Terzaghi, K., and Peck, R.B., Soil Mechanics in Engineering Practice, John Wiley & Sons, 1967.
3. Lambe, T.W. and Whitman, R.V., Soil Mechanics, John Wiley & Sons, 1979.

Subject Code	Subject Category	Subject Title	L	T	P	IM	EM	Credits
1851102		Advanced Foundation Engineering	03	00	00	40	60	03

COURSE OBJECTIVES

- To emphasize the importance of soil investigations including destructive and non-destructive methods
- To explain the concept of bearing capacity and how to estimate the safe bearing capacity for various foundation system including settlement consideration
- To explain the need and how do analysis the pile and pile group under various soil conditions and the concepts of Terzaghi and IRC Methods and individual components
- To explain the concepts of collapsible and expansive soils and design of foundations
- To analyse the foundations under uplifting loads

COURSE OUTCOME

- The students will be able to decide the type of foundations to be recommended for construction of different engineering structures
- The students will be able to design different types of foundations

Unit – 1

Planning of Soil Exploration for Different Projects, Methods of Subsurface Exploration, Methods of Borings Along with Various Penetration Tests

Unit – 2

Shallow Foundations, Requirements for Satisfactory Performance of Foundations, Methods of Estimating Bearing Capacity, Settlements of Footings and Rafts, Proportioning of Foundations Using Field Test Data, IS Codes.

Unit – 3

Pile Foundations, Methods of Estimating Load Transfer of Piles, Settlements of Pile Foundations, Pile Group Capacity and Settlement, Negative Skin Friction of Piles, Laterally Loaded Piles, Pile Load Tests, Analytical Estimation of Load- Settlement Behavior of Piles, Proportioning of Pile Foundations, Lateral and Uplift Capacity of Piles.

Well Foundation, IS and IRC Codal Provisions, Elastic Theory and Ultimate Resistance Methods

Unit – 4

Foundations on Problematic Soils: Foundations for Collapsible and Expansive Soil

Unit – 5

Coffer Dams, Various Types, Analysis and Design Foundations under Uplifting Loads

Text Books:

1. Bowles. J.E., Foundation Analysis and Design, Tata McGraw-Hill International Edition, 5th Edn, 1997.
2. Das B.M., Shallow Foundations: Bearing capacity and settlement, CRC Press, 1999.

Reference Books:

1. Tomlinson M.J., Pile design and construction Practice, Chapman and Hall Publication, 1994.
2. Poulos, H. G. and Davis, F. H., "Pile Foundation Analysis and Design", Wiley and Sons. 1980

Subject Code	Subject Category	Subject Title	L	T	P	IM	EM	Credits
1851103		Soil Structure Interaction	03	00	00	40	60	03

COURSE OBJECTIVES

- To study the soil and foundation behaviour
- To analyse the beams on elastic foundations
- To analyse the plates on elastic medium
- To analyse the piles on elastic medium
- To analyse the load prediction on piles

COURSE OUTCOME

- Students can apply different soil response models for specific problem based on the requirement.
- Students can analyze footings/rafts resting on soil as beams/plates on elastic foundation and work out design bending moments/shear and displacements.
- Student can compute pile response for various loading condition for design purpose.

Unit – 1

Soil-Foundation Interaction: Introduction to soil - Foundation interaction problems, Soil behavior, Foundation behavior, Interface, behavior, Scope of soil-foundation interaction analysis, soil response models, Winkler, Elastic continuum, two parameter elastic models, Elastic plastic behavior, Time dependent behavior.

Unit – 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.

Unit – 3

Plate on Elastic Medium: Infinite plate, Winkler, Two parameters, Isotropic elastic medium, Thin and thick plates, Analysis of finite plates, rectangular and circular plates, Numerical analysis of finite plates, simple solutions.

Unit – 4

Elastic Analysis of Pile: Elastic analysis of single pile, Theoretical solutions for settlement and load distribution, Analysis of pile group, Interaction analysis, Load distribution in groups with rigid cap.

Unit – 5

Laterally Loaded Pile: Load deflection prediction for laterally loaded piles, sub-grade reaction and elastic analysis, Interaction analysis, and pile raft system, solutions through influence charts.

Text Books:

1. Structure Soil Interaction - State of Art Report, Institution of structural Engineers, 1978.
2. McCarthy, D.F. Essentials of Soil Mechanics and Foundations, basic geo-techniques (6^{th} Edition), Prentice Hall, 2002.
3. Selvadurai, A.P.S., Elastic Analysis of Soil Foundation Interaction, Elsevier, 1979.
4. Hemsley, J.A, Elastic Analysis of Raft Foundations, Thomas Telford, 1998.

Reference Books:

1. Poulos, H.G., and Davis, E.H., Pile Foundation Analysis and Design, John Wiley, 1980.
2. Scott, R.F. Foundation Analysis, Prentice Hall, 1981.
3. ACI 336, Suggested Analysis and Design Procedures for Combined Footings and Mats, American Concrete Institute, Dehit, 1988.

Subject Code	Subject Category	Subject Title	L	T	P	IM	EM	Credits
1851104		Ground Improvement Techniques	03	00	00	40	60	03

COURSE OBJECTIVES

- To study the problems associated with problematic geo-materials and the methods for their improvement to support buildings and various types of structures

COURSE OUTCOME

- At the completion of the course the students will be able to understand the different types of ground modification can be done depending upon the site condition, type and purpose of structure to be constructed.

Unit – 1

Dewatering: Introduction - Scope and necessity of ground improvement in Geotechnical engineering- basic concepts and philosophy, Drainage - Ground Water lowering by well points deep wells, vacuum and electro-osmotic methods. Stabilization by thermal and freezing techniques

Unit – 2

Compaction and Sand Drains: In-situ compaction of granular and cohesive soils, Shallow and Deep compaction sand piles – concept, design, factors influencing compaction Blasting and dynamic consolidation – Preloading with sand drains, fabric drains, wick drains etc. – theories of sand drain – design and relative merits.

Unit – 3

Stone Column, Lime Piles and Soil Nailing: Stone column, lime piles – Functions – Methods of installation – design, estimation of load carrying capacity and settlement-slope stability-stability of trenches-lime-sand columns-Root piles, soil nailing – Applications.

Unit – 4

Earth Reinforcement: Earth reinforcement – Principles and basis mechanism of reinforced earth-reinforced soil retaining structures-simple design, Synthetic and natural fibre based Geo-textiles and their applications. Filtration, drainage, separation, erosion control – case studies

Unit – 5

Grouting: Grouting techniques – Types of grout – Suspension and solution grouts – Basic requirements of grout, Grouting equipment – principle of injection-injection methods – properties of treated ground-application of jet grouting-grout monitoring – Electro – chemical stabilization – Stabilization with cement, lime etc. – Stabilization of expansive clays.

Text Books

1. Dr. P. Purushothama Raj., "Ground Improvement Techniques", Lakshmi Publications Pvt. Ltd.
2. Das, B.M., Principles of Foundation Engineering, (Fourth Edition). PWS Publishing, 1999
3. Jones, J.E.P., Earth Reinforcement and Soil Structure, Butterworths, 1985.
4. Koerner, R.M. and Welsh, J.P., Construction and Geotechnical Engineering using Synthetic Fabrics, John Wiley, 1990.

Reference Books:

1. Moseley, M.D., Ground Treatment, Blackie Academic and Professional, 1998.
2. Hehn, R.W., Practical Guide to Grouting of Underground Structures, ASCE, 1996.
3. Koerner, R.M., Designing with Geosynthetics (Third Edition), Prentice Hall, 1997.

Subject Code	Subject Category	Subject Title	L	T	P	IM	EM	Credits
1851105		Pavement Analysis and Design	03	00	00	40	60	03

COURSE OBJECTIVES

- To understand the different types of pavements.
- To conduct analysis of flexible pavements for stresses, strains, and deflections in one-, two-, and three-layered systems.
- To design flexible pavements using the AASHTO design procedure.
- To conduct analysis of rigid pavements for stresses, strains, and deflections.
- To design rigid pavements using the AASHTO design procedure.

COURSE OUTCOME

- The students will be able to design flexible as well rigid pavements

Unit – 1

Introduction: Types and component parts of pavements, Factors affecting design and performance of pavements. Highway and airport pavements

Unit – 2

Stresses and strains in flexible pavements: 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

Unit – 3

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. IRC method of pavement design

Unit – 4

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.

Unit – 5

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

Text Books:

1. Yang H Huang - Pavement Analysis and Design, 2nd Edition, Pearson Education
2. KhannaS.K& Justo C.E.G – Highway Engineering, Khanna Publishers.
3. Srinivasa Kumar R – Pavement design, University press (India) Pvt. Ltd 2013

Reference Books:

1. Design and Specification of Rural Roads (Manual), Ministry of Rural Roads, Government of India, New Delhi, 2001
2. Yoder R.J And Witchakm.W., Principles of Pavement Design, John Wiley, 2000.
3. Guidelines for the Design of Flexible Pavements, IRC: 37 - 2001, the Indian Roads Congress, New Delhi.
4. Guideline for the Design of Rigid Pavements for Highways, IRC: 58-1998, the Indian Roads Congress, New Delhi.

Subject Code	Subject Category	Subject Title	L	T	P	IM	EM	Credits
1851106		FEM in Geo-Mechanics	03	00	00	40	60	03

COURSE OBJECTIVES

- To explain the basic concepts of FEM
- To explain the principles and formulation of variational methods
- To analyse the displacements and explain the problems in soils and rocks
- To explain the applications of FEM in geotechnical engineeirng

COURSE OUTCOME

- Students can understand basic stress-strain relationship for soil and develop Stress deformation analysis.
- Students can develop finite element formulation for different geotechnical problems including shallow foundation, seepage and consolidation problems.

Unit – 1

Basic Concepts: Basic concepts - Discretization of continuum, typical elements, the element characteristic matrix, Element assembly and solution for unknowns - Applications.

