**GOVERNMENT COLLEGE OF TECHNOLOGY**

**(An Autonomous Institution Affiliated to Anna University, Chennai)**

**Coimbatore – 641 013**

**M.E. GEOTECHNICAL ENGINEERING**

**CURRICULUM**

**(2018 REGULATIONS)**

**MASTER OF ENGINEERING**

**GEOTECHNICAL ENGINEERING**

**CURRICULUM**

*(Full Time Candidates admitted during 2018*– *2019and onwards)*

**FIRST SEMESTER**

|  |  |  |  |  |  |  |  |  |  |  |
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| **SL.NO.** | **COURSE**  **CODE** | **COURSE TITLE** | **CAT** | **CA**  **MARKS** | **END SEM.**  **MARKS** | **TOTAL**  **MARKS** | **L** | **T** | **P** | **C** |
| 1. | 18GEPC01 | Advanced Foundation Engineering | PC | 50 | 50 | 100 | 3 | 0 | 0 | 3 |
| 2. | 18GEPCO2 | Strength and Deformation Characteristics of Soils | PC | 50 | 50 | 100 | 3 | 0 | 0 | 3 |
| 3. | ELECTIVE-I | 18CEPE01Analytical and Numerical Methods | PE | 50 | 50 | 100 | 3 | 0 | 0 | 3 |
| 18GEPE02 Remote Sensing and its Applications in Geotechnical Engineering |
| 18GEPE03 Soil Properties and Behaviour |
| 18GEPE05 Reinforced Soil Structures |
| 4. | ELECTIVE-II | 18GEPE04Finite Element Analysis | PE | 50 | 50 | 100 | 3 | 0 | 0 | 3 |
| 18GEPE08 Foundation in Expansive Soils |
| 18GEPE10Soil Structure Interaction |
| 18GEPE12Environmental Engineering Structures |
| 5. | ELECTIVE-III | 18GEPE07 Rock Mechanics in Engineering Practice | PE | 50 | 50 | 100 | 3 | 0 | 0 | 3 |
| 18GEPE11 Geotechnical Earthquake Engineering |
| 18GEPE16 Design of Underground Excavations |
| 18GEPE17 Computational Geomechanics |
| 6. | 18GEPC04 | Soil Mechanics Laboratory | PC | 50 | 50 | 100 | 0 | 0 | 4 | 2 |
| 7. | 18GEMLC01 | Research Methodology and IPR | MLC | 50 | 50 | 100 | 1 | 0 | 0 | 2 |
| 8. | AUDIT 1 | Audit Course-1 | AC | -- | -- | -- | 2 | 0 | 0 | 0 |
|  |  | TOTAL |  |  |  | 600 |  |  |  | **19** |

**SECOND SEMESTER**

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| **SL.NO.** | **COURSE**  **CODE** | **COURSE TITLE** | **CAT** | **CA**  **MARKS** | **END SEM.**  **MARKS** | **TOTAL**  **MARKS** | **L** | **T** | **P** | **C** |
| 1. | 18GEPC03 | Soil Dynamics and Machine Foundations | PC | 50 | 50 | 100 | 3 | 0 | 0 | 3 |
| 2. | 18GEPC04 | Site Exploration and Soil Investigation | PC | 50 | 50 | 100 | 3 | 0 | 0 | 3 |
| 3. | ELECTIVE IV | 18GEPE06 Slope Stability and Landslides | PE | 50 | 50 | 100 | 3 | 0 | 0 | 3 |
| 18GEPE09 Geology in Geotechnical Engineering |
| 18GEPE19 Highway Project Management |
| 18GEPE20 Land Reclamation |
| 4. | ELECTIVE V | 18GEPE13 Environmental Geotechnology | PE | 50 | 50 | 100 | 3 | 0 | 0 | 3 |
| 18GEPE14 Pavement Engineering |
| 18GEPE15 Theoretical Soil Mechanics |
| 5. | 18GEPC05 | Subsoil Exploration Laboratory | PC | 50 | 50 | 100 | 0 | 0 | 4 | 2 |
| 6. | 18GEPC06 | Finite Element Analysis and Design Laboratory | PC | 50 | 50 | 100 | 0 | 0 | 4 | 2 |
| 7. | 18GEPC07 | Mini Project | PROJ | 50 | 50 | 100 | 0 | 0 | 4 | 2 |
| 8. | Audit 2 | Audit Course - 2 | AC |  |  |  | 2 | 0 | 0 | 0 |
|  |  | TOTAL |  |  |  | 600 |  |  |  | 18 |

**MASTER OF ENGINEERING**

**GEOTECHNICAL ENGINEERING**

**CURRICULUM**

*(Full Time Candidates admitted during 2018 – 2019 and onwards)*

**THIRD SEMESTER**

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| **SL.NO.** | **COURSE**  **CODE** | **COURSE TITLE** | **CAT** | **CA**  **MARKS** | **END SEM.**  **MARKS** | **TOTAL**  **MARKS** | **L** | **T** | **P** | **C** |
| 1. | ELECTIVE VI | 18GEPE01 Earth Retaining Structures | PE | 50 | 50 | 100 | 3 | 0 | 0 | 3 |
| 18GEPE18 Professional Practices in Designof Geotechnical Structures |
| 18GEPE21 Ground Improvement Techniques |
| 2. | OPEN ELECTIVE | 18GEOE01 Industrial Safety | OE | 50 | 50 | 100 | 3 | 0 | 0 | 3 |
| 18GEOE02 Operations Research |
| 18GEOE03 Cost Management of Engineering Projects |
| 3. | 18GEEE01 | Project Phase - I | PROJ | 100 | 100 | 200 | 0 | 0 | 12 | 10 |
|  |  | TOTAL |  |  |  | 500 |  |  |  | 16 |

**FOURTH SEMESTER**

|  |  |  |  |  |  |  |  |  |  |  |
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| **SL.NO.** | **COURSE**  **CODE** | **COURSE TITLE** | **CAT** | **CA**  **MARKS** | **END SEM.**  **MARKS** | **TOTAL**  **MARKS** | **L** | **T** | **P** | **C** |
|  | 18GEEE02 | Project Phase - II | PROJ | 200 | 200 | 400 | 0 | 0 | 24 | 16 |
|  |  | TOTAL |  |  |  | 400 |  |  |  | 16 |

**MASTER OF ENGINEERING**

**GEOTECHNICAL ENGINEERING**

**CURRICULUM**

*(Full Time Candidates admitted during 2016* – *2017 and onwards)*

**LIST OF PROFESSIONAL CORE COURSES**

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **SL.NO.** | **COURSE**  **CODE** | **COURSE TITLE** | **CAT** | **CA**  **MARKS** | **END SEM.**  **MARKS** | **TOTAL**  **MARKS** | **L** | **T** | **P** | **C** |
| 1. | 18GEPC01 | Advanced Foundation Engineering | PC | 50 | 50 | 100 | 3 | 0 | 0 | 3 |
| 2 | 18GEPCO2 | Strength and Deformation Characteristics of Soils | PC | 50 | 50 | 100 | 3 | 0 | 0 | 3 |
| 3. | 18GEPC03 | Soil Dynamics and Machine Foundations | PC | 50 | 50 | 100 | 3 | 0 | 0 | 3 |
| 4. | 18GEPC04 | Site Exploration and Soil Investigation | PC | 50 | 50 | 100 | 3 | 0 | 0 | 3 |
| 5. | 18GEPC05 | Soil Mechanics Laboratory | PC | 50 | 50 | 100 | 0 | 0 | 4 | 2 |
| 6. | 18GEPC06 | Subsoil Exploration Laboratory | PC | 50 | 50 | 100 | 0 | 0 | 4 | 2 |
| 7. | 18GEPC07 | Finite Element Analysis and Design Laboratory | PC | 50 | 50 | 100 | 0 | 0 | 4 | 2 |
| 8. | 18GEPC08 | Mini Project | PC | 50 | 50 | 100 | 0 | 0 | 4 | 2 |

**MASTER OF ENGINEERING**

**GEOTECHNICAL ENGINEERING**

**CURRICULUM**

*(Full Time Candidates admitted during 2018* – *2019and onwards)*

**LIST OF PROFESSIONAL ELECTIVES**

|  |  |  |  |  |  |  |  |  |  |  |
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| **SL.NO.** | **COURSE**  **CODE** | **COURSE TITLE** | **CAT** | **CA**  **MARKS** | **END SEM.**  **MARKS** | **TOTAL**  **MARKS** | **L** | **T** | **P** | **C** |
|  | 18CEPE01 | Analytical and Numerical Methods  (Common with M.E. Structural Engg.) | PE | 50 | 50 | 100 | 3 | 0 | 0 | 3 |
|  | 18GEPE01 | Earth Retaining Structures | PE | 50 | 50 | 100 | 3 | 0 | 0 | 3 |
|  | 18GEPE02 | Remote Sensing and its Applications In Geotechnical Engineering | PE | 50 | 50 | 100 | 3 | 0 | 0 | 3 |
|  | 18GEPE03 | Soil Properties and Behaviour | PE | 50 | 50 | 100 | 3 | 0 | 0 | 3 |
|  | 18GEPE04 | Finite Element Analysis | PE | 50 | 50 | 100 | 3 | 0 | 0 | 3 |
|  | 18GEPE05 | Reinforced Soil Structures | PE | 50 | 50 | 100 | 3 | 0 | 0 | 3 |
|  | 18GEPE06 | Slope Stability and Landslides | PE | 50 | 50 | 100 | 3 | 0 | 0 | 3 |
|  | 18GEPE07 | Rock Mechanics in Engineering Practice | PE | 50 | 50 | 100 | 3 | 0 | 0 | 3 |
|  | 18GEPE08 | Foundation in Expansive Soils | PE | 50 | 50 | 100 | 3 | 0 | 0 | 3 |
| 1. 1 | 18GEPE09 | Geology in Geotechnical Engineering | PE | 50 | 50 | 100 | 3 | 0 | 0 | 3 |
|  | 18GEPE10 | Soil Structure Interaction | PE | 50 | 50 | 100 | 3 | 0 | 0 | 3 |
|  | 18GEPE11 | Geotechnical Earthquake Engineering | PE | 50 | 50 | 100 | 3 | 0 | 0 | 3 |
|  | 18GEPE12 | Environmental Engineering Structures | PE | 50 | 50 | 100 | 3 | 0 | 0 | 3 |
|  | 18GEPE13 | Environmental Geotechnology | PE | 50 | 50 | 100 | 3 | 0 | 0 | 3 |
|  | 18GEPE14 | Pavement Engineering | PE | 50 | 50 | 100 | 3 | 0 | 0 | 3 |
|  | 18GEPE15 | Theoretical Soil Mechanics | PE | 50 | 50 | 100 | 3 | 0 | 0 | 3 |
|  | 18GEPE16 | Design of Underground Excavations | PE | 50 | 50 | 100 | 3 | 0 | 0 | 3 |
|  | 18GEPE17 | Computational Geomechanics | PE | 50 | 50 | 100 | 3 | 0 | 0 | 3 |
|  | 18GEPE18 | Professional Practices In Design of Geotechnical Structures | PE | 50 | 50 | 100 | 3 | 0 | 0 | 3 |
|  | 18GEPE19 | Highway Project Management | PE | 50 | 50 | 100 | 3 | 0 | 0 | 3 |
|  | 18GEPE20 | Land Reclamation | PE | 50 | 50 | 100 | 3 | 0 | 0 | 3 |
|  | 18GEPE21 | Ground Improvement Techniques | PE | 50 | 50 | 100 | 3 | 0 | 0 | 3 |

MASTER OF ENGINEERING

**GEOTECHNICAL ENGINEERING**

**CURRICULUM**

*(Full Time Candidates admitted during 2018 – 2019and onwards)*

**LIST OF MANDATORY COURSES**

|  |  |  |  |  |  |  |  |  |  |  |
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| **SL.NO.** | **COURSE**  **CODE** | **COURSE TITLE** | **CAT** | **CA**  **MARKS** | **END SEM.**  **MARKS** | **TOTAL**  **MARKS** | **L** | **T** | **P** | **C** |
| 1. | 18GEMLC01 | Research Methodology and IPR | MLC | 50 | 50 | 100 | 1 | 0 | 0 | 2 |
| 2. | 18GEMLC02 | Industrial Training | MLC | 50 | 50 | 100 | 1 | 0 | 0 | 2 |

**LIST OF AUDIT COURSES**

|  |  |  |  |  |  |  |  |  |  |  |
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| **SL.NO.** | **COURSE**  **CODE** | **COURSE TITLE** | **CAT** | **CA**  **MARKS** | **END SEM.**  **MARKS** | **TOTAL**  **MARKS** | **L** | **T** | **P** | **C** |
| 1. | 18GEAC01 | Research Paper Writing | AC |  |  |  | 2 | 0 | 0 | 0 |
| 2. | 18GEAC02 | Disaster Management | AC |  |  |  | 2 | 0 | 0 | 0 |
| 3. | 18GEAC03 | Value Education | AC |  |  |  | 2 | 0 | 0 | 0 |
| 4. | 18GEAC04 | Constitution of India | AC |  |  |  | 2 | 0 | 0 | 0 |
| 5. | 18GEAC05 | Stress Management | AC |  |  |  | 2 | 0 | 0 | 0 |

**LIST OF OPEN ELECTIVES**

|  |  |  |  |  |  |  |  |  |  |  |
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| **SL.NO.** | **COURSE**  **CODE** | **COURSE TITLE** | **CAT** | **CA**  **MARKS** | **END SEM.**  **MARKS** | **TOTAL**  **MARKS** | **L** | **T** | **P** | **C** |
| 1. | 18GEOE01 | Industrial Safety | OE | 50 | 50 | 100 | 3 | 0 | 0 | 3 |
| 2. | 18GEOE02 | Operations Research | OE | 50 | 50 | 100 | 3 | 0 | 0 | 3 |
| 3. | 18GEOE03 | Cost Management of Engineering Projects | OE | 50 | 50 | 100 | 3 | 0 | 0 | 3 |

**18GEPC01 ADVANCED FOUNDATION ENGINEERING**

**L T P C**

**3 0 0 3**

**COURSE OBJECTIVE**

To study about the different exploration techniques and to estimate the capacity of shallow and deep foundations on expansive soil.

**COURSE OUTCOMES**

At the end of the course, students will be able to

CO1: Identify and select suitable exploration techniques for different projects.

CO2: Evaluate the bearing capacity and settlement of shallow foundations.

CO3: Estimate the pile capacity and settlement of piles.

CO4: Understand the various components and forces acting on well foundation.

CO5: Gain knowledge about different types of foundations in problematic soil.

**UNIT I - PLANNING OF SOIL EXPLORATION (09)**

Exploration methods for different projects - methods of borings-penetration tests-pressure meter test, field vane shear test-field permeability test-rock boring, preservation, shipment and storage of samples.