Unit – 2

Variational Principles: Variational principles, variational formulation of boundary value problems, Variational methods approximation such as Ritz and weighted residual (Galerkin) methods, Applications.

Unit – 3

Displacements Based Elements: Displacements based elements, finite elements for axial symmetry. One-dimensional problems of stress, deformation and flow, Assembly, Convergence requirements, Finite elements analysis of two-dimensional problems. The linear and quadratic triangle, Natural coordinates.

Unit – 4

Iso-parametric Formulation: Application of FEM to Problems in soils and rocks, Introduction to non-linearity, Finite difference method, Description and application to consolidation, seepage, Winkler foundation etc.,

Unit – 5

Applications in Geotechnical Engineering: Application of FEM to Problems in soils, Introduction to non-linearity, Finite difference method, Description and application to consolidation, seepage, Winkler foundations

Text Books:

1. Reddy, J.N., An Introduction to the Finite Element Method, McGraw Hill, 1984.
2. Tirupathi R. Chandrupatla and Ashok D. Belegundu., Introduction to Finite Elements in Engineering, Prentice- Hall, 1991.
3. Rajasekaran, S., Finite Element Analysis in Engineering Design, Wheller Publishing, Allahabad, 1993.
4. Smith, I.M., Programming the Finite Element Method with Application to Geomechanics, John Wiley and sons, New Delhi, 2000.

Reference Books:

1. Cook, R.D., Malkus, D.S., and Plesha, M.E., Concepts and Applications of Finite Element Analysis, John Wiley, 1989.
2. Gupta, O.P. Finite and Boundary Element Methods in Engineering, Oxford &IBH Publishing Co., Pvt. Ltd., New Delhi, 2000.
3. Potts, D.M. and Zdramcovic, L., Finite Element analysis in Geotechnical Engineering - Application, Thomas Telford, 2001.

Subject Code	Subject Category	Subject Title	L	T	P	IM	EM	Credits
1851107		Environmental Geo-Technology	03	00	00	40	60	03

COURSE OBJECTIVES

- To learn concepts of geo-environmental engineering, and planning and design of waste in landfills, ash ponds and tailing ponds.
- Explain the effects of pollutants in soil properties
- Awareness about the adverse effects of soil and ground water contaminants
- Analyse and apply the various techniques for remediation of the contaminants

COURSE OUTCOME

- Students can understand Soil-environment interaction, Soil mineralogy and Mechanisms of soil-water interaction
- Students can lean ground water flow and predict contaminant transport phenomenon. Can apply remediation techniques for contaminated site.

Unit – 1

Introduction: Industrialization and Urbanization, Pollution, Control and remediation.

Contamination: Surface contamination, Contamination transport, Soil-a Geotechnical trap, Effect of subsurface contamination, Detection of polluted zone, Monitoring and Effectiveness of designed facilities.

Unit – 2

Contaminants of Solid Waste in Landfills: Waste contaminants, landfills, types, shape and size of landfills. Liner and liner system, Cover and cover system, Stability of landfills. Landfill construction & operation, sustainable waste management.

Unit – 3

Contaminants of Slurry wastes: Slurry transported wastes, slurry ponds, operation, Embankment construction and raising, Design aspects, Environmental Impact and control.

Unit – 4

Vertical Barriers for Contaminant: Contaminated sites, Types of barriers, Soil-Bentonite slurry trench walls, Cement-Bentonite slurry trench walls, construction, material and design aspects.

Unit – 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.

Text Books:

1. Geo-environmental Engineering by Sharma H.D&Reddy K.R
2. Geo-environmental Engineering by ReddiL.N&Inyang.H.I
3. Geo Technical Practice for Waste Disposal by Daniel.D.EWentz, C.A., Hazardous Waste Management, McGraw Hill, Singapore, 1989.
4. Fried, J.J., Ground Water Pollution, Elsevier, 1975.

Reference Books:

1. Geotechnical Geo – Environmental Engineering hand Book – Kerry Row
2. Ground Water Contamination: Bedient, Refai& Newell.
3. Daniel, B.E., Geotechnical Practice for waste disposal, Chapman and Hall, London, 1993.
4. Proceedings of the International symposium of Environmental Geo-technology (Vol.I and II), Environmental Publishing Company, 1986 and 1989.
5. ASTM Special Technical Publication 874, Hydraulic Barrier in Soil and Rock, 1985.

Subject Code	Subject Category	Subject Title	L	T	P	IM	EM	Credits
1851108		Critical Soil Mechanics	03	00	00	40	60	03

COURSE OBJECTIVES

- To demonstrate basic mechanisms behind index properties and tests on soil, relate behaviour of soils subjected to various loading and drainage conditions within unified framework of Critical state soil mechanics.
- To analyse theory of elasticity and plasticity to characterize the stress – strain behaviour of soils and to formulate basic elasto-plastic model based on Critical State Soil Mechanics (CSSM) like Cam-clay

COURSE OUTCOME

- At the completion of the course the students will be able to decide the type of mathematical models to be used for analyzing the behavior of soil mass at critical state

Unit – 1

Soil Behavior: State of Stress and Strain in Soils, Stress and Strain Paths and Invariants, Behavior of Soils under Different Laboratory Experiments

Unit – 2

The Critical State Line and the Roscoe Surface: Families of Undrained Tests, Families of Drained Tests, The Critical State Line, Drained and Undrained Surfaces, The Roscoe Surface

Unit – 3

Behavior of Overconsolidated Samples: The Hvorslev Surface: Behaviour of Overconsolidated Samples, Drained and Undrained Tests, TheHvorslev Surface, Complete State Boundary Surface, Volume Changes and Pore Water Pressure Changes

Unit – 4

Behaviour of Sands: The Critical State Line for Sands, Normalized Plots, The Effect of Dilation, Consequences of Taylor's Model

Unit – 5

Behaviour of Soils before Failure: Elastic and Plastic Deformations, Plasticity Theory, Development of Elastic-Plastic Model Based on Critical State Soil Mechanics, The Cam-Clay Model, The Modified Cam-Clay Model

Text Books:

1. J. H. Atkinson and P. L. Bransby, "The Mechanics of Soils: An Introduction to Critical State Soil Mechanics", Mcgraw Hill, 1978

Reference Books:

1. D. M. Wood, "Soil Behaviour and Critical State Soil Mechanics", Cambridge University Press, 1990
2. B. M. Das, 'Fundamental of Geotechnical Engineering", Cengage Learning, 2013

Subject Code	Subject Category	Subject Title	L	T	P	IM	EM	Credits
1851110		Soil Mechanics – 1 Laboratory	00	00	04	50	50	02

COURSE OBJECTIVES

- To estimate index properties of soils (coarse and fine),
- To estimate consistency limit of fine grained soils,

COURSE OUTCOMES

Upon completion of this course, students will be able to,

- Classify soil by physical observation of the soils,
- Carry out interpolation among the estimated soil design parameters

List of Practicals:

1. Determination of Moisture Content and Specific Gravity of Soil
2. Grain Size Distribution Analysis and Hydrometer Analysis
3. Atterberg Limits (Liquid Limit, Plastic Limit, Shrinkage Limit)
4. Visual Classification Tests
5. Vibration Test for Relative Density of Sand
6. Standard and Modified Proctor Compaction Test
7. Falling Head Permeability Test and Constant Head Permeability Test
8. Consolidation Test

Subject Code	Subject Category	Subject Title	L	T	P	IM	EM	Credits
1851111		Soil Mechanics – 2 Laboratory	00	00	04	50	50	02

COURSE OBJECTIVES

- To estimate shear strength of soils by direct shear test and unconfined compressive test
- To estimate the engineering properties of the soils by density test, CBR, permeability test

COURSE OUTCOMES

Upon completion of this course, students will be able to,

- Classify soil based on estimated engineering characteristics of soils
- Carry out interpolation among the estimated soil design parameters

List of Practicals:

1. Unconfined Compression Test
2. Direct Shear Test
3. Tri-Axial Compression Test – UU, CU, CD Tests
4. Laboratory Vane Shear Test
5. Field Vane Shear Test
6. Field Direct Shear Test

Subject Code	Subject Category	Subject Title	L	T	P	IM	EM	Credits
1851201		Dynamics of Soil and Foundations	03	00	00	40	60	03

COURSE OBJECTIVES

- To study vibration concepts in soils like damping, wave propagation, resonance and effect of modes of vibrations
- To study dynamic soil properties. Determination of dynamic properties by field and laboratory tests
- Effect of liquefaction and antiliquifaction measures
- To study vibration isolation, machine foundation design

COURSE OUTCOME

- Students understand theory of vibration and resonance phenomenon, dynamic amplification.
- Students understand propagation of body waves and surface waves through soil.
- Student exposed to different methods for estimation of dynamic soil properties required for design purpose.
- Students can predict dynamic bearing capacity and assess liquefaction potential of any site.
- Students apply theory of vibrations to design machine foundation based on dynamic soil properties and bearing capacity.

Unit – 1

Fundamentals of Vibration: Definitions, Simple harmonic motion, Response of SDOF systems of Free and Forced vibrations with and without viscous damping, Frequency dependent excitation, Systems under transient loads, Rayleigh's method of fundamental frequency, Logarithmic decrement, Determination of viscous damping, Transmissibility, Systems with Two and Multiple degrees of freedom, Vibration measuring instruments - Types of damping - Equivalent stiffness of springs in series and parallel - Principles of vibration measuring devices

Unit – 2

Wave Propagation and Dynamic Soil Properties: Propagation of seismic waves in soil deposits - Attenuation of stress waves, Stress-strain behaviour of cyclically loaded soils, Strength of cyclically loaded soils, Dynamic soil properties - Laboratory and field testing techniques, Elastic constants of soils, Correlations for shear modulus and damping ratio in sand, gravels, clays and lightly cemented sand. Liquefaction of soils: An introduction and evaluation using simple methods.

Unit – 3

Vibration Analyses: Types, General Requirements, Permissible amplitude, Allowable soil pressure, Modes of vibration of a rigid foundation block, Methods of analysis, Lumped Mass models, elastic half space method, elasto-dynamics, effect of footing shape on vibratory response, dynamic response of embedded block foundation, Vibration isolation.