**UNIT II SHALLOW FOUNDATIONS (09)**

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 III - PILE FOUNDATIONS (09)**

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 behaviour of piles, proportioning of

pile foundations, lateral and uplift capacity of piles.

**UNIT IV WELL FOUNDATION (09)**

Introduction- applications, different shapes, grip length, scour depth, forces acting on well foundation-Terzaghi’s method of analysis (general case), design of individual components of wells-measures for rectification of tilts and shifts.

**UNIT V FOUNDATIONS ON PROBLEMATIC SOILS AND COFFERDAMS (09)**

Foundations for collapsible and expansive soil. Cofferdams-various types, analysis and design Foundations under uplifting loads.

**TOTAL: 45hrs**

***REFERENCE BOOKS:***

1. Narayan V. Nayak, Foundation Design Manual for Practising Engineers and Civil Engineering Students,
2. DhanpatRai Publications Pvt. Ltd., Fourth edition 1996 (Reprint 2001).
3. Bowles. J.E., Foundation Analysis and Design, Tata McGraw-Hill International Edition,5th edition 1997.
4. Das B.M., Shallow Foundations: Bearing capacity and Settlement, CRC Press,1999.
5. Tomlinson M.J., Pile design and Construction Practice, Chapman and Hall Publication,1994.
6. Poulos, H.G. AND Davis,F.H., “Pile Foundation Analysis and Design”, Wilkey and Sons,1980.
7. Dunnicliff., J., and Green, G.E., Geotechnical Instrumentation for Monitoring Field Performance, John Wiley, 1993.
8. Hanna T.H., Field Instrumentation in Geotechnical Engineering, Trans Tech., 1985.
9. Bowles J.E., Foundation Analysis and Design, The McGraw Hill companies, inc., New York, 2001.

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|  | *PO1* | *PO2* | *PO3* | *PO4* | *PO5* | *PO6* | *PO7* | *PO8* | *PO9* | *PO10* | *PO11* |
| *CO1* | *L* |  |  | *M* | *M* |  |  |  |  |  |  |
| *CO2* |  |  | *H* |  |  | *M* |  |  | *H* |  |  |
| *CO3* | *H* |  |  | *M* |  |  |  | *H* | *M* |  |  |
| *CO4* |  | *H* | *H* |  |  |  | *M* |  |  |  | *H* |
| *CO5* |  | *H* | *H* |  |  |  |  | *M* |  |  | *H* |

**18GEPC02 STRENGTH AND DEFORMATION CHARACTERISTICS OF SOILS**

**L T P C**

**3 003**

**COURSE OBJECTIVE**

To impart knowledge on stress-strain characteristics of soils and its behaviour in the form of stress path and concepts of yield and failure criteria.

**COURSE OUTCOMES**

At the end of the course, students will be able to

CO1: Evaluate the shear strength parameters of cohesionlesssoil and the gain knowledge about liquefaction.

CO2: Ability to obtain shear strength parameters of cohesive soil under different drainage conditions.

CO3: Understand failure criteria of soils and apply models to study the time-deformation behaviour of soils.

CO4: Use the concepts of stress path for different conditions and characterize stress strain behaviour of soils.

CO5: Exposure towards various rheological models.

**UNIT I SHEAR STRENGTH OF COHESIONLESS SOILS (09)**

Shear strength of granular soils – Direct shear – Triaxial Testing – Drained and undrained – Stress-strain behaviour – Dilatation – Contraction and critical states – Liquefaction and Liquefaction potential. Factors influencing – Stress-strain – Volume change behaviour of soils.

**UNIT II SHEAR STRENGTH OF COHESIVE SOILS (09)**

Shear strength of clays – Stress-strain behaviour – Vane shear – UCC – Triaxial testing and stress path plotting – Pore pressure parameter of Skempton and Henkel – Total stress and effective stress approach – Shear strength of partially saturated clay in terms of stress state variables – Drained and undrained – Factors influencing stress-strain and shear strength.

**UNIT III YIELD CRITERION (09)**

Concepts of yield and failure in soils – Yield criteria of Von Mises, Tresca,KvikPatriak, Drucker and Prager and their extended form – their applicability to soils – Detailed discussion of Mohr – Coulomb failure criterion.

**UNIT IV STRESS PATH AND STRESS – STRAIN LAWS (09)**

Lambe’s stress path for different cases – Stress path tests – Stress-strain laws for soils – Hyperbolic law – Linear visco-elastic and Elasto – Plastic laws – Yield functions, hardening law, flow rules and plastic strain computation – Elastic module – Cyclic loading – Limitation of linearity elastic model – Hyperbolic stress-strain model.

**UNIT V CRITICAL STATE SOIL MECHANICS AND RHEOLOGICAL**

**MODELS (09)**

Introduction to critical state soil mechanics – Boundary Surface – Roscoe and Hvorslev’s – Rheological models of Kelvin, Maxwell and Burger as applied to soils.

**TOTAL: 45hrs**

***REFERENCE BOOKS:***

1. Lambe, T.W. and Whitman R.V., Soil Mechanics in S.I. Units John Wiley, 1979.
2. Hotlz, R.D. and Kovais, W.D., Introduction of Geotechnical Engineering, Prentice – Hall1981.
3. Atkinson, J.H and Brandsby, P.L., Introduction to critical state soil mechanics, Cambridge University Press, New York, 1990
4. Braja, M. Das, Fundamentals of Geotechnical Engineering, Brooks/Cole, Thomson Learning Academic Resource, Center, ISBN-O0534-37114-0.
5. Keedwell, M.J., Rheology and Soil mechanics, Elsevier Applied Science Publishers Ltd. 1984, ISBN 0-85334-285-7.
6. Braja, M. Das, Advanced soil mechanics, McGraw Hill, 1997.
7. Wood. D.M., Soil behaviour and Critical State Soil Mechanics, Cambridge University Press New York, 1990.
8. Bazant, Z.P., Mechanics of Geo-materials, Rocks, Concrete and Soil, John Willey and Sons, Chilchester, 1985.

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|  | *PO1* | *PO2* | *PO3* | *PO4* | *PO5* | *PO6* | *PO7* | *PO8* | *PO9* | *PO10* | *PO11* |
| *CO1* | *H* | *L* |  | *M* |  |  |  |  |  |  |  |
| *CO2* | *H* | *L* |  | *M* | *M* |  |  |  |  |  |  |
| *CO3* |  |  |  | *M* | *H* |  |  |  | *L* |  |  |
| *CO4* | *H* | *L* |  | *M* |  |  |  |  | *L* |  |  |
| *CO5* |  |  | *L* |  | *H* |  |  |  | *L* |  |  |

**18GEPC03 SOIL DYNAMICS AND MACHINE FOUNDATIONS**

**L T P C**

**3 003**

**COURSE OBJECTIVE**

To design different types of machine foundations based on the dynamic properties of soils and to get an exposure on vibration isolation techniques.

**COURSE OUTCOMES**

At the end of the course, students will be able to

CO1 :Acquire knowledge to apply theories of vibration to solve dynamic soil problems.

CO2 :Evaluate the dynamic properties of soil using laboratory and field tests.

CO3 :Acquire basic knowledge about machine foundations and design various types of machine foundation

CO4:To know and capable of selecting the types of vibration isolation materials

CO5:To apply vibration isolation techniques for various field problems..

**UNIT I THEORY OF VIBRATION (09)**

Introduction – Nature of dynamic loads – Basic definitions – Simple harmonic motion – Fundamentals of vibration – Single degree and multi degree of freedom systems – Free vibrations of spring – Mass systems – Forced vibrations – Resonance – Viscous damping – Principles of vibrations measuring systems – Effect of transient and pulsating loads.

**UNIT II DYNAMIC SOIL PROPERTIES (09)**

Dynamic stress-strain characteristics – Principles of measuring dynamic properties – Laboratory techniques – Field tests – Block vibration test – Factors affecting dynamic properties – Typical values. Mechanism of liquefaction – Influencing factors – Evaluation of liquefaction potential – Analysis from SPT test – Dynamic bearing capacity – Dynamic earth pressure.

**UNIT III MACHINE FOUNDATIONS (09)**

Introduction – Types of machine foundations – General requirements for design of machine foundations – Design approach for machine foundation – Vibration analysis – Elastic Half-Space theory – Mass-spring-dashpot model – Permissible amplitudes – Permissible bearing pressures.

**UNIT IV DESIGN OF MACHINE FOUNDATION (09)**

Evaluation of design parameters – Types of Machines and foundations – General requirements – their importance – Analysis and design of block type and framed type machine foundations – Modes of vibration of a rigid foundation – Foundations for reciprocating machines, impact machines, Two – Cylinder vertical compressor, Double-acting steam hammer –Codalrecommendations.Emprical approach – Barken’s method – Bulb of pressure concept – Pauw’s analogy – Vibration table studies.

**UNIT V VIBRATION ISOLATION (09)**

Vibration isolation – Types of isolation – Transmissibility – Passive and active isolation – Methods of isolation – Use of springs and damping materials – Properties of isolating materials – Vibration control of existing machine foundation.

**TOTAL: 45hrs**

***REFERENCE BOOKS:***

1. KameswaraRao, N.S.V., Dynamics soil tests and applications, Wheeler Publishing, New Delhi, 2000.
2. Prakash, S and Puri, V.K., Foundations for machines, McGraw Hill, 1987.
3. Moore, P.J.,Analysis and Design of Foundations for Vibrations, Oxford and IBH, 1985.
4. Vaidyanathan, C.V., and Srinivasalu, P., Handbook of Machine Foundations, McGraw Hill, 1995.
5. Arya, S., O’Nelt; S., Design of Structures and Foundations for Vibrating Machines, Prentice Hall, 1981.
6. Major, A., Vibration Analysis and Design of Foundations for Machines and Turbines, Vol. I. II and III Budapest, 1964.
7. Barkan, D.D., Dynamics of Basis of Foundation, McGraw Hill, 1974.
8. Swami Saran, Soil Dynamics and Machine Foundation, Galgotia publications Pvt. Ltd. New Delhi 2010.
9. Das B.M., Principles of Soil Dynamics, McGraw Hill, 1992.
10. Krammer S.L., Geotechnical Earthquake Engineering, Prentice Hall, International series, Pearson Education (Singapore) Pvt Ltd, 2004.
11. KameswaraRao, Vibration Analysis and Foundation Dynamics, Wheeler Publishing, New Delhi, 1998.

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|  | *PO1* | *PO2* | *PO3* | *PO4* | *PO5* | *PO6* | *PO7* | *PO8* | *PO9* | *PO10* | *PO11* |
| *CO1* | *H* |  | *L* |  | *M* |  |  |  |  |  |  |
| *CO2* |  |  | *H* | *M* |  |  |  |  |  |  |  |
| *CO3* | *H* |  | *H* |  |  | *H* |  |  | *H* |  |  |
| *CO4* | *L* |  | *M* |  |  | *H* |  |  | *M* |  |  |
| *CO5* | *L* |  |  |  | *M* |  | *H* |  | *H* |  |  |

**16GEPC04 SITE EXPLORATION AND SOIL INVESTIGATION**

**L T PC**

**3 00 3**

**COURSE OBJECTIVE**

To impart knowledge on the preparation of soil exploration report based on laboratory, field exploration and testing techniques.

**COURSE OUTCOMES**

At the end of the course, students will be able to

CO1: Plan for soil investigation and exploration in soil and rock.

CO2 : Select appropriate equipment for the exploration work for different sub soil condition. CO3: Gain the practice of recovering samples using advanced sampling techniques.

CO4: Understand the importance of field testing and handling of field.

CO5: Implement geotechnical instrumentation in the field and evolve solutions for different

soil conditions.

**UNIT I - SCOPE AND OBJECTIVES OF SITE INVESTIGATION AND SUBSURFACE EXPLORATION (09)**

Scope and objectives – Preliminary desk studies – Planning an exploration programme – Location – Spacing – Depth of borings – Stabilization of bore holes– Soil Profile – Bore logs – Data Presentation – Soil investigation and exploration reports.

**UNIT II - EXPLORATION TECHNIQUES (09)**

Methods of boring and drilling – Non-displacement and displacement methods – Drilling in difficult subsoil conditions – Geophysical exploration and interpretation – Seismic refraction and electrical resistivity methods.

**UNIT III - SAMPLES AND SAMPLERS (09)**

Type of samples – Disturbed and undisturbed – Sample disturbance – Design features affecting sample disturbance – Area and recovery ratio – RQD – Types of samplers –Methods for preventing loss of samples – Shallow penetration samplers – Advanced sampling techniques – Offshore sampling – Preservation and handling of samples.

**UNIT IV - FIELD TESTING (09)**

Field tests – Importance– Penetration testing – Standard Penetration Test – Static Cone Penetration Test – Dynamic cone penetration test – Plate load test – Field Vane shear test – Pressuremeter test – Data interpretation –Field Permeability test.

**UNIT V - INSTRUMENTATION (09)**

Instrumentation in soil Engineering – Pore pressure – Ground water table – Strain gauges – Resistance and induction type – Load cells – Earth pressure cells – Settlement and heave gauges – Piezometers and slope indications – Inclinometer.

**TOTAL: 45hrs**

***REFERENCE BOOKS:***

1. Site Investigation by CRI clayton, N.E. Simon’s and M.C.Mathews – Cranada, 1976.
2. Surface exploration and sampling of soils for Civil Engineering – Purposes – M.JundHvorslev – Waterways Experiment Station, MISSISSIPPI, 1978.
3. Hunt R.E. Geotechnical Engineering Investigation Manual, McGraw Hill, 1984.
4. Winterkorn, H.F. and Fang, H.Y., Foundation Engineering Hand Book, a Nostrand Reinhold 1994.
5. Nair, R.J. and Wood, P.M., Pressuremeter Testing Methods and Interpretation, Butter worths, 1987.
6. Dunnicliff., J., and Green, G.E., Geotechnical Instrumentation for Monitoring Field Performance, John Wiley, 1993.
7. Hanna T.H., Field Instrumentation in Geotechnical Engineering, Trans Tech., 1985.
8. Bowles J.E., Foundation Analysis and Design, The McGraw Hill companies, inc., New York, 2001.

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| *CO1* | *L* |  |  | *M* | *M* |  |  |  |  |  |  |
| *CO2* |  |  | *H* |  |  | *M* |  |  | *H* |  |  |
| *CO3* | *H* |  |  | *M* |  |  |  | *H* | *M* |  |  |
| *CO4* |  | *H* | *H* |  |  |  | *M* |  |  |  | *H* |
| *CO5* |  | *H* | *H* |  |  |  |  | *M* |  |  | *H* |

**18GEPC05 SOIL MECHANICS LABORATORY**

**L T P C**

**0 04 2 COURSE OBJECTIVES**

To gain practical knowledge about the type and strength of soil through laboratory tests.

**COURSE OUTCOMES**

At the end of the course, students will be able to

CO1 :Determine the physical characteristics of soils.

CO2 : Classify the given soils as per IS classification test.

CO3 : Evaluate the strength of the soil.

CO4 : Evaluate the compressibility characteristics of soils.

CO5 : Familiarize with handling of laboratory equipments.

**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. Vibration test for relative density of sand  
5. Standard and modified proctor compaction test  
6. Constant head permeability test and Falling head permeability test  
7. Consolidation test  
8. Unconfined compression test  
9. Direct shear test  
10. Tri-axial compression test – UU, CU, CD tests  
11. Laboratory vane shear test

***REFERENCE BOOKS:***

1. Shashi K Gulhati and Manoj Datta., Geotechnical Engineering, The McGraw Hill Company Limited, New Delhi, 2009

2. C.Venkatramaiah, Geotechnical Engineering, New Age International Publishers, 2009

3. GopalRanjan, A S R Rao, Basic and Applied Soil Mechanics, New Age International Publishers, 2004

4. Iqbal H Khan, Textbook of Geotechnical Engineering, PHI Learning Private limited, 2012

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|  | *PO1* | *PO2* | *PO3* | *PO4* | *PO5* | *PO6* | *PO7* | *PO8* | *PO9* | *PO10* | *PO11* |
| *CO1* | *H* | *L* | *H* | *M* |  |  |  |  |  |  | *H* |
| *CO2* | *M* |  |  |  | *H* |  |  | *M* |  |  |  |
| *CO3* |  | *L* | *H* | *M* |  | *H* | *M* | *L* |  | *M* |  |
| *CO4* |  |  | *H* |  |  |  |  |  | *H* |  | *H* |
| *CO5* |  |  | *H* |  |  | *H* |  |  |  |  |  |

**18GEPC06 SUBSOIL EXPLORATION LABORATORY**

**L T P C**

**0042**

**COURSE OBJECTIVES**

To impart practical exposure to subsurface exploration through different field and laboratory testing.

**COURSE OUTCOMES**

At the end of the course, students will be able to

CO1: Attain adequate knowledge in assessing compressibility and shear strength characteristics of soils

CO2: Trained to gain knowledge in assessing the safe bearing capacity of soil through field tests.

CO3: Assessing the subgrade modulus of soil for design of pavement thickness.

CO4: Learn to conduct geophysical exploration test and interpret the results.

CO5: Ability to solve geotechnical problems in field.

**List of Practicals:**

1. Auger boring

2.One dimensional Consolidation Test

3.Triaxial test

4. Standard Penetration test

5. Dynamic Cone Penetration test

6. Static cone penetration test

7. LightWeight Deflectometer test

8. Ring shear Apparatus

9. Electrical Resistivity meter test

10. Plate load test (Demo only)

***REFERENCE BOOKS:***

1.J.E. Bowles,Physical and Geotechnical Properties of Soils, 2nd Edition, Mc. Graw Hill, New York.

2.Das, B.M., Soil Mechanics Laboratory Manual, Engineering Press, Austin,1997

3.. Al-Khataji, A.W. and Anderstand, O.B., Geotechnical Engineering & Soil Testing, Sounders College Publishing, Fort Worth, 1992.

4.Alam Singh and Chowdary, G.R.,Soil Engineering in Theory and Practice (Vol.2) Geotechnical Testing and Instrumentation, CBS Publishers and Distributors, NewDelhi,2006.

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| *CO1* | *L* |  | *H* |  |  | *L* |  |  | *L* | *L* |  |
| *CO2* | *L* |  | *H* |  |  | *L* |  |  | *L* | *L* |  |
| *CO3* | *L* |  | *H* |  |  | *L* |  |  | *L* | *L* |  |
| *CO4* | *L* |  | *H* |  |  | *L* |  |  | *L* | *L* |  |
| *CO5* |  |  | *H* |  | *L* |  | *H* |  | *M* | *H* | *H* |

**18GEPC07 FINITE ELEMENT ANALYSIS LABORATORY**

**L T P C**

**0 0 4 2**

**COURSE OBJECTIVES**

To acquire software applications for various field problems and for various conditions.

**COURSE OUTCOMES**

At the end of the course, students will be able to

CO1: Attain ample knowledge in analyzing the settlement of the substructure

CO2: Trained to gain data in assessing the flow around the sheet pile wall

CO3: Analyzing capability for various the slope stability problems

CO4: Gain knowledge in various dynamic analysis problems.

CO5: Analyzing various structures like Raft, piled raft, embankment etc.

**ANALYSIS OF THE FOLLOWING**

1. Settlement analysis of footings on Cohesive and Cohesionless soil

2. Settlement analysis of piles

3. Analysis of Footings on stone columns

3. Analysis of an embankment

4. Analysis of Flow around a sheet pile wall

5. Settlement analysis of tunnel construction

6. Dynamic Analysis of a machine on an elastic foundation

7. Stability analysis of a dam under Rapid drawdown

8. Analysis of Raft foundation

9. Analysis of Piled Raft

10. Slope Stability Analysis

**SOFTWARES TO BE USED:**

Plaxis, Oaysis

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| *CO2* | *L* |  | *H* |  |  |  | *H* |  |  |  |  |
| *CO3* | *H* | *M* |  |  |  |  |  |  | *M* |  |  |
| *CO4* | *L* | *M* |  |  | *L* |  |  |  | *H* |  |  |
| *CO5* | *H* | *M* |  |  | *M* |  |  |  | *M* |  |  |

**18GEPC08 MINI PROJECT**

**L T P C**

**0 0 4 2**

**COURSE OBJECTIVE**

To get an idea on literature collection, problem identification and solution techniques in various geotechnical problems.

**COURSE OUTCOMES**:

At the end of the course, the student will be able to:

CO1. Identify geotechnical engineering problems reviewing available literature.

CO2. Study different techniques used to analyze complex Geotechnical systems.

CO3. Work on the solutions given and present solution by using his/her technique applying

engineering principles.

**SYLLABUS CONTENTS:**

Mini Project will have mid semester presentation and end semester presentation. Mid semesterpresentation will include identification of the problem based on the literature review on the topicreferring to latest literature available.

End semester presentation should be done along with the report on identification of topic for thework and the methodology adopted involving scientific research, collection and analysis of data, determining solutions highlighting individuals’ contribution.

Continuous assessment ofMini Project at Mid Sem and End Sem will be monitored by thedepartmental committee.

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| *CO1* | *L* |  |  | *H* |  |  |  |  |  |  |  |
| *CO2* | *L* |  | *H* |  |  |  | *H* |  |  |  |  |
| *CO3* | *H* | *M* |  |  |  |  |  |  | *M* |  |  |

**18GEPE01 ANALYTICAL AND NUMERICAL METHODS**

**(Common with M.E Structural Engineering)**

**L T P C**

**3 00 3**

**COURSE OBJECTIVES**

* To familiarize with numerical solutions of equation with one variable and system of equations.
* To obtain the knowledge of numerical interpolation, numerical differentiation and numerical integration.
* To acquire knowledge of numerical solution to first order ordinary differential equations using single and multi step techniques.
* To gain the knowledge of numerical solution to second order partial differential equations using explicit and implicit methods.

**COURSE OUTCOMES**

At the end of the course, the student will be able to

CO1:Understand the numerical solutions to algebraic, exponential, logarithmic, transcendental and linear system of simultaneous equations.

CO2**:** Acquire fluency in numerical interpolation techniques with equal and unequal intervals.

CO3:Understand the techniques of finite differences to apply for numerical differentiation, numerical quadrature and numerical cubature.

CO4:Understand numerical solution to first order ordinary differential equations by different methods like single step and multistep etc.

CO5:Understand numerical solution to second order partial differential equations by different methods using finite differences.

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| **UNIT I - SOLUTIONS OF EQUATIONS AND EIGEN VALUE PROBLEMS** | (09) |
| Error Analysis, Solutions of nonlinear algebraic and transcendental equations: Fixed point iteration method, Newton Raphson method, Solutions of linear system of equations: Gauss Elimination, Gauss Jordan, Gauss Seidel method - Eigen value of Matrix by Power method and Jacobi method. | |
| **UNIT II-CURVE FITTING AND INTERPOLATION** | (09) |
| Curve fitting: Method of least squares – Fitting a straight line, parabola and curves reducible to linear form, Newton’s divided difference formula - Lagrange’s interpolation - Newton Forward and backward difference formula. | |
| **UNIT III - NUMERICAL DIFFERENTIATION AND NUMERICAL INTEGRATION** | (09) |
| Numerical approximation of derivatives using interpolation polynomials - Numerical integration by Trapezoidal, Simpson’s one third and Simpson’s three eighth rules - Two point and three point Gaussian quadrature formula - Double integration using Trapezoidal and Simpson one third rule. | |
| **UNIT-IV : NUMERICAL SOLUTION OF ORDINARY DIFFERENTIAL EQUATIONS** | (09) |
| Taylor series method - Euler method - Modified Euler method - Fourth order RungeKutta method for solving first order equations - Predictor and corrector methods: Milne’s and Adam Bashforth methods | |
| **UNIT-V : NUMERICAL SOLUTION OF PARTIAL DIFFERENTIAL EQUATIONS** | (09) |
| Finite difference solutions for the second order ordinary differential equations - Finite difference solutions for one dimensional Heat Equation (Both Explicit and Implicit Methods) – One dimensional wave equation - Laplace and Poisson equation.  **TOTAL: 45hrs**  ***REFERENCE BOOKS:*** | |
| 1.Srimanthapal, Numerical Methods, Principles, Analyses and Algorithm,Oxford University Press,New Delhi, Ist Edition, 2009.  2.Kandasamy P, Thilagavathy K and Gunavathy K “Numerical Methods” for I year B.E/B.Tech” S.Chand& Co, Ramnagar, New Delhi, Reprint 2013.  3.Kandasamy P, Thilagavathy K and Gunavathy K “Numerical Methods” for I year B.E/B.Tech” S.Chand& Co, Ramnagar, New Delhi, Reprint 2013.  4.Veerarajan T and Ramachandran T “Numerical Methods with Programming in C” McGraw Hill Education Pvt Ltd, New Delhi, Ist Edition, Reprint,2016.  5.S.S.Sastry, Introduction to Methods of Numerical Analysis, Prentice Hall of India, Delhi, 5th Edition,2015.  6.Dr. J.S Chitode “Numerical Methods” Technical Publications, Pune, 2010. | |

**18GEPE02EARTH RETAINING STRUCTURES**

**L T P C**

**3 00 3**

**COURSE OBJECTIVE**

To impart knowledge on earth pressure theories, design of retaining walls, sheet pile walls with and without geosynthetic reinforcements.

**COURSE OUTCOMES**

At the end of the course, students will be able to

CO1: Understand earth pressure theoriesand computation of earth pressure

CO2: Capability to calculate the forces on retaining walls and design the retaining walls

CO3: Carry out Analysis and design of sheet pile walls

CO4: Design excavations, soil nailing, pinning, and anchoring on stability considerations.

CO5: Apply concepts of reinforcement in earth retaining structures.

**UNIT I EARTH PRESSURE THEORIES (09)**

Introduction – State of stress in retained soil mass – Classical earth pressure theories – Active and Passive earth pressures – Earth pressure at rest – Earth pressure due to external loads – Empirical methods – Wall movements and complex geometry – Graphical method of computing earth pressure – Rehbann’s and Culmann’s approach.

**UNIT II RETAINING WALLS (09)**

Retaining walls – Uses and types – Forces on retaining walls – Design of retaining walls by limit state method – General principles – Design and construction details – Design of solid gravity walls, Semi – gravity walls, cantilever walls, counterfort walls – Stability of retaining walls – Drainage arrangements and its influence.

**UNIT III SHEET PILE WALLS (09)**

Earth retaining structures – Selection of soil parameters – Analysis and design of cantilever and anchored sheet pile walls – Deadman and continuous anchor – Diaphragm and bored pile walls – Design requirements.

**UNIT IV BRACED EXCAVATION (09)**

Braced cuts in sand and clay – Lateral pressure on sheeting in Braced excavation – Stability against piping and bottom heaving – Procedure for computation of lateral earth pressure for braced cuts and Flexible Bulk heads – Soil anchors – Soil nailing – Soil pinning – Methods of design.

**UNIT V REINFORCED EARTH RETAINING WALL (09)**

Reinforced earth retaining wall – General principles, Concepts and Mechanism of reinforced earth – Design consideration of reinforced earth – Geotextile, geogrids, metal strips and facing elements – Construction – Selection of type of retaining structures – Construction practice – Field observations.

**TOTAL: 45hrs**

***REFERENCE BOOKS:***

1. Winterkorn H.F. and Fang H.Y., Foundation Engineering Hand book, Galgotia Book-source, 2000.
2. Rowe R.K., Geotechnical and Geo environmental Engineering Hand Book, Kluwer Academic Publishers, 2001.
3. Militisky .J and Woods R., Earth and earth retaining structures, Routledge, 1992.
4. Das B.M., Principles of Geotechnical Engineering (Fourth edition). The PWS series in Civil Engineering, 1998.
5. Clayton C.R.I. Militisky, J and Woods R., Earth pressure and earth retaining structures (second edition) Survey University Press, 1993.
6. McCarthy D.F., Essentials of soil Mechanics and foundations; Basic Geotechnics (sixth Edition) Prentice Hall, 2002

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| *CO2* |  |  | *H* |  | *M* |  |  |  | *H* |  |  |
| *CO3* | *H* |  |  |  | *L* |  |  |  |  |  |  |
| *CO4* | *M* |  | *M* |  | *H* |  |  |  | *M* |  |  |
| *CO5* | *M* |  | *M* | *L* | *H* |  |  |  | *H* |  |  |

**18GEPE03 REMOTE SENSING AND ITS APPLICATIONS IN**

**GEOTECHNICAL ENGINEERING**

**L T P C**

**3 0 0 3**

**COURSE OBJECTIVE**

To introduce the elements of GIS applied to Geotechnical Engineering and to be familiar with the use of GIS and GPS.

**COURSE OUTCOMES**

At the end of the course, students will be able

CO1: To study about the remote sensing system, analysis of data and the interpretation of data.

CO2: To obtain knowledge about remote sensing sensors and platforms.

CO3: To gain the knowledge about image interpretation and processing techniques.

CO4: To gain the knowledge about data collection and management of GIS.

CO5: Students know the application of GIS in various fields.

**UNIT I INTRODUCTION (09)**

Remote sensing Fundamentals: Definition – Scope –Types and historical development – Ideal and real remote sensing system. Comparison of conventionalsurvey, aerial remote sensing and satellite remote sensing –Advantages and limitationof satellite remote sensing.