Unit – 4

Design of Machine Foundations: Analysis and design of block foundations for reciprocating engines, Dynamic analysis and design procedure for a hammer foundation, IS code of practice design procedure for foundations of reciprocating and impact type machines. Vibration isolation and absorption techniques.

Unit – 5

Machine Foundations on Piles: Introduction, Analysis of piles under vertical vibrations, Analysis of piles under translation and rocking, Analysis of piles under torsion, Design procedure for a pile supported machine foundation.

Text Books:

1. Swami Saran - Soil Dynamics and Machine Foundation, Galgotia Publications Pvt. Ltd. (2010)
2. Prakash, S. - Soil Dynamics, McGraw Hill Book Company (1981)

Reference Books:

1. I.Chowdhary and S P Dasgupta - Dynamics of Structures and Foundation, 2009.
2. Prakash, S. and Puri, V. K. - Foundation for Machines: Analysis and Design, John Wiley & Sons, 1998.
3. KameswaraRao, N. S. V. - Vibration Analysis and Foundation Dynamics, Wheeler Publication Ltd., 1998.
4. Das, B. M. - Principles of Soil Dynamics, PWS KENT publishing Company, Boston.2002

Subject Code	Subject Category	Subject Title	L	T	P	IM	EM	Credits
1851202		**Subsurface Investigations and Instrumentation**	**03**	**00**	**00**	**40**	**60**	**03**

COURSE OBJECTIVES

- To identify the soil type of soil from a job site or in a professional setting, determine that soil's properties based on type and evaluate design decisions from your understanding of that soil's properties.
- To explore the scientific principles used to describe the major engineering properties of soil, and the engineering testing methods used to quantify these properties

COURSE OUTCOME

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

Unit – 1

General: Scopes and objectives of explorations – Planning a subsurface exploration – Stages in sub surface exploration – Explorations for preliminary and detailed design – Spacing and depth of exploration

Unit – 2

Open Excavation and Borings of Exploration: Pits and Trenches – Drifts and Shafts – Methods of boring – Auger Borings – Wash Borings –Rotary Drilling –Percussion Drilling – Core Drilling

Unit – 3

Soil Samples and Samplers: Types of soil samples – Disturbed samples –Undisturbed samples – Design features affecting the sample disturbance –Split spoon samplers – Scraper Bucket

Samplers –Shell by Tubes and Thin walled Samplers – Piston Samplers – Denis Samplers – Preservation and handling of samples

Unit – 4

In-Situ Testing: Field tests – Standard Penetration Tests – Cone Penetration Tests – In-situ Vane Shear Test– Plate Load Test, monotonic and cyclic –Field Permeability Tests – In-situ Tests using Pressure meter – Observation of Ground Water Table– Instrumentation in soil engineering, strain gauges, resistance and inductance type

Unit – 5

Geophysical Methods: Types–Electrical Resistivity Methods – Electrical Profiling Method – Electrical Sounding Method – Seismic Methods – Seismic refraction method – Sub-soil Investigation Report

Mechanical Wave Measurements: Crosshole Tests (CHT), Downhole Tests (DHT), Spectral Analysis of Surface Waves, Seismic Refraction, Suspension Logging::Electromagnetic Wave Techniques: Ground Penetrating Radar (GPR), Electromagnetic Conductivity (EM), Surface Resistivity (SR), Magnetometer Surveys (MT)

Text Books:

1. V.N.S. Murthy,Soil Mechanics & Foundation Engineering, Vol. 2, SaiKripa Technical Consultants, Bangalore
2. C. Venkataramaiah, Geotechnical Engineering, Wiley Eastern Ltd., New Delhi

Reference Books:

1. Hvorslev, MJ, Sub Surface Exploration and Sampling of Soils for Civil Engineering Purpose, Water-ways Station, Vicksburg, Mississippi, 1949.
2. Noel Simons, Bruce Menzies and Marcus Matthews, A Short Course in geotechnical Site Investigation, Thomas Telford.
3. SP36- Compendium of Indian Standards on Soil Engineering - Part –II
4. Dobrine,Geophysical methods

Subject Code	Subject Category	Subject Title	L	T	P	IM	EM	Credits
1851203		Offshore Geo-Technical Engineering	03	00	00	40	60	03

COURSE OBJECTIVES

- To analyze distribution of marine sediments along the Indian coasts.
- To analyze geotechnical challenges in case of marine sediments
- To implement in-situ testing procedures for determining the properties of marine clays.
- To analyzebehavior of marine soil deposits under repetitive loading conditions.

COURSE OUTCOME

- Students can execute investigation program for marine soil deposits and select necessary design parameters. Design suitable marine foundation as per project requirement. Can develop numerical model for response of marine foundation for offshore conditions.

Unit – 1

Marine Soil Deposits: Offshore Environment, Offshore Structures and Foundations, Specific Problems Related to Marine Soil Deposits, Physical and Engineering Properties of Marine Soils

Unit – 2

Behavior of Soils Subjected to Repeated Loading: Effect of Wave Loading on Offshore Foundations, Behavior of Sands and Clays Under Cyclic Loading, Laboratory Experiments Including Repeated Loading, Cyclic Behavior of Soils Based on Fundamental Theory of Mechanics, Approximate Engineering Methods which can be used for Practical Cases

Unit – 3

Site Investigation in the Case of Marine Soil Deposits: Challenges of Site Investigation in Marine Environment, Different Site Investigation Techniques, Sampling Techniques, Geophysical Methods, Recent Advancements in Site Investigation and Sampling used for Marine Soil Deposits

Unit – 4

Foundations in Marine Soil Deposits: Different Offshore and Nearshore Foundations, Gravity Platforms, Jack-Up Rigs, Pile Foundations. Cassions, Spudcans

Unit – 5

Numerical Modeling of Marine Foundations Subjected to Wave Loading: Numerical Modeling of Cyclic Behavior of Soils, Empirical Models, Elastic-Plastic Models, Fem Analysis of Marine Foundations Subjected to Wave Loading

Textbooks

1. H. G. Poulos. "Marine Geotechnics", Unwin Hyman Ltd, London, UK, 1988

Reference Books

1. D. V. Reddy And M. Arockiasamy, "Offshore Structures", Volume: 1, R.E. Kreiger Pub And Co., 1991
2. D. Thomson And D. J. Beasley, "Handbook of Marine Geotechnical Engineering", US Navy, 2012

Subject Code	Subject Category	Subject Title	L	T	P	IM	EM	Credits
1851204		Computational Geo-Mechanics	03	00	00	40	60	03

COURSE OBJECTIVES

- To analyse linear and non-linear equations using numerical techniques.
- To apply finite difference and finite element method for analysing behaviour of geotechnical structures.
- To apply correlation and regression analysis for the geotechnical data.
- To solve problem of consolidation and flow through porous media using numerical technique.

COURSE OUTCOME

- Students can understand different numerical and statistical tools for analyzing various geotechnical engineering problems.
- Students can apply probabilistic approach for selection of design parameters and compute their impact on risk assessment

Unit – 1

Solution of Non-Linear Equations: Bisection, False Position, Newton-Raphson, Successive Approximation Method, Iterative Methods

Solution of Linear Equations: Jacobi's Method, Gauss Seidal Method, Successive over Relaxation Method.

Unit – 2

Finite Difference Method: Two Point Boundary Value Problems – Disichlet Conditions, Neumann Conditions; Ordinary and Partial Differential Equations.

Finite Element Method: Fundamentals, Constitutive Finite Element Models for Soils.

Unit – 3

Correlation and Regression Analysis: Correlation - Scatter Diagram, Karl Pearson Coefficient of Correlation, Limits of Correlation Coefficient; Regression –Lines of Regression, Regression Curves, Regression Coefficient, Differences Between Correlation and Regression Analysis.

Unit – 4

One-Dimensional Consolidation - Theory of Consolidation, Analytical Procedures, Finite Difference Solution Procedure for Multilayered Systems, Finite Element Formulation

Unit – 5

Flow through Porous Media - Geotechnical Aspects, Numerical Methods, Applications and Design Analysis, Flow in Jointed Media.

Risk Assessment in Geotechnical Engg. - Probabilistic Site Characterisation and Design of Foundations

Textbooks

1. S. Chandrakant., Desai and John T. Christian, "Numerical Methods in Geotechnical Engineering", Mc. Graw Hill Book Company, 1977.
2. M.K. Jain, S.R.K. Iyengar and R.K. Jain, "Numerical Methods for Scientific and Engineering Computations", Third Edition, New Age International (P) Ltd. Publishers, New Delhi.

Reference Books

1. D.J. Naylor and G.N. Pande, "Finite Elements in Geotechnical Engineering", Pineridge Press Ltd., UK.
2. Sam Helwany, "Applied Soil Mechanics", John Wiley & Sons, Inc,

Subject Code	Subject Category	Subject Title	L	T	P	IM	EM	Credits
1851205		Engineering Rock Mechanics	03	00	00	40	60	03

COURSE OBJECTIVES

- To identify type of the rock, analyse the rock quality designation and also evaluate its strength, and to determine the methods of tunnelling and mining

COURSE OUTCOME

- The students will be able to perform various laboratory tests on rock and classify rock mass. Be able to predict strength of rock mass with respect to various Civil Engineering applications

Unit – 1

Rock: Formation of Rocks, Physical Properties, Classification of Rocks and Rock Masses, Elastic Constants of Rock; In-situ Stresses in Rock

Rock Testing: Laboratory and Field Tests

Unit – 2

Discontinuities in Rock Masses: Discontinuity Orientation, Effect of Discontinuities on Strength of Rock

Unit – 3

Strength Behaviour: Compression, Tension and Shear, Stress-Strain Relationships, Rheological Behavior

Unit – 4

Strength/ Failure Criterion: Mohr-Coulomb, Griffith Theory, Hoek and Brown, Strength and other Strength Criteria. Stresses in Rock near Underground Openings;

Unit – 5

Application of Rock Mechanics in Civil Engineering: Rock Tunneling, Rock Slope Stability, Bolting, Blasting, Grouting and Rock Foundation Design. Modern Modelling Techniques & Analyses in Rocks.