EMR and Remote Sensing: Energy sources –Electro Magnetic Radiation – Spectralregions– Energy Interaction in the atmosphere – Atmospheric windows – EnergyInteraction with earth surface features – Spectral reflectance patterns for differentregion of EMR.

**UNIT II SENSORS AND PLATFORMS (09)**

Land observation satellites and sesnors LANDSAT- Classification of sensors and platforms LANSAT, SPOT, IRS and IKONSsensors– scanning and orbiting mechanisms – Resolution: spatial, spectral, radiometric and temporal resolution of the satellites –Classification of platforms.

**UNIT III IMAGES INTERPRETATION AND DIGITAL IMAGE PROCESSING (09)**

Interpretation procedure –Elements of Photo Interpretation–Strategies of Image Interpretation –Keys of Image Interpretation –Basic equipments for Image Interpretation –Digital Signal Processing Digital analysis – Image Rectification and Restoration – Geometric correction – Image Enhancement and Image transformation.

**UNIT IV GEOGRAPHICAL INFORMATION SYSTEM (GIS) (09)**

Definition data input and output : Topology, Digital elevation data – Data management – Relational data model –Spatial data models – Raster and Vector data Models –GIS analysis – Classification, overlay operation.

**UNIT V APPLICATION OF RS AND GIS IN GEOTECHNICAL ENGINEERING (09)**

Role of Remote Sensing and GIS in terrain investigation – Digital Terrain Modelling(DTM) –Triangulated Irregular Network(TIN) – Land use and Land cover mapping –Landslide studies and seismic hazard mapping.

**TOTAL:45hrs**

***REFERENCE BOOKS:***

1. AM Chandra, SK Ghosh,Remote Sensing and Geographic information system, Narosa Publishing house.

2. Lillesand T.M. and Kiefer R.W., Remote Sensing and image interpretation*,* John Wiley and Sons. New York.

3. J.B. Campbell, Taylor & Francis, Introduction to remote sensing*,* London.

4. J.R. Jensen*,* Introductory digital image processing, Prentice Hall International Ltd., London.

5. Kennie, T.J.M. and Matthews M.C., Remote Sensing in Civil Engineering, Surrey University Press, Glasgow.

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| *CO2* |  |  |  | *L* |  |  |  |  |  |  |  |
| *CO3* |  |  |  | *M* |  |  |  |  |  |  |  |
| *CO4* |  | *M* |  | *H* |  | *H* |  |  | *H* |  |  |
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**16GEPE04SOIL PROPERTIES AND BEHAVIOUR**

**L T P C**

**3 003**

**COURSE OBJECTIVE**

To study about clay minerals, physical, physio-chemical, expansive and conduction behaviourof soils.

**COURSE OUTCOMES**

At the end of the course, students will be able to

CO1 : Get knowledge about the structure and identification of clay minerals.

CO2 : Use the concept of diffuse double layer theory and the cation exchange capacity to .determine the chemical behaviour of soils.

CO3 : Understand the mechanism and effects of swelling, shrinkage in clay soils.

CO4 : Understand the behaviour of collapsible soil.

CO5 : Use the clay models in conduction phenomenon to predict the engineering behaviour . of soils.

**UNIT I - FORMATION OF SOILS AND CLAY MINERALS (09)**

Introduction – Soil Formation – Types of soils – Geological and pedogical background – Various soil deposits and their engineering suitability – Composition and structure of clay minerals – Structure of allophone, kaolinite, hallosite, montmorillonite, illite, chlorite and vermiculite minerals, mixed layer minerals - Classification and identification of clay minerals – X- ray diffraction data – electron microscopic analysis – Differential thermal analysis – Anion and cation exchange capacity of clays – Specific surface area – Bonding in clays.

**UNIT II - PHYSICAL AND PHYSIO-CHEMICAL BEHAVIOUR OF SOILS (09)**

Physical and Physio-Chemical behaviour of Soils – Diffused double layer theory – Computation of double layer distance – Dielectric constant – Temperature on double layer – Ion Exchange – Cation exchange capacity – Causes of cation exchange effect – Fixation of cations – Determination of cation exchange capacity – Exchangeable cations.

**UNIT III - EXPANSIVE AND SHRINKING SOIL (09)**

Introduction – Swelling and shrinking behaviour of soils – Problems associated – Characteristics affecting shrinkage – Crack formation during shrinkage – Measurements of shrinkage for samples – Factors influencing swell – Shrink characteristics – Swelling pressure of soils – Swell pressure determination – Mechanism of swelling – Volume changes and Engineering problems in the field – Osmotic swell pressure – Soil fabric and measurement – Sensitivity, activity - thixotrophy - Stress history – Identification of expansive clays.

**UNIT IV - COMPRESSIBILITY AND COLLAPSIBLE SOIL (09)**

Introduction – Compressibility – Permeability behaviours of soils and clays – Mechanism involved – Factors governing compressibility – Soil water – Consumption of soil water – Capillary tube, capillary potential – Soil moisture – Methods of determination of soil moisture – Physical behaviour of soil water systems – Liquefaction – Liquefaction potential – Soil suction – Determination of suction potential – Collapsible soil – its identification – Effect on foundation.

**UNIT V - CONDUCTION PHENOMENON AND PREDICTION OF SOIL BEHAVIOUR (09)**

Conduction in soils – Coupled flows – Electrical, Chemical, Hydraulic and Thermal flows in soils – Consolidation by Electro-osmosis – Clay mineralogy in relation to physical and engineering properties of clay minerals – Prediction of engineering behaviour of soils – Empirical correlations and their applicability – Granular soil structure – Clay structure models.

**TOTAL: 45hrs**

***REFERENCE BOOKS:***

1. Bowles J.E., Engineering properties of soils and their measurement, McGraw Hill 1970.
2. Mitchell J.K., Fundamentals of Soil Behaviour, John Wiley, New York, 1993.
3. Yong R.N. and Warkentin, B.P., Introduction of Soil Behaviour, Macmillan, Limited, London, 1979.
4. Das B.M. Principles of Foundation Engineering , PWS Publishing company, Boston, 1999.
5. McCarthy D.F., Essentials of Soil Mechanics and Foundations, Prentice Hall, 2002.

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| *CO1* | *L* |  | *H* | *M* | *H* | *H* |  |  |  |  |  |
| *CO2* | *M* |  |  |  | *L* |  |  |  |  |  |  |
| *CO3* |  |  |  | *H* |  |  |  |  | *L* | *M* | *H* |
| *CO4* |  |  |  |  |  | *H* |  |  |  |  |  |
| *CO5* | *H* | *M* |  |  |  | *H* |  |  |  |  |  |

**16GEPE05 FINITE ELEMENT ANALYSIS**

**L T P C**

**3 0 0 3**

**COURSE OBJECTIVE**

To develop skills in the matrix operations to obtain solution for 1D and 2D problemsand axisymmetric and non-linear analysis.

**COURSE OUTCOMES**

At the end of the course, students will be able to

CO1 : Understand the various stress-strain-displacement relations.

CO2 : Know the concept of stiffness matrix and understand choosing boundary conditions.

CO3 :Do the discretization of elements to solve the problems of plane stresses and plane strain, types of non linearity and their solutions.

CO4: Exposure towards various concepts in geotechnical finite element analysis

CO5:Software applications of variousgeotechnical field problems

**UNIT I INTRODUCTION TO ELASTICITY (09)**

Principles of Elasticity – Stress equations – Strain-Displacement relationships in matrix form – Plane stress – Plane strain and axisymmetric bodies of revolution with axisymmetric loading.

**UNIT III: FINITE ELEMENT PROCESS(09)**

Principles of discretization, element stiffness and mass formulation based on direct,

variational and weighted residual techniques and displacements approach, Shape functions andnumerical integrations, convergence.

**UNITIII ELEMENT PROPERTIES AND ISOPARAMETRIC FORMULATIONS (09)** Concept of an element – Various element shapes– Displacement models – Generalized coordinates – Shape functions – Formulation of 4-noded and 8-noded isoparametric quadrilateral elements – Lagrangian elements – Serendipity elements.

**UNIT IV: SOIL APPLICATIONS(09)**

Settlement Analysis, 2-D elastic solutions for homogeneous, isotropic medium, Steady

Seepage Analysis: Finite element solutions of Laplace’s equation, Consolidation Analysis:

Terzaghi consolidation problem, Choice of Soil Properties for Finite Element Analysis

**UNIT V SOFTWARE APPLICATIONS (09)**

Introduction to PLAXIS software – Applications of PLAXIS 2D on tunnel construction – Consolidation analysis of embankments – Soil displacement around excavation pit – Pore pressure distribution – Flow around a sheet pile wall – Pile driving –Flow through an embankment – Settlement of a footing on sand and clay – Construction of a road embankment.

**TOTAL: 45hrs**

***REFERENCE BOOKS:***

1. Krishnamurthy, Finite Element Analysis – Theory and programming, Second edition, Tata McGraw Hill Publishing Co., 1994.
2. Desai C.S., Elementary Finite Element Method, Prentice Hall, IINC, 1979.
3. Rajasekaran S., Finite Element Analysis in Engineering Design, Wheeler publishing 1993.
4. ChandrapatlaTirupathi, R and Belegundu Ashok, D., Introduction to Finite Elements in Engineering, Second edition, Prentice Hall of India, 1997

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| *CO3* | *H* |  | *H* |  |  | *H* |  |  |  |  |  |
| *CO4* | *M* |  |  |  | *M* |  | *H* |  | *M* |  |  |
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**18GEPE06 REINFORCED SOIL STRUCTURES**

**L T P C**

**3 00 3**

**COURSE OBJECTIVE**

To impart knowledge on geosynthetics, design principles and mechanism of reinforced soil, soil nailing and its applications in dams, embankments, pavements and foundation structures.

**COURSE OUTCOMES**

At the end of the course, students will be able to

CO1 :Understand the soil reinforcement interaction mechanism.

CO2: Enrich their knowledge on properties, testing methods of geosynthetics in earth reinforcement.

CO3: Detailed knowledge on soil reinforcement functions and the ability to select suitable reinforcing material to suit the functional requirement

CO4: Understand the design criteria for use of geosynthetics in landfills, pavement, liners

CO5: Design various soil reinforcements, soil nailing in major projects.

**UNIT I PRINCIPLES AND MECHANISMS (09)**

Historical background – Initial and recent developments – Principles – Concepts and mechanisms of reinforced soil – Factors affecting behaviour and performance of soil – Reinforcement interactions.

**UNIT II MATERIALS AND MATERIAL PROPERTIES (09)**

Materials used in reinforced soil structures – Fill materials, reinforcing materials, metal strips, Geotextile, Geogrids, Geomembranes, Geocomposites, Geojutes, Geofoam, natural fibres, coir Geotextiles – Bamboo – Timber – Facing elements – Properties – Methods of testing – Advantages and disadvantages – Preservation methods.

**UNIT III DESIGN PRINCIPLES AND APPLICATIONS (09)**

Design aspects of reinforced soil – Soil reinforcement function – Separator, Filtration, Drainage, Barrier function – Design and applications of reinforced soil of various structures – Retaining walls – Foundations – Embankments and slopes.

**UNIT IV GEOSYNTHETICS AND APPLICATIONS (09)**

Introduction – Historical background – Applications – Design criteria – Geosynthetics in roads – Design – Giroud and Noiray approach – Geosynthetics in landfills – Geosynthetic clay liner – Design of landfills – Barrier walls.

**UNIT V SOIL NAILING AND CASE HISTORIES (09)**

Soil nailing – Introduction – Overview – Soil-Nail interaction – Behaviour – Design procedure – Behaviour in seismic conditions.

Performance studies of reinforced dams, embankments, Pavements, Railroads, Foundations– Case studies.

**TOTAL:45hrs**

***REFERENCE BOOKS:***

1. Jewell, R.A., Soil Reinforcement with Geotextile, CIRIA, London, 1996.
2. John, N.W.M., Geotextiles, John Blackie and Sons Ltd., London, 1987.
3. Jones, C.J.F.P., Earth Reinforcement and Soil Structures, Earthworks, London, 1982.
4. Koerner, R.M., Designing with Geosynthetics, (Third Edition), Prentice Hall, 1997.
5. Proc. Conference on polymer and Reinforcement, Thomas Telford Co., London, 1984.
6. Gray, D.H., and Sotir, R.B., Biotechnical and Soil Engineering Slope Stabilization. A Practical Guide for Erosion Control, John Wiley & Son Inc., New York, 1996.
7. RamanathaAyyar, T.S., Ramachandran Nair, C.G. and Balakrishna Nair, N., Comprehensive reference book on Coir Geotextile, Centre for Development for Coir Technology, 2002.

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**18GEPE07 SLOPE STABILITY AND LANDSLIDES**

**L T P C**

**3 003**

**COURSE OBJECTIVE**

To impart knowledge on investigation, analysis, design and stabilization of slopes.

**COURSE OUTCOMES**

At the end of the course, students are able to

CO1: Gain knowledge about the purpose of computing slope stability.

CO2: Ability to analyse stability of slopes in cohesive and cohesionless soils.

CO3: Familiar on the analysis of irregular slopes with different approaches

CO4: Reasoning about causes of landslides in different soil conditions

CO5: Understand the use of instrumentation in the slope stability and execute suitable ground improvement techniques in the field.

**UNIT I STABILITY OF SLOPES (09)**

Introduction – Importance – General characteristics – Types of failures – Causes of failures – Purpose of stability computation – Investigation of failures – Procedure – Case studies.

**UNIT II STABILITY ANALYSIS (09)**

Stability analysis – Method of slices – Friction circle method – Soils with cohesion – Soils with cohesion and angle of internal friction. Critical states for design for embankments – Stability computations – Evaluation of pore water pressure.

**UNIT III IRREGULAR SLOPES (09)**

Non-uniform soils – Janbu’s analysis – Taylor’s analysis – Bishop’s analysis – Total stress and effective stress approaches – Composite surfaces of sliding – Block sliding.

**UNIT IV LAND SLIDES (09)**

General Characteristics – Sources–Stability of Hill side slopes – Open cuts – Engineering problems involving the stability of slopes – Cuts in sand – Cuts in loess – Homogeneous and soft clay slopes – Sudden spreading of clay slopes – Clay flows – Clays containing pockets and sand masses – Slides in stiff clay slopes on shale – Slopes on weathered rock; talus slopes, slopes on over consolidated clays – Slides along coastal areas and tropically weathered residual soils – Long term stability of clay slopes.

**UNIT V FIELD OBSERVATIONS AND SLOPE STABILIZATION (09)**

Field instrumentation – Observation studies during construction – Post construction, piezometers – Settlement plates – Inclinometer – Case histories.Compaction of new embankments – Compaction of natural masses of soil and existing fills – Compaction of deep deposits of sand – Vibroflotation – Compaction of compressible soils – Drainage as a means of stabilization – Use of Geotextiles – Soil nailing.