Textbooks

1. Hudson J.A. and J.P. Harrison. Engineering Rock Mechanics: An Introduction to the Principles, 1997. Elsevier, Oxford
2. Goodman, R.E. Introduction to Rock Mechanics, John Wiley & Sons.
3. Ramamurthy, T., "Engineering in Rocks", Phi Learning Pvt. Ltd.

Reference Books

1. Jaeger, J.C. and Cook, N.G.W, Fundamentals of Rock Mechanics, Chapman and Hall, 1976.
2. Wyllie, D.C., Foundations on Rock, E &FnSpon. 2nd Edition, 1992.

Subject Code	Subject Category	Subject Title	L	T	P	IM	EM	Credits
1851206		Earth Retaining Structures	03	00	00	40	60	03

COURSE OBJECTIVES

- To calculate earth pressure on various earth retaining structures such as gravity retaining walls, sheet pile, bulkheads, bracing/struts and coffer dams, design a relevant earth retaining structure for given soil condition, design of sheet pile with and without anchors, and to design the reinforced wall by using different materials

COURSE OUTCOME

- The students will be able to do analysis and design of different types of retaining structures

Unit – 1

Earth Pressure Theories: Introduction – State of stress in retained soil mass – Earth pressure theories – Analytical and graphical techniques – Active and passive cases – Earth pressure due to homogeneous and layered backfills, uniform surcharge,uniformly sloping surcharge and randomly positioned surcharges, - Empirical methods – Wall movement and complex geometry

Unit – 2

Drainage and Stability Considerations: Lateral pressure due to compaction, strain softening, wall flexibility – influence of drainage – Earth pressure due to earthquake forces – Stability of retaining structures

Unit – 3

Sheet Pile Walls: Retaining structure – Selection of soil parameters – Analysis and design of cantilever and anchored sheet pile walls – Deadman and continuous anchors – Diaphragm and bored pile walls – Design requirements

Caissons: Types – Stability of caissons – principles of analysis and design – seismic influences - IRC Guidelines

Unit – 4

Supported Excavations: Lateral pressure on sheeting in braced excavation, stability against piping and bottom heaving - Earth pressure around tunnel lining, shaft and silos

Unit – 5

Design of Reinforced Earth Retaining Wall: Reinforced earth retaining wall – principles, Concepts and mechanism of reinforced Earth – Design consideration of reinforced earth – Materials used in reinforced earth - Geotextile – Geo-grids, Metal strips, facing elements.

Text Books:

1. Koerner, R.M., Design with Geosynthetics (Third Edition), Prentice Hall, 1997.
2. Das, B.M., Principles of Geotechnical Engineering (Fourth Edition). The PWS series in Civil Engineering, 1998
3. Mandal, J.N., Reinforced Soil and Geo-textiles, Oxford &IBH Publishing Co. Pvt. Ltd., New Delhi.
4. J E Bowles, Foundation Engineering to add this text book

Reference Books:

1. Winterkorn, H.F. and Fang, Y.F., Foundation Engineering Handbook, Van Nostrand Reinhold, 1994.
2. Day, R.W., Geotechnical and Foundation Engineering, Design and Construction, McGraw Hill 1999.
3. McCarthy, D.F., Essentials of Soil Mechanics and Foundations: Basic Geo-techniques (Sixth Edition), Prentice Hall, 2002.
4. Militisky, J. and Woods, R., Earth and Earth retaining structures, Routledge, 1992.

Subject Code	Subject Category	Subject Title	L	T	P	IM	EM	Credits
1851207		Design of Underground Excavations	03	00	00	40	60	03

COURSE OBJECTIVES

- To know the planning and exploration of various underground projects, analyse the stress distribution, analyse the rock quality designation and also evaluate its strength
- To analyse the interaction between the rock mass and tunnel surface

COURSE OUTCOME

- Students can understand the use of elastic and plastic analysis in the design of underground support system.
- Students will have idea about the field tests generally conducted during and after construction of under structures.

Unit – 1

Introduction, Planning and Exploration for Various Underground Construction Projects, Stereographic Projection Method, Principle and its Application in Underground Excavation Design.

Unit – 2

Elastic Stress Distribution around Tunnels, Stress Distribution for Different Shapes and Under Different In-Situ Stress Conditions, Greenspan Method, Design Principles, Multiple Openings, Openings in Laminated Rocks, Elasto-Plastic Analysis of Tunnels, Daemen's Theory

Unit – 3

Application of Rock Mass Classification Systems, Ground Conditions in Tunneling, Analysis of Underground Openings in Squeezing and Swelling Ground, Empirical Methods, Estimation of Elastic Modulus and Modulus of Deformation of Rocks; Uniaxial Jacking / Plate Jacking Tests, Radial Jacking and Goodman Jacking Tests, Long Term Behaviour of Tunnels and Caverns, New Austrian Tunneling Method (Natm), Norwegian Tunneling Method (Ntm), Construction Dewatering.

Unit – 4

Rock Mass-Tunnel Support Interaction Analysis, Ground Response and Support Reaction Curves, Ladanyi'selasto-Plastic Analysis of Tunnels, Design of Various Support Systems Including Concrete and Shotcrete Linings, Steel Sets, Rock Bolting and Rock Anchoring, Combined Support Systems, Estimation of Load Carrying Capacity of Rock Bolts

Unit – 5

In-Situ Stress, Flat Jack, Hydraulic Fracturing and Over Coring Techniques and USBM type Drill Hole Deformation Gauge, Single and Multi-Point Bore Hole Extensometers, Load Cells, Pressure Cells, etc. Instrumentation and Monitoring of Underground Excavations, During and After Construction, Various Case Studies

Text Books:

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

Reference Books:

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

Subject Code	Subject Category	Subject Title	L	T	P	IM	EM	Credits
1851208		Physical and Constitutive Modeling on Geo-Mechanics	03	00	00	40	60	03

COURSE OBJECTIVES

- To understand the concept of linear, quasi linear concept, basics of plasticity in soils,
- To analyse theory of elasticity and plasticity to characterize the stress – strain behaviour of soils and to formulate basic elasto-plastic model based on Critical State Soil Mechanics (CSSM) like Cam-clay
- To understand the concept of consolidation, formulation and implementation of plasticity theory.

COURSE OUTCOME

- Students can understand theory of plasticity and various yield criteria and flow rule.
- Students can apply critical state concept to consolidation and triaxial soil behavior.

Unit – 1

Role of Constitutive Modeling; Importance of Laboratory Testing with Relation to Constitutive Modeling; Elasticity: Linear, Quasi Linear, Anisotropic;

Unit – 2

Plasticity Basics: Yield Criteria, Flow Rule, Plastic Potential, Hardening/Softening; Rate Independent Plasticity: Mohr-Coulomb, Nonlinear Failure Criteria, DruckerPrager, and Cap Models;

Unit – 3

Critical State Soil Mechanics: Critical State Concept, Cam Clay Models, Simulation of Single Element Test Using Cam Clay,

Unit – 4

Consolidation, Drained and UndrainedTriaxial Test; Stress Dilatancy Theory;

Unit – 5

Work Hardening Plasticity Theory: Formulation and Implementation; Applications of Elasto-Plastic Models; Special Topics: Hypoelasticity-Plasticity, Disturbed State Concept.

Text Books:

1. Hicherand Shao, "Constitutive Modelingof Soils and Rocks", John Wiley. 2008
2. C.S. Desai and H. J. Siriwardane, "Constitutive Laws for Engineering Materials with Emphasis on Geologic Materials", Prentice-Hall, Inc., New Jersey. 1984
3. David M Potts and Lidijazdravkovic, "Finite Element Analysis in Geotechnical Engineering Theory and Application", Thomas Telford. 1999

Reference Books:

1. C.S. Desai, "Mechanics of Materials and Interfaces: The Disturbed State Concept", CRC Press Ltd. 2000
2. A.P.S. Selvadurai, M.J. Boulon, "Mechanics of Geomaterial Interfaces, Elsevier.

Subject Code	Subject Category	Subject Title	L	T	P	IM	EM	Credits
1851210		Sub Soil Exploration Laboratory	00	00	04	50	50	02

COURSE OBJECTIVES

- To estimate the load carrying capacity and soil profile

COURSE OUTCOMES

Upon completion of this course, students will be able to,

- Classify soil based on the collection of soil by borings
- Design the suitable foundation based upon the load carrying capacity of the soil
- Carry out interpolation among the estimated soil design parameters

List of Practicals:

1. Exploratory Borings by Different Methods Including Auger Boring, Wash Boring, Percussion Drilling and Rotary Drilling.
2. Standard Penetration Test
3. Dynamic Cone Penetration Test
4. Static Cone Penetration Test
5. Plate Load Test
6. Pressure Meter Test
7. Geophysical Exploration Tests

Subject Code	Subject Category	Subject Title	L	T	P	IM	EM	Credits
1851211		Geo-Technical Engineering Modeling Laboratory	00	00	04	50	50	02

COURSE OBJECTIVES

- To estimate the safe slope, load carrying capacity

COURSE OUTCOMES

Upon completion of this course, students will be able to,

- Design suitable slope, pile for both static and dynamic conditions

List of Practicals:

1. Slope Modeling
2. Sigma modelling
3. Quake modelling
4. Analysis of slope by Fellenius, Bishop and Janbu method
5. Boussinesq analysis for displacement due to loads
6. Mindlin analysis for displacement due to loads
7. Analysis of pile (capacity, end bearing, bearing capacity and settlement)
8. Analysis of one-dimensional soil column to an earthquake motion

Software:

1. GeoStudio
2. Oasys – Geo Suite

Subject Code	Subject Category	Subject Title	L	T	P	IM	EM	Credits
1851301		Stability Analysis of Slopes	03	00	00	40	60	03

COURSE OBJECTIVES

- To introduce the concepts of slope stability, introduce the concepts of slope stability analyses using simplified methods, and to describe some of the sophisticated methods of slope stability analyses.

COURSE OUTCOME

- Student will be able to check the stability of earthen dams, and the safety measures to be undertaken to prevent the instability of slopes, earthen dams and embankments

Unit – 1

Slopes: Types and Causes of Slope Failures, Mechanics of Slope Failure, Failure Modes.

Unit – 2

Stability Analysis: Infinite and Finite Slopes with or Without Water Pressures; Concept of Factor of Safety, Pore Pressure Coefficients, Mass Analysis, Wedge Methods, Friction Circle Method; Method of Slices, Bishop's Method, Janbu's Method, Morgenstern And Price, Spencer's Method

Unit – 3

Stability Analysis in the Presence of Seepage: Two Dimensional Flow – Laplace Equation and it's Solution, Graphical Method, Determination of Phreatic Line, Flow Nets in Homogeneous and Zoned Earth Dams under Steady Seepage and Draw-Down Conditions, Seepage Control in Earth Dams, Influence of Seepage on Slope Stability Stability Analysis of Dam Body During Steady Seepage

Unit – 4

Strengthening Measures: Stabilization of Slopes by Drainage Methods, Surface and Subsurface Drainage, Use of Synthetic Filters, Retaining Walls, Stabilization and Strengthening of Slopes, Shotcreting, Rock Bolting and Rock Anchoring, Instrumentation and Monitoring of Slopes, Slope Movements, Warning Devices, Maintenance of Slopes

Unit – 5

Case studies of urban slope stability: Aims, Regional perspective, Landslide inventory, Stability analyses of three sites, Case study 1 – Site 64 in the suburb of Scarborough, Case study 2 – Site 77, Morrison Avenue – Wombarra, Case study 3 – Site 134, Woonona Heights, Concluding remarks on the three case studies, Landslide-triggering rainfall, Landslide susceptibility and hazard, Observational approach and monitoring.

Text Books:

1. Chowdhary R Phil Flentje and Bhattacharya G, "Geotechnical Slope Analysis", CRC Press.
2. YM Cheng and CK lau, "Slope Stability Analysis and Stabilization", CRC Press.

Reference Books:

1. Harr M.E., "Ground Water and Seepage", McGraw Hill. 1962

Subject Code	Subject Category	Subject Title	L	T	P	IM	EM	Credits
1851302		Foundation on Weak Rocks	03	00	00	40	60	03

COURSE OBJECTIVES

- To study the properties of weak rock and classification, analyse the effect of structural planes, study the requirements of satisfactory performance of foundation and analyse the pile on weak rock

COURSE OUTCOME

- The students will be able to classify different types of rock mass and design different types of foundations placed over rock mass.

Unit – 1

Engineering Properties of Weak Rocks, Different Rock Mass Classification Systems, Relative Merits and Demerits, Failure Criteria for Weak Rocks, Bi-Linear Mohr-Coulomb Failure Criterion, Hoek and Brown Criterion and Modified Hoek and Brown Failure Criterion Etc.

Unit – 2

Effect of Structural Planes on Rock Foundations, Possible Modes of Failure of Foundations on Rocks/ Rock Masses, Determination of In-Situ Shear Strength of Rocks and Rock Masses

Unit – 3

Requirements for Satisfactory Performance of Foundations, Bearing Capacity of Foundations on Rocks and Rock Masses, Allowable Bearing Pressure of Rock Foundations Using a Nonlinear Failure Criterion, Monotonic and Cyclic Plate Load Tests, Pressure-Settlement Characteristics, Effect of Layering, Anisotropy, Heterogeneity and Inelasticity

Unit – 4

Shallow Foundations, Shallow Foundations on Sloping Ground, Raft Foundations, Stilt Foundations, Foundations for Suspension Bridges, Transmission Line Towers, Framed Buildings etc, Treatment of Foundations - Open Joints, Solution Cavities, Weak Seams

Unit – 5

Piles in Weak Rocks, Bearing Capacity and Settlement of Piles, Piles in Stratified Rock Masses, Field Load Tests on Piles in Weak Rocks, Behaviour of Bored / Driven Piles in Soft / Weathered Rocks

Text Books:

1. Singh, B. and Goel, R.K., "Rock Mass Classification- A Practical Engineering Approach", Elsevier.
2. Ramamurthy, T., "Engineering In Rocks", PHI Learning Pvt. Ltd.
3. Hoek, E., "Practical Rock Engineering", Rock Science.

Reference Books:

1. Wyllie Duncan C.," Foundations on Rock: Engineering Practice", E&FnSpon, Taylor And Francis.
2. Hudson J.A. and J.P. Harrison. Engineering Rock Mechanics: An Introduction tothe Principles, 1997. Elsevier, Oxford

Subject Code	Subject Category	Subject Title	L	T	P	IM	EM	Credits
1851303		Geo-Technical Earthquake Engineering	03	00	00	40	60	03

COURSE OBJECTIVES

- To determine size of earthquake and strong ground motion parameters from a recorded seismogram or accelerogram.
- To analyse deterministic or probabilistic seismic hazard analysis considering the different soil properties and site conditions
- To study principles of wave propagation through rocks and soil media to derive transfer functions for ground response analysis.
- To analyze liquefaction susceptibility of a site and determine factor of safety against liquefaction.
- To design earthquake resistant geotechnical structures like shallow and deep foundations, retaining walls, slopes

COURSE OUTCOME

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

Unit – 1

Elements of Earthquake Seismology and Dynamics: Theory of vibration - Basic Definition - Governing equation for single degree freedom system - Forced vibrations - Rotating mass type excitation - Base excitation - Isolation vibration measuring instruments. Mechanism of Earthquakes - Causes of earthquake - Earthquake Fault sources - Elastic Rebound theory - Seismic wave in Earthquake shaking - Definition of earthquake terms - Locating an earthquake - Quantification of earthquakes.

Unit – 2

Ground Motion Characteristics: Strong Motion Records -characteristics of ground motion - Factors influencing ground motion - Estimation of frequency content parameters - (Seismic site investigations - Evaluation of Dynamic soil properties

Unit – 3

Ground Response Analysis - Local Site Effects and Design Ground Motion: Wave propagation Analysis - Site Amplification Need for Ground Response Analysis - Method of analysis - One Dimensional Analysis - Equipment linear Analysis site effects - Design Ground Motion - Developing Design Ground Motion

Unit – 4

Seismic Stability Analysis: Earthquake - Resistant Design of foundation of buildings - Design considerations - Geotechnical - Architectural - Structures - Capacity Design - Seismic analysis. Earthquake Response of slopes - Evaluation of slope stability - Pseudostatic Analysis - Newmark's Study of Block Analysis - Dynamic Analysis - Earth pressure due to ground shaking Evaluation, Liquefaction-Susceptibility-Evaluation Cyclic stress approach - Liquefaction Resistance - Laboratory and Field Tests with interpretation - Lateral Deformation - Case Study

Unit - 5

Earthquake Hazard Mitigation: Seismic risk vulnerability and hazard - Percept of risk - risk mapping - scale - hazard assessment - Maintenance and modifications to improve hazard resistance - Different type of foundation and its impact on safety - Ground Improvement Techniques.

Text Books:

1. KameswaraRao, N.S.V., Dynamics soil tests and applications, Wheeler Publishing - New Delhi, 2000.
2. KrammerS.L., Geotechnical Earthquake Engineering, Prentice Hall, International Series, Pearson Education (Singapore) Pvt. Ltd., 2004.
3. KameswaraRao, Vibration Analysis and Foundation Dynamics, Wheeler Publishing, New Delhi, 1998.

Reference Books:

1. ShamsherPrakash and Vijay Kumar Puri., Foundations for Machines, John Wiley and Sons, New Delhi, 1988
2. "Earth Quake" W.H. Freeman, New York.

OPEN ELECTIVES

Subject Code	Subject Category	Subject Title	L	T	P	IM	EM	Credits
1851304		Business Analytics	03	00	00	40	60	03

COURSE OBJECTIVES

- Understand the role of business analytics within anorganization.
- Analyze data using statistical and data mining techniques and understand relationships between the underlying business processes of anorganization.
- To gain an understanding of how managers use business analytics to formulate and solve business problems and to support managerial decisionmaking.
- To become familiar with processes needed to develop, report, and analyze businessdata. Use decision-making tools/Operations researchtechniques.Mange business process using analytical and managementtools.
- Analyze and solve problems from different industries such as manufacturing, service, retail, software, banking and finance, sports, pharmaceutical, aerospaceetc.

COURSE OUTCOME

- Students will demonstrate knowledge of dataanalytics.
- Students will demonstrate the ability of think critically in making decisions based on data and deepanalytics.
- Students will demonstrate the ability to use technical skills in predicative and prescriptive modeling to support businessdecision-making.
- Students will demonstrate the ability to translate data into clear, actionableinsights.

Unit – 1

Business analytics: Overview of Business analytics, Scope of Business analytics, Business Analytics Process, Relationship of Business Analytics Process and organisation, competitive advantages of Business Analytics. Statistical Tools: Statistical Notation, Descriptive Statistical methods, Review of probability distribution and data modeling, sampling and estimation methods overview.

Unit – 2

Trendiness and Regression Analysis: Modeling Relationships and Trends in Data, simple Linear Regression.Important Resources, Business Analytics Personnel, Data and models for Business analytics, problem solving, Visualizing and Exploring Data, Business Analytics Technology.

Unit – 3

Organization Structures of Business analytics, Team management, Management Issues, Designing Information Policy, Outsourcing, Ensuring Data Quality, Measuring contribution of Business analytics, Managing Changes.Descriptive Analytics, predictive analytics, predicative Modelling, Predictive analytics analysis, Data Mining, Data Mining Methodologies, Prescriptive analytics and its step in the business analytics Process, Prescriptive Modelling, nonlinear Optimization.