**TOTAL: 45hrs**

***REFERENCE BOOKS:***

1. Chowdhury, D.F., Slope analysis, Prentice Hall, 1988.
2. Winterkorn, H.F. and Fang, H.Y., Foundation Engineering Handbook, Van Nostrand Reinhold, 1994.
3. Bramhead, E.N., The Stability of Slopes, Blacky Academic and Professionals Publications, Glasgow 1986.
4. Anderson, M.G., and Richards, K.S., Slope Stability, John Wiley, 1987.

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| *CO5* |  |  |  | *L* |  |  |  |  | *H* |  | *M* |

**18GEPE08 ROCK MECHANICS IN ENGINEERING PRACTICE**

**L T P C**

**3 0 0 3**

**COURSE OBJECTIVE**

To make the students understand the properties of rock, pattern of failure, evaluation of stresses and stability considerations of rock masses.

**COURSE OUTCOMES**

At the end of the course, students will be able to

CO1:Know the formation and classification of rocks in India.

CO2:To understand the strength of the rocks in field assessment

CO3:Understand the in-situ stresses developed and methods of measurement.

CO4:Evaluate the strength parameters of rocks and adopt appropriate remedial measures for stability of critical slopes of rocks.

CO5:To give suitable remedial measures in fractured rocks.

**UNIT I CLASSIFICATION OF ROCKS (09)**

Rocks of peninsular India and the Himalayas – Index properties and classification of rock masses, competent and incompetent rock – Value of RMR and ratings in field estimations.

**UNIT II STRENGTH CRITERIA OF ROCKS (09)**

Behaviour of rock under hydrostatic compression and deviatoric loading – Modes of rock failure – Planes of weakness and joint characteristics – Joint testing, Mohr – Coulomb failure criterion and tension cut-off, Hoek and Brown Strength criteria for rocks with discontinuity sets.Value of RQD rating in field estimations.

**UNIT III DESIGN ASPECTS IN ROCKS (09)**

Insitu stresses and their measurements, flat jack – Over and under coring methods – stress around underground excavations – Design aspects of openings in rocks – Case studies.

**UNIT IV SLOPE STABILITY OF ROCKS (09)**

Rock slopes – Role of discontinuities in slope failure, slope analysis and factor of safety – Remedial measures for critical slopes – Case studies.

**UNIT V REINFORCEMENT OF ROCKS (09)**

Reinforcement of fractured and jointed rocks – Shotcreting – Bolting – Anchoring – Installation methods – Case studies.

**TOTAL: 45hrs**

***REFERENCE BOOKS:***

1. Goodman, R.E., Introduction to Rock Mechanics, John Wiley and Sons, 1989.
2. Hool, E and Bray, J., Rock Slope Engineering, Institute of Mining and Metallurgy, U.K. 1981.
3. Hoek, E and Brown, E.T., Underground Excavations in Rock, Institute of Mining and Metallurgy, U.K. 1981.
4. Obvert, L. and Duvall, W., Rock Mechanics and the Design of Structures in Rock, John Wiley, 1967.
5. Bazant, Z.P., Mechanics of Geomaterials Rocks, Concrete and Soil, John Wiley and Sons, Chichester, 1985.
6. Wittke, W., Rock Mechanics:Theroy and Applications with Case Histories, Springerverlag, Berlin, 1990.

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**16GEPE09FOUNDATION IN EXPANSIVE SOILS**

**L T P C**

**3 0 0 3**

**COURSE OBJECTIVE**

To get exposure on the properties of expansive soils and to study about the substructures placed on expansive soils.

**COURSE OUTCOMES**

At the end of the course, students will be able to

CO1: To Assess the occurrence and distribution of expansive soils.

CO2: To Study the properties of expansive soils and the controlling techniques.

CO3: To Understand various methods of stabilization of expansive soils and foundations

used in expansive soils.

CO4: Design foundations on expansive soil.

CO5: Select suitable techniques and understand the mechanism of treatment of swelling

Soils.

**UNIT I - GENERAL PRINCIPLES (09)**

Origin of expansive soils – Physical properties of expansive soils –Mineralogical composition – Identification of expansive soils – Fieldconditions that favour swelling – Consequences of swelling.

**UNIT II - SWELLING CHARACTERISTICS(09)**

Swelling characteristics – Laboratory tests – Prediction of swellingcharacteristics – Evaluation of heave.

**UNIT III - TECHNIQUES FOR CONTROLLING SWELLING(09)**

Horizontal moisture barriers – Vertical moisture barriers – Surface andsubsurface drainage – Prewetting – Soil replacement – Sand cushiontechniques – CNS layer technique.

**UNIT IV - FOUNDATIONSON EXPANSIVE SOILS(09)**

Belled piers – Bearing capacity and skin friction –Advantages anddisadvantages – Design of belled piers – Underreamed piles – Design andconstruction.

**UNIT V - MODIFICATION OF SWELLING CHARACTERISTICS (09)**

Lime stabilization – Mechainsms – Limitations – Lime injection – Limecolumns – Mixing – Chemical stabilization – Construction.

**TOTAL :45hrs**

***REFERENCE BOOKS:***

1. Fu Hua Chen, Foundations on Expansive Soils, Elsevier ScientificPublishing Company, New York.

2. GopalRanjan and A.S.RRao, Basic and Applied Soil Mechanics,NewAge International Publishers –New

Delhi.

3. Hand Book on Underreamed and Bored Compaction Pile Foundation,CBRI, Roorkee.

4. IS : 2720 (Part XLI) – 1977 – Measurement of Swelling Pressure of Soils.

5. R.K.Katti, Search for Solutions in Expansive Soils.

6. Alam Singh, Modern Geotechnical Engineering, Geo-EnvironAcademia, Jodhapur.

7. Swami Saran, Analysis and Design of Substructures.

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| *CO2* | *L* |  | *H* | *M* | *H* |  |  | *M* |  |  |  |
| *CO3* | *H* |  |  |  | *H* | *M* |  |  | *M* |  | *M* |
| *CO4* | *H* |  |  |  | *H* | *H* |  | *H* |  |  | *H* |
| *CO5* | *M* |  |  |  | *H* | *H* |  | *M* |  |  |  |

**18GEPE10 GEOLOGY IN GEOTECHNICAL ENGINEERING**

**L T P C**

**3 003**

**COURSE OBJECTIVE**

To understand microscopic study of rocks, geophysical exploration for ground water and structural geology and also causes and preventing measures of landslides.

**COURSE OUTCOMES**

At the end of the course, students will be able to

CO1: To identify the soil types and its historical background of formation.

CO2 : Identify mineral content, texture and structural behaviour of rocks using microscopic study.

CO3: Carryout investigation for foundations of massive structures, handle situations of earthquake and landslide.

CO4: Do ground water survey and understand ground water investigation studies.

CO5: To obtain knowledge about structural problems and recognition of field and give the suitable remedial measures.

**UNIT I INTRODUCTION (09)**

Soil formation – Soil types of India – Texture formation and structure of igneous, sedimentary and metamorphic rocks. Microscopic study – Microscopic study of rocks with particular reference to texture – microscopic study of unconsolidated sediments with reference to their grain size and mineral content.

**UNIT II GEOPHYSICAL INVESTIGATION (09)**

Geotechnical Investigation – Geophysical methods of subsurface investigations – Electrical, Magnetic, gravitational, seismic, radioactive and geochemical methods – Influence of structure and texture of rocks, Engineering properties, foundation problems in igneous, sedimentary and metamorphic rocks including recent sediments – Case studies.Investigations for foundation of dams and reservoirs – Problem encountered and treatment, case studies – Investigation of canals and deep cuts – Case studies.

**UNIT III LAND SLIDES (09)**

Land Slides – Causes – Preventive and control measures – Engineering problems related to earthquakes, case studies- seismic zones in India-causes and features of earthquake

**UNIT IV GROUND WATER (09)**

Ground Water problems – Location of water tables, composition of ground water – Ground water surveys – Conservation of ground water – Scope of ground water investigation in Civil Engineering.

**UNIT V STRUCTURAL GEOLOGY (09)**

Altitude of beds – Dip and Strike, Characteristics, Types, Causes and mechanism of folding, Classification, Causes and mechanism of faults – Field evidences and Recognition of faults.Joint systems – Classification and its types, Difference between faults and joints.Definition, importance and field recognition of unconformity.

**TOTAL: 45hrs**

***REFERENCE BOOKS:***

1. ParbinSingh,Engineering and General Geology, Katson Publication House, 1987.
2. Blyth, Geology for Engineering, ELBS 1995.
3. Legget, Geology and Engineering, McGraw Hill Book Company, 1998.
4. Krynine and Judd, Principles of Engineering Geology and Geo techniques, 1998.

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| *CO4* | *M* |  |  |  | *L* |  | *L* |  | *L* |  |  |
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**18GEPE11 SOIL STRUCTURE INTERACTION**

**(Common with M.E Structural Engineering)**

**L T P C**

**3 003**

**COURSE OBJECTIVE**

To get an idea on soil structure interaction, soil foundation models, finite difference and finite element analysis and elastic analysis of piles and piled raft.

**COURSE OUTCOMES**

At the end of the course, students will be able to

CO1: Understand various soil response models applicable to soil-foundation interaction analysis.

CO2: Come up with elastic solutions for problems of pile, pile-raft system.

CO3: Use software packages to analyze soil-foundation system including laterally loaded piles.

CO4:Acquire knowledge on elastic analysis of pile and pile group

CO5:Acquire knowledge on analysis of laterally loaded piles

**UNIT I - SOIL - FOUNDATION INTERACTION (09)**

Introduction to soil – Foundation interaction problems – Soil behaviour – Foundation behaviour – Interface behaviour – Scope of soil-foundation interaction analysis – Soil response models – Winkler, Elastic continuum, Two parameter elastic models, Elastic – Plastic behaviour – Time dependent behaviour.

**UNIT II - BEAMS ON ELASTIC FOUNDATION - SOIL MODELS (09)**

Infinite beam – Two parameters – Isotropic elastic half space – Analysis of beams of finite length – Classification of finite beams in relation to their stiffness – Analysis through application packages.

**UNIT III - PLATE ON ELASTIC MEDIUM (09)**

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 – Analysis of braced cuts – Application packages.

**UNIT IV ELASTIC ANALYSIS OF PILE (09)**

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 – Pile raft – Application packages.

**UNIT V LATERALLY LOADED PILE (09)**

Load deflection prediction for laterally loaded piles – Subgrade reaction and elastic analysis – Interaction analysis – Pile raft system – Solutions through influence charts –Application packages.

**TOTAL: 45hrs**

***REFERENCE BOOKS:***

1. Saran, S., Analysis and design of substructures, Taylor & Francis Publishers, 2006.
2. Hemsley, J.A., Elastic Analysis of Raft Foundations, Thomas Telford, 1998.
3. Poulos, H.G., and Davis, E.H., Pile Foundation Analysis and Design, John Wiley, 2008.
4. Murthy, V.N.S., Advanced Foundation Engineering, CBS Publishers, New Delhi, 2007.
5. McCarthy, R.N., Essentials of Soil Mechanics and Foundations: Basic Geotechnics, Sixth Edition, Prentice Hall, 2002.
6. Selvadurai, A.P.S., Elastic Analysis of Soil Foundation Interaction, Elsevier, 1979.
7. Scott, R.F., Foundation Analysis, Prentice Hall, 1981.
8. Structure Soil Interaction – State of Art Report, Institution of structural Engineers, 1978.
9. ACI 336, Suggested Analysis and Design Procedures for Combined Footings and Mats, American Concrete Institute, Delhi, 1988.

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**18GEPE12 GEOTECHNICAL EARTHQUAKE ENGINEERING**

**(Common with M.E Structural Engineering)**

**L T P C**

**3 003**

**COURSE OBJECTIVE**

To understand the mechanism of earthquake, wave propagation analysis, ground motion, earthquake hazards, their mitigation and design of earthquake resistant foundations.

**COURSE OUTCOMES**

At the end of the course, students will be able to

CO1 :Acquire knowledge about the earthquake ground motion, making familiar with code and software packages to study the ground motion.

CO2 :Analyze the liquefaction susceptibility of the site using laboratory and field tests.

CO3 : Design earthquake resistant geotechnical structures and the methods to improve the ground for hazard resistance.

CO4:Acquire knowledge about Seismic related codes in geotechnical engineeing

CO5:Acquire knowledge about soil improvement for remediation of seismic hazards

**UNIT I EARTHQUAKE SEISMOLOGY (09)**

Causes of earthquake – Plate tectonics –Earthquake Fault sources – Elastic Rebound theory – Seismic waves– Elastic Rebound theory – Locating an earthquake – Quantification of earthquakes – Intensity and magnitudes – Locating an earthquake –Case studies.

**UNIT II GROUND MOTION AND GROUND RESPONSE ANALYSIS (09)**

Characteristics of ground motion – Factors influencing ground motion – Evaluation of shear wave velocity – Lab tests – Need for Ground Response Analysis – Methods of Ground Response analysis.

**UNIT III LIQUEFACTION AND LATERAL SPREADING (09)**

Liquefaction related phenomena – Liquefaction susceptibility – Evaluation of liquefaction by Cyclic Stress and Cyclic Strain approaches – Lateral deformation and spreading – Criteria for mapping liquefaction hazard zones – Liquefaction computation from Lab and Field tests.

**UNIT IV SEISMIC DESIGN OF FOUNDATIONS, RETAINING WALLS AND SLOPES (09)**

Seismic design requirements of foundation – Seismic design of pile foundations – Seismic design of retaining walls – Behaviour of reinforced slope under seismic condition – Recommendations of seismic codes related to geotechnical engineering.

**UNIT V SEISMIC HAZARD ANALYSIS (09)**

Seismic hazard analysis – DSHA – PSHA – Seismic microzonation – Soil Improvement for remediation of seismic hazards.

**TOTAL: 45hrs**

***REFERENCE BOOKS:***

1. KameswaraRao, N.S.V., Dynamics soil tests and applications, Wheller Publishing – New Delhi, 2000.
2. Krammer S.L., Geotecnical Earthquake Engineering, Prentice hall, International series Pearson Education (Singapore) Pvt. Ltd., 2004.
3. KameswaraRao, Vibration Analysis and Foundation Dynamics, Wheeler Publishing, New Delhi, 1998.
4. McGuire, R.K., Seismic Hazard and Risk Analysis, Earthquake Engineering Research Institute. MNo – 10, ISBN 0-943198-01-1, 2004.
5. Mahanti, N.C., Samal, S.K., Datta, P., Nag N.K., Disaster Management, Narosa Publishing House, New Delhi, India ISBN : 81-7319-727X-2006.
6. Bharat Bhushan Prasad, Fundamentals of Soil Dynamics and Earthquake Engineering, PHI Learning Pvt.Ltd.,NewDelhi, 2009.
7. Bharat Bhushan Prasad, Advanced Soil Dynamics and Earthquake Engineering, PHI Learning Pvt.Ltd.,NewDelhi, 2011.