Unit – 4

Forecasting Techniques: Qualitative and Judgmental Forecasting, Statistical Forecasting Models, Forecasting Models for Stationary Time Series, Forecasting Models for Time Series with a Linear Trend, Forecasting Time Series with Seasonality, Regression Forecasting with Casual Variables, Selecting Appropriate Forecasting Models.Monte Carlo Simulation and Risk Analysis: Monte Carle Simulation Using Analytic Solver Platform, New-Product Development Model, Newsvendor Model, Overbooking Model, Cash Budget Model.

Unit – 5
Decision Analysis: Formulating Decision Problems, Decision Strategies with the without Outcome Probabilities, Decision Trees, The Value of Information, Utility and Decision Making. Recent Trends in: Embedded and collaborative business intelligence, Visual data recovery, Data Storytelling and Data journalism.

Reference Books:

1. Business analytics Principles, Concepts, and Applications by Marc J. Schniederjans, Dara G. Schniederjans, Christopher M. Starkey, Pearson FTPress.
2. Business Analytics by James Evans, personsEducation.

Subject Code	Subject Category	Subject Title	L	T	P	IM	EM	Credits
1851305		**Industrial Safety**	**03**	**00**	**00**	**40**	**60**	**03**

Unit – 1
Industrial safety: Accident, causes, types, results and control, mechanical and electrical hazards, types, causes and preventive steps/procedure, describe salient points of factories act 1948 for health and safety, wash rooms, drinking water layouts, light, cleanliness, fire, guarding, pressure vessels, etc, Safety color codes. Fire prevention and firefighting, equipment andmethods.

Unit – 2
Fundamentals of maintenance engineering: Definition and aim of maintenance engineering, Primary and secondary functions and responsibility of maintenance department, Types of maintenance, Types and applications of tools used for maintenance, Maintenance cost & its relation with replacement economy, Service life of equipment.

Unit – 3
Wear and Corrosion and their prevention: Wear- types, causes, effects, wear reduction methods, lubricants-types and applications, Lubrication methods, general sketch, working and applications, i. Screw down grease cup, ii. Pressure grease gun, iii. Splash lubrication, iv. Gravity lubrication, v. Wick feed lubrication vi. Side feed lubrication, vii. Ring lubrication, Definition, principle and factors affecting the corrosion. Types of corrosion, corrosion prevention methods

Unit – 4
Fault tracing: Fault tracing-concept and importance, decision treeconcept, need and applications, sequence of fault finding activities, show as decision tree, draw decision tree for problems in machine tools, hydraulic, pneumatic,automotive, thermal and electrical equipment's like, I. Any one machine tool, ii. Pump iii. Air compressor, iv. Internalcombustion engine, v. Boiler,Electrical motors, Types of faults in machine tools and their generalcauses

Unit – 5
Periodic and preventive maintenance: Periodic inspection-concept and need, degreasing, cleaning and repairing schemes, overhauling of mechanical components, overhauling of electrical motor, common troubles and remedies of electric motor, repair complexities and its use, definition, need, steps and advantages of preventive maintenance. Steps/procedure for periodic and preventive maintenance of: i. Machine tools, ii. Pumps, iii.Air compressors, iv. Diesel generating (DG)sets, Program and schedule of preventive maintenance of mechanical and electrical equipment, advantages of preventive maintenance. Repair cycle concept andimportance

Reference Books:

1. Maintenance Engineering Handbook, Higgins & Morrow, Da InformationServices.
2. Maintenance Engineering, H. P. Garg, S. Chand andCompany.
3. Pump-hydraulic Compressors, Audels, Mcgrew HillPublication.
4. Foundation Engineering Handbook, Winterkorn, Hans, Chapman & HallLondon.

Subject Code	Subject Category	Subject Title	L	T	P	IM	EM	Credits
1851306		Operation Research	03	00	00	40	60	03

COURSE OUTCOME: At the end of the course, the student should be able to

- Students should able to apply the dynamic programming to solve problems of discreet and continuous variables.
- Students should able to apply the concept of non-linearprogramming
- Students should able to carry out sensitivityanalysis
- Student should able to model the real world problem and simulateit.

Unit – 1

Optimization Techniques, Model Formulation, models, General L.R Formulation, Simplex Techniques, Sensitivity Analysis, Inventory Control Models

Unit – 2

Formulation of a LPP - Graphical solution revised simplex method - duality theory - dual simplex method - sensitivity analysis - parametric programming

Unit – 3

Nonlinear programming problem - Kuhn-Tucker conditions min cost flow problem - max flow problem - CPM/PERT

Unit – 4

Scheduling and sequencing - single server and multiple server models - deterministic inventory models - Probabilistic inventory control models - Geometric Programming.

Unit – 5

Competitive Models,Single and Multi-channel Problems, Sequencing Models, Dynamic Programming, Flow in Networks, Elementary Graph Theory, Game Theory Simulation

Reference Books:

1. H.A. Taha, Operations Research, An Introduction, PHI,2008
2. H.M. Wagner, Principles of Operations Research, PHI, Delhi,1982.
3. J.C. Pant, Introduction to Optimisation: Operations Research, Jain Brothers, Delhi,2008
4. Hitler Libermann Operations Research: McGraw Hill Pub.2009
5. Pannerselvam, Operations Research: Prentice Hall of India2010
6. Harvey M Wagner, Principles of Operations Research: Prentice Hall of India2010

Subject Code	Subject Category	Subject Title	L	T	P	IM	EM	Credits
1851307		Cost Management of Engineering Projects	03	00	00	40	60	03

Unit-1

Introduction and Overview of the Strategic Cost Management ProcessCost concepts in decision-making; Relevant cost, Differential cost, Incremental cost and Opportunity cost.Objectives of a Costing System; Inventory valuation; Creation of a Database for operational control; Provision of data for Decision-Making.

Unit-2
Project: meaning, Different types, why to manage, cost overruns centres, various stages of project execution: conception to commissioning. Project execution as conglomeration of technical and non- technical activities.Detailed Engineering activities. Pre project execution main clearances and documents Project team: Role of each member. Importance Project site: Data required with significance. Project contracts.Types and contents. Project execution Project cost control. Bar charts and Network diagram. Project commissioning: mechanical and process

Unit-3
Cost Behavior and Profit Planning Marginal Costing; Distinction between Marginal Costing and Absorption Costing; Break-even Analysis, Cost-Volume-Profit Analysis. Various decision-making problems.Standard Costing and Variance Analysis. Pricing strategies: Pareto Analysis. Target costing, Life Cycle Costing. Costing of service sector.

Unit-4
Just-in-time approach, Material Requirement Planning, Enterprise Resource Planning, Total Quality Management and Theory of constraints.Activity-Based Cost Management, Bench Marking; Balanced Score Card and Value-Chain Analysis.Budgetary Control; Flexible Budgets; Performance budgets; Zero-based budgets.Measurement of Divisional profitability pricing decisions including transfer pricing.

Unit-5
Quantitative techniques for cost management, Linear Programming, PERT/CPM, Transportation problems, Assignment problems, Simulation, Learning Curve Theory.

References:

1. Cost Accounting a Managerial Emphasis, Prentice Hall of India, NewDelhi
2. Charles T. Horngren and George Foster, Advanced ManagementAccounting
3. Robert S Kaplan Anthony A. Alkinson, Management & CostAccounting
4. AshishK. Bhattacharya, Principles & Practices of Cost Accounting A. H. Wheelerpublisher
5. N.D. Vohra, Quantitative Techniques in Management, Tata McGraw Hill Book Co.Ltd.

Subject Code	Subject Category	Subject Title	L	T	P	IM	EM	Credits
1851308		**Composite Materials**	**03**	**00**	**00**	**40**	**60**	**03**

Unit – 1
INTRODUCTION: Definition – Classification and characteristics of Composite materials. Advantages and application of composites.Functional requirements of reinforcement and matrix.Effect of reinforcement (size, shape, distribution, volume fraction) on overall composite performance.

Unit – 2
REINFORCEMENTS: Preparation-layup, curing, properties and applications of glass fibers, carbon fibers, Kevlar fibers and Boron fibers. Properties and applications of whiskers, particle

reinforcements. Mechanical Behavior of composites: Rule of mixtures, Inverse rule of mixtures. Isostrain and Isostress conditions.

Unit – 3

Manufacturing of Metal Matrix Composites: Casting – Solid State diffusion technique, Cladding – Hot isostaticpressing.Properties and applications. Manufacturing of Ceramic Matrix Composites: Liquid Metal Infiltration – Liquid phase sintering. Manufacturing of Carbon – Carbon composites: Knitting, Braiding, Weaving. Properties and applications.

Unit – 4

Manufacturing of Polymer Matrix Composites: Preparation of Moulding compounds and prepregs – hand layup method – Autoclave method – Filament winding method – Compression moulding – Reaction injection moulding. Properties and applications.

Unit – 5

Strength: Laminar Failure Criteria-strength ratio, maximum stress criteria, maximum strain criteria, interacting failure criteria, hygrothermal failure. Laminate first play failure-insight strength; Laminate strength-ply discount truncated maximum strain criterion; strength design using caplet plots; stress concentrations.

Text Books:

1. Material Science and Technology – Vol 13 – Composites by R.W.Cahn – VCH, West Germany.
2. Materials Science and Engineering, An introduction. WD Callister, Jr., Adapted by R. Balasubramaniam, John Wiley & Sons, NY, Indian edition,2007.

Reference Books:

1. Hand Book of CompositeMaterials-ed-Lubin.
2. Composite Materials – K.K.Chawla.
3. Composite Materials Science and Applications – Deborah D.L.Chung.
4. Composite Materials Design and Applications – Danial Gay, Suong V. Hoa, and Stephen W. Tasi.

Subject Code	Subject Category	Subject Title	L	T	P	IM	EM	Credits
1851309		**Waste to Energy**	**03**	**00**	**00**	**40**	**60**	**03**

Unit – 1

Introduction to Energy from Waste: Classification of waste as fuel – Agro based, Forest residue, Industrial waste - MSW – Conversion devices – Incinerators, gasifiers, digestors

Unit – 2

Biomass Pyrolysis: Pyrolysis – Types, slow fast – Manufacture of charcoal – Methods - Yields and application – Manufacture of pyrolytic oils and gases, yields and applications.