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**18GEPE13 ENVIRONMENTAL ENGINEERING STRUCTURES**

**(Common with M.E Structural Engineering and M.E Environmental Engineering)**

**L T P C**

**3 003**

**COURSE OBJECTIVES**

**To acquire knowledge about design of pipes, concrete roofing , design of water tank and special structures.**

**COURSE OUTCOMES**

At the end of the course students will be able to

CO1 :   Design concrete roofing systems, pipelines and pumping stations.

CO2 :   Analyze and Design water tanks and special purpose structures

CO3 :   Get knowledge about serviceability and durability of structures.

CO4 :   To acquire knowledge about design of pipes and concrete roofing

CO5 :  Able to do design of water tank and special structures

**UNIT I DESIGN OF PIPES (09)**

**Structural design of Concrete, Prestressed Concrete, Steel and Cast iron pipes - piping mains – joints – Leak detection - sewerage tank design – anchorage for pipes – massive outfalls – structural design - laying – Testing - hydrodynamic considerations - Advances in the manufacture of pipes.**

**UNIT II DESIGN OF CONCRETE ROOFING SYSTEMS (09)**

**Design of concrete roofing systems – Cylindrical, Spherical and Conical shapes using membrane theory and design of various types of folded plates for roofing with concrete – Design of pumping stations – Drainage plan of a building.**

**UNIT III ANALYSIS AND DESIGN OF WATER TANKS (09)**

**IS Codes for the design of water retaining structures.**

**Design of circular, rectangular, spherical and Intze type of tanks using concrete. Design of prestressed concrete cylindrical tanks – Economic analysis – introduction to computer aided design and packages.**

**UNIT IV DESIGN OF SPECIAL PURPOSE STRUCTURES (09)**

**Underground reservoirs and swimming pools, Intake towers, Structural design including foundation of water retaining structures such as settling tanks, clari-flocculators, aeration tanks, etc.,- effect of earth pressure and uplift considerations – selection of materials of construction.**

**UNIT V REPAIR AND REHABILITATION OF STRUCTURES (09)**

**Diagnosing the cause and damage, identification of different types of structural and non-structural cracks – repair and rehabilitation methods for Masonry, Concrete and Steel Structures.Exposure on Steel, Lattice Structures used in water and sewerage works.**

***REFERENCE BOOKS****:*

**1.Prestressed Concrete by KrishnaRaju, Tata McGraw Hill Publishing Co. 2nd edition, 1988.**

**2. Reinforced Concrete by N. C. Sinha& S .K. Roy -S. Chand and Co.1985.**

**3. Hulse R. and Mosley W. H., Reinforced Concrete Design by Computer, Macmillan Education Ltd., 1986.**

**4. Ramaswamy G. S., Design and Construction of Concrete shell roofs, CBS Publishers, India, 1986**

**5. Green J. K. and Perkins P. H., Concrete liquid retaining structures, Applied Science Publishers, 1981**

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| *CO3* |  | *H* |  |  | *H* |  |  |  |  |  |  |
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**16GEPE14 ENVIRONMENTAL GEOTECHNOLOGY**

**L T P C**

**3 0 0 3**

**COURSE OBJECTIVE**

To acquire knowledge on the geotechnical engineering problems associated with soil contamination, safe disposal of waste, stabilization of waste, transportation of contaminant and site remediation techniques.

**COURSE OUTCOMES**

At the end of the course, students will be able to

CO1: Assess the causes of soil pollution and identify the factors governing soil pollutant

interaction.

CO2: Design landfill for safe disposal sub soil of waste.

CO3: Understand the mechanism of transport of contaminants in subsoil.

CO4: Select suitable technique for the stabilization of solid waste.

CO5: Select appropriate technique for the remediation of contaminated site.

**UNIT I - SOIL POLLUTANT INTERACTION (09)**

Introduction to Geoenvironmental engineering – Environmental cycle – Sources, production and classification of waste – Causes of soil pollution – Factors governing soil – Pollutant interaction – Failures of foundations due to pollutants – Case studies.

**UNIT II - SITE SELECTION AND SAFE DISPOSAL OF WASTE (09)**

Safe disposal of waste – Site selection for landfills – Characterization of landfill sites– Risk assessment – Stability of landfills – Current practice of waste disposal – Design of landfill - Monitoring facilities – Passive containment system – Leachate contamination - Hydrological consideration in landfill design – Application of geosynthetics in solid waste management – Rigid and flexible liners – Design.

**UNIT III - TRANSPORT OF CONTAMINANTS (09)**

Contaminant transport in sub surface – Advection – Diffusion – Dispersion – Governing equations – Contaminant transformation – Sorption – Biodegradation – Ion exchange – Precipitation –Ground water pollution – Bearing capacity of compacted fills – Foundation for waste fill ground – Pollution of aquifers by mixing of liquid waste – Protection of aquifers.

**UNIT IV - WASTE STABILIZATION AND DISPOSAL (09)**

Hazardous waste control and storage system – Stabilization/Solidification of wastes – Micro and Macro encapsulation – Absorption, adsorption, precipitation – Detoxification – Mechanism of stabilization – Organic and inorganic stabilization – Utilization of solid waste for soil improvement – Case studies.

**UNIT V - REMEDIATION OF CONTAMINATED SOILS (09)**

Rational approach to evaluate and remediate contaminated sites – Monitored natural attenuation – Ex-situ and in-situ remediation – Solidification, Bio-remediation, incineration, soil washing, electro kinetics, soil heating, vitrification, bio-venting – Ground water remediation – Pump and treat, air sparging, reactive well –Case studies.

**TOTAL: 45hrs**

***REFERENCE BOOKS:***

1. Wentz, C.A., Hazardous Waste Management, McGraw Hill, Singapore, 1989.
2. Daniel, D.E., Geotechnical Practice for waste disposal, Chapman and Hall, London, 1993.
3. Proceedings of the International symposium of Environmental Geotechnology (Vol. I and II), Environmental Publishing Company, 1986 and 1989.
4. Ott, W.R., Environmental Indices, Theory and Practice, Ann. Arbor, 1978.
5. Fried, J.J., Ground Water Pollution, Elsevier, 1975.
6. ASTM Special Technical Publication 874, Hydraulic Barrier in Soil and Rock, 1985.
7. Westlake, K., Landfill Waste pollution and Control, Albion Publishing Ltd., England, 1995.
8. Lagrega, M.D., Buckingham, P.L., and Evans, J.C., Hazardous Waste Management, McGraw Hill, Inc. Singapore, 1994.
9. Zheng C “Applied Contaminant Transport Modelling” John Wiley and Sons.
10. Oweis I.S and Khera R.P, “Geotechnology of waste management, PWS publishing company, Boston
11. Fang H.Y “Introduction to Environmental Geotechnology “CRC press , Boca Raton.

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| *CO3* |  |  |  |  |  |  | *M* | *H* | *L* |  |  |
| *CO4* | *H* |  |  |  |  | *M* |  |  |  |  | *H* |
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**16GEPE15 PAVEMENT ENGINEERING**

**L T P C**

**3 00 3**

**COURSE OBJECTIVE**

To gain knowledge on assessing stresses, design of flexible and rigid pavements and pavement rehabilitation techniques.

**COURSE OUTCOMES**

At the end of the course, students will be able to

CO1 : Learn loading conditions and corresponding stresses and deformation developed.

CO2: Carry out material characterization and the designof flexible pavement.

CO3: Design of rigid pavement as per IRC guidelines.

CO4: Evaluate pavement and to select appropriate rehabilitation technique.

CO5: Select suitable stabilizers and there applicability in pavements.

**UNIT I - BASIC CONCEPTS (09)**

Pavement – types – Historical developments – Approaches to pavement design – Vehicle and traffic considerations – Behaviour of road materials under repeated loading – Stresses and deflections in layered systems.

**UNIT II - FLEXIBLE PAVEMENT (09)**

Factors affecting flexible pavements–Material characterization for analytical pavement design – CBR and stabilometer tests – Resilient modulus – Fatigue subsystem – Failure criteria for bituminous pavements – IRC design guidelines.

**UNIT III - RIGID PAVEMENT (09)**

Factors affecting rigid pavements – Design procedures for rigid pavement – IRC guidelines – Design of joints, reinforcements , tie bars, dowel bars - Airfield pavements – CRC pavements.

**UNIT IV - PAVEMENT EVALUATION AND REHABILITATION (09)**

Pavement evaluation and rehabilitation, condition and evaluation surveys – Causes and types of distress in flexible and rigid pavements – PSI models – Serviceability index of rural roads – Overlay design - pavements maintenance management and construction.

**UNIT V- STABILIZATIONOF SOILS FOR ROAD CONSTRUCTIONS (09)**

The need for a stabilized soil – Design criteria and choice of stabilizers – Testing and field control – Stabilisation for rural roads – Use of geofabrics in road construction – Case studies.

**TOTAL: 45hrs**

***REFERENCE BOOKS:***

1. Wright, P.H., Highway Engineers, Johwiley& Sons, Inc. New York, 2009.
2. Yoder, R.J and Witchak, M.W., Principles of Pavment Design, John wiley, 2000.
3. Khanna, S.K and Justo C.E.G., Highway Engineering, New Chand and Brothers, Roorkee, 1998.
4. Design and specification of Rural Roads (Manual), Ministry of rural roads, Government of India, New Delhi, 2001.
5. Guidelines for the Design of Flexible Pavements, IRC : 37 – 2012, The Indian Roads Congress, New Delhi.
6. Guidelines for the Design of Rigid Pavements, IRC : 58 – 2012, The Indian Roads Congress, New Delhi.
7. O’ Flaherty, C.A., Highway Engineering (Vol. 2), Edward Arnold Cp. 1978.
8. Kadiyali, L.R., Transport planning & Traffic Engineering, Khanna Publishers, 2008.

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| *CO3* | *H* |  |  |  |  |  |  |  | *L* |  |  |
| *CO4* | *M* |  | *H* | *H* |  |  | *M* |  |  | *M* |  |
| *CO5* | *L* |  | *H* |  |  |  |  |  |  | *M* | *H* |

**18GEPE16THEORETICAL SOIL MECHANICS**

**L T P C**

**30 0 3**

**COURSE OBJECTIVE**

To learn elastic solutions by understanding stress-strain behaviour using theory of elasticity in anisotropic and non-homogeneous soil.

**COURSE OUTCOMES:** At the end of the course, students will be able to

CO1: Apply theories of elasticity and plasticity to characterize the stress-strain behaviour of soil

CO2: Imparting knowledge required for calculating stress and settlement at any depth in semi-infinite elastic soil medium, anisotropic and layered medium due to external loads

CO3: Acquiring knowledge on slip line solutions on drained and undrained condition.

CO4: Arrive at solutions for drained and undrained loading conditions for analysis of slopes, cuts and retaining structures for their stability using theorem of plastic collapse.

CO5: Understand the concept of flow through soil media and to construct flow nets for different cases.

**UNIT I THEORY OF ELASTICITY (09)**

Introduction – Material behaviour – Idealistic behaviour – Elastic, viscous and plastic – Elasticity and stability problems, concept of stress and strain – Plane stress, plane strain and axisymmetric problems – Equation of equilibrium and compatibility – Stress functions.

**UNIT II STRESSES AND DISPLACEMENTS (ELASTIC SOLUTIONS) (09)**

Stresses in elastic half-space medium by external loads – Fundamental solutions – Boussinesq, Flamant, Kelvin and Mindlin solution – Applications of fundamental solutions – Anisotropic and non-homogeneous linear continuum – Influence charts – Elastic displacement.

**UNIT III LIMIT EQUILIBRIUM ANALYSIS (09)**

Limit equilibrium analysis – Perfectly plastic material – Stress-strain relationship – Stress and displacement field calculations – Slip line solutions for undrained and drained loading – Dimensional similitude.

**UNIT IV LIMIT ANALYSIS (09)**

Limit analysis – Principles of virtual work – Theorems of plastic collapse – Mechanism for plane plastic collapse – Simple solutions for drained and undrained loading – Stability of slopes, cuts and retaining structures. Centrifuge model – Principles and scale effects, practical considerations.

**UNIT V FLOW THROUGH POROUS MEDIA (09)**

Flow through porous media – Darcy’s law – General equation of flow – Steady state condition – Solution by flow net – Fully saturated conditions – Flownetin anisotropic soils – construction of flownet for different cases.

**TOTAL:45hrs**

***REFERENCE BOOKS:***

1. Aysen, A., Soil Mechanics: Basic concepts and Engineering Application, A.A.Balkema Publishers, 2002.
2. Ulrich Smoltc, YK, Geotechnical Engineering Handbook (Vol. 1) Ernot&Sohn, 2002.
3. Aysen, A., Problem Solving inSoil Mechanics, A.A.Balkema Publisher, 2003.
4. Davis, R.O., and Selvadurai, A.P.S., Elasticity and Geomechanics, Cambridge University Press, 1996.
5. Taylor, R.N., Geotechnical Centrifuge Technology, Blackie Academic and Professional 1995.
6. Wai-Fah Chen, and Liu, X.L., Limit Analysis in Soil Mechanics, Elsevier Science Ltd., 1991.
7. Muni Budhu, Soil Mechanics and Foundations, John Wiley and Sons, Inc, Network, 2000.
8. Atkinson, J.H., Foundations and Slopes, McGraw Hill, 1981.
9. Harr, M.E., Foundations of Theoretical Soil Mechanics, McGraw Hill, 1966.
10. Cedergren, H.R., Seepage Drainage and Flownets, John Wiley, 1997.
11. Winterkorn, H.F., and Fang, H.Y., Foundation Engineering Handbook Galgottia, Booksource, 2000.
12. Karl Terzaghi,Theoritical Soil Mechanics, John Wiley & Sons Publications.

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| *CO3* |  |  |  |  | *M* |  |  |  | *L* |  |  |
| *CO4* | *L* |  |  |  | *M* |  |  |  | *L* |  |  |
| *CO5* | *M* |  | *M* |  | *M* | *H* |  |  |  |  |  |

**18GEPE17 DESIGN OF UNDERGROUND EXCAVATIONS**

**L T P C**

**3 0 0 3**

**COURSE OBJECTIVES**

To get exposure to analysis, design of underground support system and to learn about the various field tests conducted during and afterconstruction of underground structure.

**COURSE OUTCOMES**

At the end of the course, students will be able to

CO1: To understand the use of elastic and plastic analysis in the design of underground

support system.

CO2:To have idea about the field tests generally conducted during and after

construction of underground structures

CO3: Critically analyse the behaviour of underground structures.

CO4: Understand the different methods of tunnelling suited to different ground conditions.

CO5: Gain knowledge about instrumentation during and after construction of underground construction

**UNITI PLANNING AND EXPLORATION**(09)

Introduction, planning of and exploration for various underground construction projects,

stereographic projection method, principle and its application in underground excavation design.

**UNIT II ANALYSIS AND DESIGN**(09)

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 III TUNNELLING METHODS**(09)

Application of rock mass classification systems, ground conditions in tunnelling, analysis of underground openings in squeezing and swelling ground, empirical methods, estimation of elastic modulus and modulus of deformation of rocks; uniaxial jacking / platejacking tests, radial jacking and Goodman jacking tests, long term behaviour of tunnels and caverns, New Austrian Tunnelling Method (NATM), Norwegian Tunnelling Method (NTM),construction dewatering.

**UNIT IV ROCK MASS**(09)

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 V INSTRUMENTATION**(09)

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.

***REFERENCE BOOKS:***

1. Hoek, E and 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.

3. Singh, B. and Goel, R.K.,Rock Mass Classification- A Practical Engineering Approach,

Elsevier.

4.Singh, B. and Goel, R.K., “Tunnelling in Weak Rocks”, Elsevier

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| *CO2* |  |  | *H* | *M* | *M* | *L* |  |  |  |  |  |
| *CO3* | *M* |  | *M* | *M* | *L* | *H* |  |  |  |  |  |
| *CO4* |  |  |  | *H* | *M* |  |  |  | *M* | *M* | *L* |
| *CO5* |  |  | *L* |  | *H* |  |  |  | *M* |  | *L* |

**18GEPE18 COMPUTATIONAL GEOMECHANICS**

**L T P C**

**30 0 3**

**COURSE OBJECTIVE**

To understand and gain knowledge on the mathematical solutions for geotechnical related problems.

**COURSE OUTCOMES**

At the end of the course, students will be able to

CO1: Understand different numerical and statistical tools for analysing various geotechnical engineering problems.

CO2: Apply probabilistic approach for selection of design parameters and compute their impact on risk assessment.

CO3: Understand the fundamentals constitutive models for soil.

CO4: Evaluate finite element solutions to consolidation and flow through porous media.

CO5: Compute risk assessment both in characterisation of soil and in the design.

**UNIT I - SOLUTION OF LINEAR AND NON-LINEAR EQUATIONS (09)**

Bisection - False position - Newton-Raphson - successive approximation method - Iterative method.Solution of Linear Equation by Jacobi’s method - Gauss Seidal method - Successive over relaxation method.

**UNIT II - FINITE DIFFERENCE METHOD AND FINITE ELEMENT METHOD (09)** Two point Boundary value problems– Disichlet conditions - Neumann conditions; ordinary and partial differential equation.

**UNIT III - FINITE ELEMENT METHOD (09)**

Fundamentals - constitutive finite element models for soils. 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 IV - ONE DIMENSIONAL CONSOLIDATIN AND FLOW THROUGH POROUS MEDIA (09)**

Theory of consolidation - Analytical procedures - Finite difference solution procedure for multi-layered systems - Finite element formulation. Geotechnical aspects - Numerical methods - Applications and Design analysis - Flow in jointed media.

**UNIT V- RISK ASSESSMENT IN GEOTECHNICAL ENGINEERING (09)**

Probabilistic site characterisation and design of foundation.

**TOTAL: 45hrs**

***REFERENCE BOOKS:***

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 Computation”,Third edition ,New Age International(P)Ltd.Publishers,New Delhi-1996
3. D.J.Naylor and G.N.Pande,”Finite Elements in Geotechnical Engineering”,Pineridge press Ltd.,UK-1981
4. Sam Helwany,”Applied Soil mechanics”,John Wiley&sons,Inc-2007

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| *CO4* |  |  | *H* |  |  |  |  |  | *L* |  | *H* |
| *C05* |  |  |  |  |  |  |  |  |  |  |  |

**18GEPE19PROFESSIONAL PRACTICES IN DESIGN OF GEOTECHNICAL STRUCTURES**

**L T P C**

**3 0 0 3**

**COURSE OBJECTIVE**

To gain exposure on practical aspects of design relating to substructure elements using software, Geotechnical construction practices,and field execution of the works.

**COURSE OUTCOMES**

At the end of the course, students will be able to

CO1: To know the field practises in investigations,safety, and quality on substructure components.

CO2: To design foundations for special structures using softwares.

CO3:To evaluate dynamic properties of soils and design Earthquake resistant foundations.

CO4:To know about various substructure retrofitting techniques

CO5:Acquire knowledge about software applications in finite element analysis

**UNIT I- Construction Techniques (09)**

Project planning – Geotechnical engineering practices – Soil profile – Bore log – Report review and preparation – Geotechnical Plant and Machinery – Safety aspects at site– Construction management – Quality control – Quality management – Geosynthetics–Geomembrane.

**UNIT II- Retaining Structures (09)**

Design of retaining wall – Design of culvert – Design of deep excavations – Sheet pile – diaphragm walls – Shoring system – Design of Caisson.

**UNIT III- Substurctures(09)**

Design of Tower Foundation – Design of Floating foundation– Design of Pile and Pile group – Design of underreamed pile – Design of abutment – Design of Pier – Design of mat foundation – Design of piled raft foundation.

**UNIT IV- Dynamic Response of Foundations (09)**

Soil behaviour – Dynamic properties of soil– Seismic performance analysis – Calculation of seismic loads in foundation – Design procedure for earthquake resistant foundation – Soil structure interaction – Retrofitting.

**UNIT V-Finite Element Analyses and Software Application (09)** Finite Element Analysis applied to Geotechnical Engineering – ANSYS – Modelling – Applications – Oasys – PLAXIS.

**TOTAL:45hrs**

***Reference books:***

1. Helmsley, Design Applications of Raft Foundations.
2. Michael John Tomlinson,R.Boorman,Foundation Design & Construction, Prentice Hall PTR,2001.
3. George paaswell, Retaining Walls:Design& Construction,Bibliobazaar,2009.
4. Design & Construction of bridge approaches,Transportation Research Board,1990.
5. M.J. Tomlinson,Taylor and Francis ltd., Pile design and construction practice, 1994.
6. Davies and Poulos, Analysis and design of pile foundation, John Wiley and Sons, 1980
7. J.E. Bowles, Foundation Analysis and Design, McGraw-Hill, 1997
8. V.N.S. Murthy, Advanced Foundation Engineering, CBS Publishers & Distributors, 2007
9. Swami Saran, Soil Dynamics and Machine Foundations, Galgotia Publications, New Delhi.
10. Potts and Zdravkovic, Finite Element Analyses Applied to Geotechnical Engineering, Vol.1 (Theory) and Vol. 2 Applications.

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| *CO2* |  |  | *H* |  |  |  |  |  | *H* |  |  |
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| *CO4* | *L* |  | *H* |  |  |  |  |  | *M* |  |  |
| *CO5* | *L* |  | *H* |  |  | *M* |  |  |  |  |  |

**18GEPE20 STRUCTURAL DESIGN OF FOUNDATIONS AND SUBSTRUCTURES**

**L T P C**

**3 00 3**

**COURSE OBJECTIVES**

To give exposure to students the structural design of shallow , deep and special foundations.

**COURSE OUTCOMES**

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

CO1: Design the isolated and combined footing.

CO2: Carry out analysis and design of rafts.

CO3: Get familiarised with design of piles and pier.

CO4: Carryout structural design of well foundation and coffer dam.

CO5: Carryout design of retaining wall.

**UNIT I – DESIGN OF FOOTINGS (09)**

Introduction to Limit State Design of reinforced concrete in foundations; Soil pressure  
for structural design, Conventional structural design of continuous footings,  
individual footings – rectangular and circular, combined footings – rectangular,  
trapezoidal and strap.

**UNIT II – DESIGN OF RAFTS (09)**

Raft Foundations – Structural Design of rectangular and circular rafts and mats using  
conventional method of analysis, Analysis and design of rafts and mats incorporating  
soil structure interaction using any FEM software.

**UNIT III – DESIGN OF PILES AND PIERS (09)**

Structural design of piles including pile caps, under-reamed piles, Structural Design  
of pier

**UNIT IV – DESIGN OF FOUNDATION AND COFFER DAM (09)**

Types of well foundation – components – structural design of well foundation – types of coffer dam – design – lateral pressure stability

**UNIT V – DESIGN OF RETAINING WALLS (09)**

Structural design of retaining walls-Reinforced Concrete Cantilever retaining wall,  
Counterfort retaining wall, Flexible retaining Structures –Sheet Pile Wall, Anchored  
Bulk Heads.

**TOTAL:45hrs**

***REFERENCE BOOKS:***  
1. Nainan P. Kurian “Design of Foundation Systems: Principles and Practices”,Narosa publish House, New Delhi.  
2. Swami Saran, “Analysis and Design of Substructures”, Oxford & IBHPublishing Co.  
3. Tomlinson M.J., “Foundation Design and Construction”, Prentice Hall.27  
4.ShamsherPrakash, Hari D., Sharma “Pile Foundations in EngineeringPractice”, Wiley-IEEE.  
5. Nainan P. Kurian “Shell foundations: Geometry, Analysis, Design andConstruction”, Alpha Science International Ltd.  
6. Tomlinson M.J., John Woodward “Pile Design and Construction Practice”,Routledge.  
7. Som N. N., and Das S.C., “Theory and Practice of Foundation Design Prentice Hall of India.  
8. Sharat Chandra Gupta, “Raft Foundations – Design and Analysis with Practical Approach”, New Age International Pvt. Ltd , New Delhi.

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| *CO2* | *H* | *L* | *H* |  | *M* | *M* |  | *M* | *H* |  | *M* |
| *CO3* | *H* |  |  |  | *M* | *H* | *L* |  |  |  |  |
| *CO4* | *H* | *M* |  | *H* |  |  |  | *M* | *H* | *H* | *H* |
| *C05* | *H* |  |  | *H* |  | *H* |  |  | *H* | *H* | *H* |

**18GEPE21 LAND RECLAMATION**

**L T P C**

**3003**

**COURSE OBJECTIVES**

To get an idea of landfill techniques, processes and remediation techniques.

**COURSE OUTCOMES**

CO1:To make them understand the fundamentals of solid and hazardous wastes and also the types, need and sources of solid and hazardous wastes.

CO2:To understand about the methods of waste characterization and source reduction and to study the various methods of generation of wastes.

CO3: Understand in detail about the storage, collection and transport of wastes.

and also to study about the methods used for handling and segregation of wastes.

CO4:To improve the knowledge on the waste processing techniques which includes incineration, solidification and stabilization of hazardous wastes

CO5:To know about the basics of the waste disposal options and also a detailed study on the disposal in landfills and also to learn about Bioremediation.

**UNIT I-INTRODUCTION(09)**

Soil around us, Soil Water Characteristics, Soil Erosion, Soil & Pollution, Water resources, Irrigation and Wetlands, Soil Pollution Management, Nuclear Waste Management, Solid Waste Management.

**UNIT II-TRANSPORTATION(09)**

Handling and segregation of wastes at source- storage and collection of municipal solid wastes- Analysis of collection systems- Need for transfer and transport- Transfer stations Optimizing Waste allocation- compactability, storage, labelling and handling of hazardous wastes- hazardous waste manifests and transport

**UNIT III-TREATMENT OF WASTES(09)**

Objectives of waste processing- material separation and processing technologies- biological and chemical conversion technologies-method and controls of composting- thermal conversion technologies and energy recovery- incineration- solidification and stabilization of hazardous wastes- treatment of biomedical wastes.

**UNIT IV-LANDFILLS (09)**

Waste disposal options- Disposal in landfills- Landfill Classification, types and methods- site selection- design and operation of sanitary landfills, secure landfills and landfill bioreactors- leachate and landfill gas management- landfill closure and environmental monitoring- closure of landfills- landfill remediation.

**UNIT V-WASTE MANAGEMENT AND (09)**

Types and Sources of solid and hazardous wastes-Need for solid and hazardous waste management- Elements of integrated waste management and roles of stakeholders- Salient features of Indian legislations on management and handling of municipal solid wastes, hazardous wastes, biomedical wastes-Bioremediation- techniques-field applications.

**TOTAL:45hrs**

***REFERENCE BOOKS:***

1.GeorgeTchobanoglous, Hilary Theisen and Samuel A, Vigil “Integrated Solid Waste Management, McGraw- Hill International edition, New York, 1993.

2.CPHEEO “Manual on Municipal Solid waste management, Central Public Health and Environmental Engineering Organisation, Government of India, New Delhi, 2000.

3.Micheael D. Lagrega, Philip L Buckingham, Jeffrey C. E vans and Environmental Resources Management, Hazardous waste Management, McGraw- Hill International edition, New york, 2001.

4.Vesilind P.A., Worrell W and Reinhart, Solid Waste Engineering, Thomson Learning Inc., Singapore, 2002.

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**18GEPE22 GROUND IMPROVEMENT TECHNIQUES**

**L T P C**

**3 00 3**

**COURSE OBJECTIVE**

To identify weak soils, suggest suitable improvements methods and to be familiar with the equipments used for improvement.

**COURSE OUTCOMES**

At the end of the course, students will be able to

CO1 : Understand the parameters of weak soil and the techniques used for treating such soils.

CO2 : Know various types of stabilizers, stabilization techniques and its application in the field.

CO3 : Know the environmental sustainability of each method.

CO4:Know various types ofGrouting techniques

CO5:Acquire knowledge for application of grouting methods in the field

**UNIT I DEWATERING (09)**

Introduction – Scope and necessity of ground improvement – New Technologies – Basic concepts – Drainage methods – Ground water lowering by well points – Deep well, Vacuum and Electro – Osmosis methods.

**UNIT II COMPACTION AND SAND DRAINS (09)**

In-situ compaction of cohesionless and cohesive soils – Shallow and deep compaction – Vibration methods – Vibro-compaction, Blasting, Vibrating probe, Vibratory rollers, Vibro-displacement compaction, Vibroflotation – Concept, Factors influencing compaction – Heavy Tamping – Vertical drains – Preloading with sand drains, Fabric drains, Wick drains – Design of sand drains – Relative merits of different methods – Limitations.

**UNIT III STONE COLUMN AND CONSOLIDATION (09)**

Precompression and consolidation – Dynamic consolidation – Electro-osmotic consolidation – Stone column – Functions – Methods of installation – Design estimation of load carrying capacity of stone column – Settlement of stone column – Lime piles – Earth reinforcement – Soil Nailing – Types of reinforcement material – Applications.

**UNIT IV STABILIZATION (09)**

Introduction – Stabilization methods – Mechanical, Cement, Lime, Bitumen, Chemical stabilization – Electrical stabilization – Stabilization by Thermal and Freezing techniques – Ground improvement by excavating and replacing – Stabilization of expansive clays – Prewetting.