Unit – 3

Biomass Gasification: Gasifiers – Fixed bed system – Downdraft and updraft gasifiers – Fluidized bed gasifiers – Design, construction and operation – Gasifier burner arrangement for thermal heating – Gasifier engine arrangement and electrical power – Equilibrium and kinetic consideration in gasifier operation.

Unit – 4
Biomass Combustion: Biomass stoves – Improved chullahs, types, some exoticdesigns, Fixed bed combustors, Types, inclined grate combustors, Fluidized bed combustors, Design, construction and operation - Operation of all the above biomass combustors.

Unit – 5
Biogas: Properties of biogas (Calorific value and composition) - Biogas plant technology and status - Bio energy system - Design and constructional features - Biomass resources and their classification - Biomass conversion processes - Thermo chemical conversion - Direct combustion - biomass gasification - pyrolysis and liquefaction - biochemical conversion - anaerobic digestion -Types of biogas Plants – Applications - Alcohol production from biomass - Bio diesel production - Urban waste to energy conversion - Biomass energy programme inIndia.

Reference Books:

1. Non Conventional Energy, Desai, Ashok V., Wiley Eastern Ltd.,1990.
2. Biogas Technology - A Practical Hand Book - Khandelwal, K. C. and Mahdi, S. S., Vol. I & II, Tata McGraw Hill Publishing Co. Ltd.,1983.
3. Food, Feed and Fuel from Biomass, Challal, D. S., IBH Publishing Co. Pvt. Ltd.,1991.
4. Biomass Conversion and Technology, C. Y. WereKo-Brobby and E. B. Hagan, John Wiley & Sons,1996

Subject Code	Subject Category	Subject Title	L	T	P	IM	EM	Credits
1851109		**Research Methodology and IPR**	**02**	**00**	**00**	**40**	**60**	**02**

Course Outcomes: At the end of this course, students will be able to

- Understand research problemformulation.
- Analyze research relatedinformation, Follow researchethics
- Understand that today's world is controlled by Computer, Information Technology, but tomorrow world will be ruled by ideas, concept, andcreativity.
- Understanding that when IPR would take such important place in growth of individuals & nation, it is needless to emphasis the need of information about Intellectual Property Right to be promoted among students in general & engineering inparticular.
- Understand that IPR protection provides an incentive to inventors for further researchworkand investment in R & D, which leads to creation of new and better products, and in turn brings about, economic growth and social benefits

Unit – 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

Unit – 2
Effective literature studies approaches, analysis Plagiarism, Research ethics,

Unit – 3
Effective technical writing, how to write report, PaperDeveloping a Research Proposal, Format of research proposal, a presentation and assessment by a review committee

Unit – 4

Nature of Intellectual Property: Patents, Designs, Trade 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.

Unit – 5

Patent Rights: Scope of Patent Rights. Licensing and transfer of technology.Patent information and databases.Geographical Indications.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.

Reference Books:

- Stuart Melville and Wayne Goddard, "Research methodology: an introduction for science & engineeringstudents"'
- Wayne Goddard and Stuart Melville, "Research Methodology: AnIntroduction"
- RanjitKumar, 2nd Edition, "Research Methodology: A Step by Step Guide forbeginners"
- Halbert, "Resisting Intellectual Property", Taylor & Francis Ltd, 2007.
- Mayall , "Industrial Design", McGraw Hill,1992.
- Niebel , "Product Design", McGraw Hill,1974.
- Asimov, "Introduction to Design", Prentice Hall,1962.
- Robert P. Merges, Peter S. Menell, Mark A. Lemley, "Intellectual Property in New Technological Age",2016.
- T. Ramappa, "Intellectual Property Rights Under WTO", S. Chand,2008

AUDIT 1 and 2: ENGLISH FOR RESEARCH PAPER WRITING

Course objectives:

Students will be able to:

1. Understand that how to improve your writing skills and level ofreadability
2. Learn about what to write in eachsection
3. Understand the skills needed when writing a Title Ensure the good quality of paper at very first-timesubmission

Syllabus

Units	CONTENTS	Hours
1	Planning and Preparation, Word Order, Breaking up long sentences, Structuring Paragraphs and Sentences, Being Concise and Removing Redundancy, Avoiding Ambiguity and Vagueness	4
2	Clarifying Who Did What, Highlighting Your Findings, Hedging andCriticising, Paraphrasing and Plagiarism, Sections of a Paper, Abstracts. Introduction	4
3	Review of the Literature, Methods, Results, Discussion, Conclusions, The Final Check.	4
4	key skills are needed when writing a Title, key skills are needed when writing an Abstract, key skills are needed when writing an Introduction, skills needed when writing a Review of the Literature,	4
5	skills are needed when writing the Methods, skills needed when writing the Results, skills are needed when writing the Discussion, skills are needed when writing the Conclusions	4
6	useful phrases, how to ensure paper is as good as it could possibly be the first- time submission	4

Suggested Studies:

1. Goldbort R (2006) Writing for Science, Yale University Press (available on GoogleBooks)
2. Day R (2006) How to Write and Publish a Scientific Paper, Cambridge UniversityPress
3. Highman N (1998), Handbook of Writing for the Mathematical Sciences, SIAM. Highman'sbook.
4. Adrian Wallwork , English for Writing Research Papers, Springer New York Dordrecht Heidelberg London,2011

AUDIT 1 and 2: DISASTER MANAGEMENT

Course Objectives: -Students will be able to:

1. Learn to demonstrate a critical understanding of key concepts in disaster risk reduction and humanitarianresponse.
2. critically evaluate disaster risk reduction and humanitarian response policy and practice from multiple perspectives.
3. develop an understanding of standards of humanitarian response and practical relevance in specific types of disasters and conflictsituations.
4. critically understand the strengths and weaknesses of disaster management approaches, planning and programming in different countries, particularly their home countryor the countries they work in

Syllabus		
Units	**CONTENTS**	**Hours**
1	**Introduction** Disaster: Definition, Factors AndSignificance; Difference Between Hazard And Disaster; Natural And Manmade Disasters: Difference, Nature, Types AndMagnitude.	4
2	**Repercussions Of Disasters And Hazards**: Economic Damage, Loss Of Human And Animal Life, Destruction Of Ecosystem. Natural Disasters: Earthquakes, Volcanisms, Cyclones, Tsunamis, Floods, Droughts And Famines, Landslides And Avalanches, Man-made disaster: Nuclear Reactor Meltdown, Industrial Accidents, Oil Slicks And Spills, Outbreaks Of Disease And Epidemics, War And Conflicts.	4
3	**Disaster Prone Areas In India** Study Of Seismic Zones; Areas Prone To Floods And Droughts, Landslides And Avalanches; Areas Prone To Cyclonic And Coastal Hazards With Special Reference To Tsunami; Post-Disaster Diseases And Epidemics	4
4	**Disaster Preparedness And Management** Preparedness: Monitoring Of Phenomena Triggering A Disaster Or Hazard; Evaluation Of Risk: Application Of Remote Sensing, Data From Meteorological And Other Agencies, Media Reports: Governmental And CommunityPreparedness.	4
5	**Risk Assessment** Disaster Risk: Concept And Elements, Disaster Risk Reduction, Global And National Disaster Risk Situation. Techniques Of Risk Assessment, Global Co-Operation In Risk Assessment And Warning,People's Participation In Risk Assessment. Strategies for Survival.	4
6	**Disaster Mitigation** Meaning, Concept And Strategies Of Disaster Mitigation, Emerging Trends In Mitigation. Structural Mitigation And Non-Structural Mitigation, Programs Of Disaster Mitigation InIndia.	4

SUGGESTED READINGS:

1. R. Nishith, Singh AK, "Disaster Management in India: Perspectives, issues and strategies ""New Royal bookCompany.

2. Sahni, PardeepEt.Al. (Eds.)," Disaster Mitigation Experiences and Reflections", Prentice Hall Of India, NewDelhi.

3. Goel S. L. , Disaster Administration And Management Text And Case Studies", Deep &Deep Publication Pvt. Ltd., NewDelhi.

AUDIT 1 and 2: SANSKRIT FOR TECHNICAL KNOWLEDGE

Course Objectives

1. To get a working knowledge in illustrious Sanskrit, the scientific language in theworld
2. Learning of Sanskrit to improve brainfunctioning
3. Learning of Sanskrit to develop the logic in mathematics, science &other subjects enhancing the memorypower
4. The engineering scholars equipped with Sanskrit will be able to explore the huge knowledge from ancientliterature

Syllabus

Unit	Content	Hours
1	• Alphabets inSanskrit, • Past/Present/FutureTense, • Simple Sentences	8
2	• Order • Introduction ofroots • Technical information about SanskritLiterature	8
3	• Technical concepts of Engineering-Electrical,Mechanical, Architecture,Mathematics	8

Suggested reading

1. "Abhyaspustakam" – Dr.Vishwas, Samskrita-Bharti Publication, NewDelhi
2. "Teach Yourself Sanskrit" PrathamaDeeksha-VempatiKutumbshastri, Rashtriya Sanskrit Sansthanam, New DelhiPublication
3. "India's Glorious Scientific Tradition" Suresh Soni, Ocean books (P) Ltd., NewDelhi.

Course Output

Students will be able to

1. Understanding basic Sanskritlanguage
2. Ancient Sanskrit literature about science & technology can beunderstood
3. Being a logical language will help to develop logic instudents

AUDIT 1 and 2: VALUE EDUCATION

Course Objectives

Students will be able to

1. Understand value of education and self-development
2. Imbibe good values instudents
3. Let the should know about the importance ofcharacter

Syllabus

Unit	Content	Hours
1	• Values and self-development –Social values and individual attitudes. Work ethics, Indian vision ofhumanism. • Moral and non- moral valuation. Standards andprinciples. • Valuejudgements	4
2	• Importance of cultivation ofvalues. • Sense of duty. Devotion, Self-reliance. Confidence, Concentration. Truthfulness,Cleanliness. • Honesty, Humanity. Power of faith, NationalUnity. • Patriotism. Love for nature,Discipline	6

3	• Personality and Behavior Development - Soul and Scientific attitude. Positive Thinking. Integrity and discipline. • Punctuality, Love andKindness. • Avoid faultThinking. • Free from anger, Dignity oflabour. • Universal brotherhood and religioustolerance. • True friendship. • Happiness Vs suffering, love fortruth. • Aware of self-destructive habits. • Association andCooperation. • Doing best for savingnature	6
4	• Character and Competence –Holy books vsBlindfaith. • Self-management and Goodhealth. • Science ofreincarnation. • Equality, Nonviolence, Humility, Role ofWomen. • All religions and same message. • Mind your Mind,Self-control. • Honesty, Studyingeffectively	6

Suggested reading

1 Chakroborty, S.K. "Values and Ethics for organizations Theory and practice", Oxford University Press, NewDelhi

Courseoutcomes

Students will be able to

1. Knowledge of self-development
2. Learn the importance of Human values
3. Developing the overallpersonality

AUDIT 1 and 2: CONSTITUTION OF INDIA

Course Objectives:

Students will be able to:

1. Understand the premises informing the twin themes of liberty and freedom from acivil rightsperspective.
2. To address the growth of Indian opinion regarding modern Indian intellectuals' constitutionalroleandentitlementtocivilandeconomicrightsaswellastheemergenceof nationhoodintheearlyyearsofIndiannationalism.
3. ToaddresstheroleofsocialisminIndiaafterthecommencementoftheBolshevik Revolution in 1917 and its impact on the initial drafting of the Indian Constitution.

Syllabus

Units	Content	Hours
1	• **HistoryofMakingoftheIndianConstitution:** History Drafting Committee, (Composition & Working) • **Philosophy of the Indian Constitution:** Preamble Salient Features	8

2	**ContoursofConstitutionalRights&Duties:** • FundamentalRights • Right toEquality • Right toFreedom • Right againstExploitation • RighttoFreedomofReligion • Cultural and EducationalRights • Right to ConstitutionalRemedies • DirectivePrinciplesofStatePolicy • FundamentalDuties.	4
3	**Organs ofGovernance:** • Parliament • Composition • Qualifications andDisqualifications • Powers andFunctions • Executive • President • Governor • Council ofMinisters • Judiciary,AppointmentandTransferofJudges,Qualifications • Powers andFunctions	4
4	**LocalAdministration:** • District's Administration head: Role andImportance, • Municipalities: Introduction, Mayor and role of Elected Representative, CEO of MunicipalCorporation. • Pachayati raj: Introduction, PRI: ZilaPachayat. • Elected officials and their roles, CEO ZilaPachayat: Position androle. • Block level: Organizational Hierarchy (Different departments), • Village level: Role of Elected and Appointedofficials, • Importance of grass rootdemocracy	4
5	**ElectionCommission:** • ElectionCommission:RoleandFunctioning. • ChiefElectionCommissionerandElectionCommissioners. • StateElectionCommission:RoleandFunctioning. • InstituteandBodiesforthewelfareofSC/ST/OBCandwomen.	4

Suggested reading

1. The Constitution of India, 1950 (Bare Act), GovernmentPublication.
2. Dr. S. N. Busi, Dr. B. R. Ambedkar framing of Indian Constitution, 1st Edition,2015.
3. M. P. Jain, Indian Constitution Law, 7th Edn., Lexis Nexis,2014.
4. D.D. Basu, Introduction to the Constitution of India, Lexis Nexis,2015.

Course Outcomes:

Students will be able to:

1. Discuss the growth of the demand for civil right s in India for the bulk of Indians before the arrival of Gandhi in Indianpolitics.
2. Discuss the intellectual origins of the frame work of argument that informed the conceptualization of social reforms leading to revolution inIndia.
3. Discuss the circumstances surrounding the foundation of the Congress Socialist Party

[CSP] under the leadership of Jawaharlal Nehru and the eventual failure of the proposal of direct elections through adult suffrage in the IndianConstitution.

4. Discuss the passage of the Hindu Code Bill of 1956.

AUDIT 1 and 2: PEDAGOGY STUDIES

Course Objectives:

Students will be able to:

1.Reviewexistingevidenceon thereview topic to informprogrammedesignandpolicy making undertakenbythe DfID,otheragencies andresearchers.

2.Identifycriticalevidencegapstoguidethedevelopment.

Syllabus

Units	Content	Hours
1	• **Introduction andMethodology:** • Aims and rationale, Policy background, Conceptual framework and terminology • Theoriesoflearning,Curriculum,Teachereducation. • Conceptualframework,Researchquestions**.** • OverviewofmethodologyandSearching.	4
2	• Thematic overview: Pedagogical practices are being used by teachers in formal and informal classrooms in developingcountries. • Curriculum, Teachereducation.	2
3	• Evidenceontheeffectivenessofpedagogicalpractices • Methodology for the in depth stage: quality assessment of included studies. • Howcanteachereducation(curriculumandpracticum)andtheschool curriculumandguidancematerialsbestsupporteffectivepedagogy? • Theory ofchange. • Strength and nature of the body of evidence for effective pedagogical practices. • Pedagogictheoryandpedagogicalapproaches. • Teachers'attitudesandbeliefsandPedagogicstrategies.	4
4	• Professionaldevelopment:alignmentwithclassroompracticesandfollow-upsupport • Peersupport • Supportfromtheheadteacherandthecommunity. • Curriculum andassessment • Barrierstolearning:limitedresourcesandlargeclasssizes	4
5	• **Research gaps and futuredirections** • Researchdesign • Contexts • Pedagogy • Teachereducation • Curriculum andassessment • Dissemination and researchimpact.	2

Suggested reading

1. Ackers J, Hardman F (2001) Classroom interaction in Kenyan primary schools, Compare, 31 (2):245-261.
2. Agrawal M (2004) Curricular reform in schools: The importance of evaluation, Journal of Curriculum Studies, 36 (3):361-379.
3. Akyeampong K (2003) Teacher training in Ghana - does it count? Multi-site teacher education research project (MUSTER) country report 1. London:DFID.
4. Akyeampong K, Lussier K, Pryor J, Westbrook J (2013) Improving teaching and learning of basic maths and reading in Africa: Does teacher preparation count? International Journal Educational Development, 33 (3):272–282.
5. Alexander RJ (2001) Culture and pedagogy: International comparisons in primary education. Oxford and Boston:Blackwell.
6. Chavan M (2003) Read India: A mass scale, rapid, 'learning to read'campaign.
7. www.pratham.org/images/resource%20working%20paper%202.pdf.

Course Outcomes:

Students will be able to understand:

a. What pedagogical practices are being used by teachers in formal and informal classrooms in developingcountries?
b. What is the evidence on the effectiveness of these pedagogical practices, in what conditions, and with what population oflearners?
c. How can teacher education (curriculum and practicum) and the school curriculum and guidance materials best support effectivepedagogy?

AUDIT 1 and 2: STRESS MANAGEMENT BY YOGA

Course Objectives

1. To achieve overall health of body andmind
2. To overcomestress

Syllabus

Unit	Content	Hours
1	• Definitions of Eight parts of yog. (Ashtanga)	8
2	• Yam andniyam. Do`s and Don't's inlife. i) Ahinsa, satya, astheya, bramhacharya andaparigraha ii) Shaucha, santosh, tapa, swadhyay,ishwarpranidhan	8
3	• Asan andPranayam i) Various yog poses and their benefits for mind & body ii)Regularization of breathing techniques and itseffects-Types of pranayam	8

Suggested reading

1. 'Yogic Asanas for Group Tarining-Part-I" : Janardan Swami YogabhyasiMandal,Nagpur
2. "Rajayoga or conquering the Internal Nature" by SwamiVivekananda,
3. Advaitashrama(Publication Department),Kolkata

Course Outcomes:

Students will be able to:

1. Develop healthy mind in a healthy body thus improving social healthalsoImprove efficiency

AUDIT 1 and 2: PERSONALITY DEVELOPMENT THROUGH LIFE ENLIGHTENMENT SKILLS

Course Objectives

1. To learn to achieve the highest goalhappily

2. To become a person with stable mind, pleasing personality anddetermination
3. To awaken wisdom instudents

Syllabus

Unit	Content	Hours
1	Neetisatakam-Holistic development of personality • Verses- 19,20,21,22 (wisdom) • Verses- 29,31,32 (pride &heroism) • Verses- 26,28,63,65 (virtue) • Verses- 52,53,59 (dont's) • Verses- 71,73,75,78 (do's)	8
2	• Approach to day to day work andduties. • ShrimadBhagwadGeeta : Chapter 2-Verses 41,47,48, • Chapter 3-Verses 13, 21, 27, 35, Chapter 6-Verses 5,13,17, 23,35, • Chapter 18-Verses 45, 46,48.	8
3	• Statements of basicknowledge. • ShrimadBhagwadGeeta: Chapter2-Verses 56, 62,68 • Chapter 12 -Verses 13, 14, 15, 16,17,18 • Personality of Role model. ShrimadBhagwadGeeta: Chapter2-Verses 17, Chapter 3-Verses36,37,42, • Chapter 4-Verses 18,38,39 • Chapter18 – Verses37,38,63	8

Suggested reading

1. "Srimad Bhagavad Gita" by Swami SwarupanandaAdvaita Ashram (Publication Department),Kolkata
2. Bhartrihari's Three Satakam (Niti-sringar-vairagya) by P.Gopinath, RashtriyaSanskrit Sansthanam, NewDelhi.

Course Outcomes

Students will be able to

1. Study of Shrimad-Bhagwad-Geeta will help the student in developing his personality and achieve the highest goal in life
2. The person who has studied Geeta will lead the nation and mankind to peace andprosperity
3. Study of Neetishatakam will help in developing versatile personality of students.