**UNIT V GROUTING (09)**

Introduction – Applications – Functions – Characteristics of grouts – Types of grout – Suspension and solution grouts – Basic requirements of grout – Displacement – Compaction grouting, displacement – Soil fracture grouting, Jet – Displacement grouting, Permeation grouting – Grouting equipment – Injection methods – Grout monitoring.

**TOTAL: 45hrs**

***REFERENCE BOOKS:***

1. Purushothama Raj, P., Ground Improvement Techniques, Laxmi Publications (P) Ltd., New Delhi, 2005.
2. Moseley M.D., Ground Treatment, Blackie Academic and Professional, 1998.
3. Shroff, A.V., Grouting Technology, in Tunneling and Dam, Oxford & IBH Publishing Co. Pvt. Ltd., New Delhi, 2009.
4. Koerner, R.M., Designing with Geosynthetics (fourth edition), Prentice Hall, New Jersey, 1999.

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| *CO4* | *L* |  |  |  | *M* |  | *H* |  | *H* |  |  |
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**18GEMLC01 RESEARCH METHODOLOGY AND IPR**

**L T P C**

**100 2**

**COURSE OBJECTIVE**

To make the students identify the research problems applying for developing skills of proposal submission and patents.   
  
**COURSE OUTCOMES**  
At the end of this course, students will be able to  
CO1:Identify research problem and formulate the scope and objectives of the research problem  
CO2:Developing skill of writing reports and submitting proposals.

CO3 :Understand the procedures of applying patents.

CO4:Familiarize with the information and technology transfer of patent rights.

CO5:Understand the new developments in IPR.

**UNIT I – RESEARCH PROBLEM (09)**

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 II – RESEARCH ETHICS (09)**

Effective literature studies approaches - analysis Plagiarism - Research ethics, Effective technical writing - how to write report - Paper Developing a Research Proposal - Format of research proposal - a presentation and assessment by a review committee  
**UNIT III– NATURE OF INTELLECTUAL PROPERTY(09)**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 IV – PATENT RIGHTS (09)**

Patent Rights - Scope of Patent Rights - Licensing and transfer of technology - Patent  
information and databases - Geographical Indications.  
**UNIT V – NEW DEVELOPMENT IN IPR (09)**

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.

**TOTAL:45hrs**

***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. Ranjit Kumar,2ndEdition,’’ResearchMethodology:A Step by Step Guide for beginners”
4. Halbert, “Resisting Intellectual Property”, Taylor & Francis Ltd, 2007.
5. Mayall,”Industrial Design”, McGRaw Hill, 1992.
6. Niebel, “Product Design”, McGraw Hill, 1974.
7. Asimov, ”Introduction to Design”, Prentice Hall, 1962.
8. Robert P. Merges, Peter S. Menell, Mark A. Lemley,”Intellectual Property in New Technological Age”’ 2016.

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**18GEAC01 RESEARCH PAPER WRITING**

**L T P C**

**200 0**

**COURSE OBJECTIVES**

The objective is to be develop the skill of writing research papers for submission of grants and patents.

**COURSE OUTCOMES**  
At the end of this course, students will be able to  
CO1 :Develop the writing skills by structuring the paragraphs.

CO2 :Formulating different sections of a technical papers.  
CO3 :Carry out thorough study of literatures and development of methodology of work.

CO4 :Develope the skills needed for writing the key components of a research report.

CO5:Bring out good quality report for submission.  
  
**UNIT I – PLANNING OF RESEARCH WORK (06)**  
 Planning and Preparation - Word Order - Breaking up long sentences – Structuring Paragraphs and Sentences - Being Concise and Removing Redundancy - Avoiding Ambiguity and Vagueness.

**UNIT II – SECTION OF RESEARCH WORK (06)**  
Clarifying Who Did What - Highlighting Your Findings – Hedging and CriticisingParaphrasing and Plagiarism - Sections of a Paper –Abstracts-Introduction.

**UNIT III – RESEARCH COMPONENTS (06)**  
 Review of the Literature - Methods - Results - Discussion - Conclusions – The Final Check.

**UNIT IV – WRITING SKLLS (06)**  
 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 - 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

**UNIT V – REPORT PREPARATION (06)**  
 Useful phrases - how to ensure paper is as good as it could possibly be the first - time submission

**TOTAL:30hrs**  
***REFERENCE BOOKS:***

1. GoldbortR (2006) Writing for Science, Yale University Press (available on Google Books)  
2. Day R (2006) How to Write and Publish a Scientific Paper, Cambridge University Press  
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 DordrechtHeidelberg London, 2011

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**18GEAC02DISASTER MANAGEMENT**

**COURSE OBJECTIVES -**Students will be able to:

1. learn to demonstrate a critical understanding of key concepts in disaster risk reduction and

humanitarian response.

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 conflict situations.

4. critically understand the strengths and weaknesses of disaster management approaches,

planning and programming in different countries, particularly their home country or the countries they work in.

**COURSE OUTCOMES**: -Students will be able:

CO1. To study about the various disasters

CO 2. To investigate about the various repercussions of disasters and hazards

CO 3. To engage themselves in disaster preparedness and management

CO 4. To involve and expertise in risk assessment

CO 5. To know about the techniques in disaster mitigation

**UNIT 1**–**INTRODUCTION (06)**

Disaster: Definition, Factors and Significance; Difference Between Hazard and Disaster; Natural and Manmade Disasters: Difference, Nature, Types and Magnitude.

**UNIT 2REPERCUSSIONS OF DISASTERS AND HAZARDS**: **(06)**

Economic Damage, Loss Of Human And Animal Life, Destruction Of Ecosystem.

Natural Disasters: Earthquakes, Volcanisms, Cyclones, Tsunamis, Floods, Droughts and Famines, Landslides And Avalanches, Manmade disaster: Nuclear Reactor Meltdown, Industrial Accidents, Oil Slicks And Spills, Outbreaks Of Disease And Epidemics, War And Conflicts.

**UNIT 3 DISASTER PREPAREDNESS AND MANAGEMENT (06)**

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 Community Preparedness.

**UNIT 4 RISK ASSESSMENT (06)**

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.

**UNIT 5DISASTER MITIGATION (06)**

Meaning, Concept And Strategies Of Disaster Mitigation, Emerging Trends In Mitigation. Structural Mitigation And Non-Structural Mitigation, Programs Of Disaster Mitigation In India.

**TOTAL:30hrs**

***REFERENCE BOOKS:***

1. R. Nishith, Singh AK, “Disaster Management in India: Perspectives, issues and strategies “’New Royal book Company.

2. Sahni, PardeepEt.Al. (Eds.),” Disaster Mitigation Experiences And Reflections”, Prentice Hall Of India, New Delhi.

3. Goel S. L. , Disaster Administration And Management Text And Case Studies” ,Deep &Deep

Publication Pvt. Ltd., New Delhi.

**18GEAC03 VALUE EDUCATION**

**COURSE OBJECTIVES**

1***.***Understand value of education and self- development

2. Imbibe good values in students

3. Let the should know about the importance of character

**COURSE OUTCOMES**

At the end of the course, students will be able to

CO1: To Understand the values and work ethics

CO2: Toenhance personality and behaviour development

CO3: To known about the structure of our governance

CO4 Knowledge of self-development

CO5 .Learn the importance of Human values

**UNIT IETHICS AND SELF-DEVELOPMENT (06)**

Social values and individual attitudes.Work ethics, Indian vision of humanism.Moral and non- moral valuation. Standards and principles.Value judgements,

**UNIT IIPERSONALITY AND BEHAVIOR DEVELOPMENT (06)**

Soul and Scientific attitude.Positive Thinking.Integrity and discipline.Punctuality, Love and Kindness.Avoid fault Thinking.Free from anger, Dignity of labour.Universal brotherhood and religious tolerance.

**UNIT III - VALUES IN HUMAN LIFE (06)**

Importance of cultivation of values, Sense of duty.Devotion, Self-reliance.Confidence, Concentration.Truthfulness, Cleanliness.Honesty, Humanity. Power of faith, National Unity.Patriotism.Love for nature ,Discipline

**UNIT IV -VALUES IN SOCIETY (06)**

True friendship.Happiness Vs suffering, love for truth.Aware of self-destructive habits.Association and Cooperation. Doing best for saving nature

**UNIT V - POSITIVE VALUES (06)**

Character and Competence –Holy books vs Blind faith.Self-management and Good health. Science of reincarnation.Equality, Nonviolence , Humility, Role of Women.All religions and same message.Mind your Mind, Self-control.Honesty, Studying effectively

**TOTAL:30hrs**

***REFERENCE BOOKS:***

1 Chakroborty, S.K. “Values and Ethics for organizations Theory and practice”, Oxford University Press, New Delhi

**18GEAC04 CONSTITUTION OF INDIA**

**COURSE OBJECTIVES**

Understand the premises informing the twin themes of liberty and freedom from a civil rights perspective.

To address the growth of Indian opinion regarding modern Indian intellectuals’ constitutional role and entitlement to civil and economic rights as well as the emergence of nationhood in the early years of Indian nationalism.

To address the role of socialism in India after the commencement of the Bolshevik

Revolution in 1917 and its impact on the initial drafting of the Indian Constitution.

**COURSE OUTCOMES**

At the course the students will be able to,

CO1. Discuss the growth of the demand for civil rights in India for the bulk of Indians before the arrival of Gandhi in Indian politics.

CO2. Discuss the intellectual origins of the framework of argument that informed the conceptualization of social reforms leading to revolution in India.

CO3. 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 Indian Constitution.

CO4. Discuss the passage of the Hindu Code Bill of 1956.

CO5: To know importance of Election commission.

**UNIT IHISTORY OF THE INDIAN CONSTITUTION (06)**

History Drafting Committee, ( Composition& Working)Preamble, Salient Features

**UNIT IICONSTITUTIONAL RIGHTS & DUTIES: (06)**

Fundamental RightsRight to EqualityRight to FreedomRight against Exploitation Right to Freedom of ReligionCultural and Educational RightsRight to Constitutional RemediesDirective Principles of State PolicyFundamental Duties.

**UNIT III - ORGANS OF GOVERNANCE: (06)**

ParliamentCompositionQualifications and DisqualificationsPowers and FunctionsExecutivePresidentGovernorCouncil of MinistersJudiciary, Appointment and Transfer of Judges, QualificationsPowers and Functions

**UNIT IV -LOCAL ADMINISTRATION: (06)**

District’s Administration head: Role and Importance,Municipalities: Introduction, Mayor and role of Elected Representative, CEOof Municipal Corporation.Pachayati raj: Introduction, PRI: ZilaPachayat.Elected officials and their roles, CEO ZilaPachayat: Position and role.Block level: Organizational Hierarchy (Different departments),Village level: Role of Elected and Appointed officials,Importance of grass root democracy

**UNIT V - ELECTION COMMISSION: (06)**

Election Commission: Role and Functioning.Chief Election Commissioner and Election Commissioners.State Election Commission: Role and Functioning.Institute and Bodies for the welfare of SC/ST/OBC and women.

**TOTAL:30hrs**

***REFERENCE BOOKS:***

1 The Constitution of India, 1950 (Bare Act), Government Publication.

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.

**18GEAC05 STRESS MANAGEMENT**

**L T P C**

**2000**

**COURSE OBJECTIVES**

To educate the students about the importance of achieving overall health of body and mind and to overcome stress.

**COURSE OUTCOMES**

At the end of the course, students will be able to

CO1: To Understand the different parts of yoga

CO2: Toachieve overall health of body and mind

CO3: To overcome stress

**UNIT I -DEFINITIONS (06)**  Definitions of Eight parts of yoga. ( Ashtanga )

**UNIT II -YAMAND NIYAM (06)**

Do`s and Don’t’s in life-Ahinsa, satya, astheya, bramhacharya and aparigraha

-Shaucha, santosh, tapa, swadhyay, ishwarpranidhan

**UNIT III – ASANANDPRANAYAM (06)**

Various yoga poses and their benefits for mind & body-Regularization of breathing techniques and its effects-Types of pranayam

***REFERENCE BOOKS:***

1. Yogic Asanas for Group Tarining-Part-I:Janardan Swami YogabhyasiMandal, Nagpur

2. Rajayoga or conquering the Internal Nature by Swami Vivekananda, AdvaitaAshrama

(Publication Department), Kolkata

3. Light on Yoga: by B.K.S. Iyengar, Harper Collins Publishers India

4. Light on Pranayama: by B.K.S. Iyengar, Harper Collins Publishers India

5. Yoga for Dummies by Georg Feuerstein and larry Payne, Wiley India publishing

6. Yoga, Pilates, Meditation & Stress Relief ByParragon Books Ltd

**18GEOE01 INDUSTRIAL SAFETY**  
**L T P C**

**3 0 0 3**

**COURSE OBJECTIVE**

To understand the safety aspects and to take appropriate preventive measures.

**COURSE OUTCOMES**

At the end of the course, students will be able to

CO1:.To understand the various types and causes of accidents.

CO2: To know about the fundamentals of maintenance Engineering.

CO3: To get thorough knowledge on wear reduction methods.

. CO4: To know the concept and importance of fault tracing.

CO5: To understand periodic inspection and maintenance.

**UNITI - INDUSTRIAL SAFETY(09)**

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 and methods.

**UNIT II - FUNDAMENTALS OF MAINTENANCE ENGINEERING(09)**

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 III -WEAR AND CORROSION AND THEIR PREVENTION(09)**

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.

**UNITIV** - **FAULT TRACING(09)**

Fault tracing-concept and importance, decision treeconcept - need andapplications - 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. Internal combustion engine - v. Boiler - vi. Electrical motors - Types of faults in machine tools and their general causes.

**UNIT V - PERIODIC AND PREVENTIVE MAINTENANCE(09)**

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 and importance**TOTAL:45hrs**

***REFERENCE BOOKS:***

1. Maintenance Engineering Handbook , Higgins & Morrow, Da Information Services.

2. Maintenance Engineering, H. P. Garg, S. Chand and Company.

3. Pump-hydraulic Compressors, Audels, Mcgrew Hill Publication.

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**18GEOE02 OPERATIONS RESEARCH**

**L T P C**

**3 0 0 3**

**COURSE OBJECTIVES**

To educate the students to apply the dynamic programming, application of the concept of

non-linear programming and to provide knowledge about modelling the real world

problem and simulate it.

**COURSE OUTCOMES**

At the end of the course, students will be able to

CO1: To apply the dynamic programming to solve problems of discreet and

Continuous variables.

CO2: Understand and apply the theory of linear programming

CO3: To apply the concept of non-linear programming

CO4: To carry out sensitivity analysis

CO5: To model the real world problem and simulate it.

**UNIT I - BASICS OF OPERATION RESEARCH (09)**

Optimization Techniques, Model Formulation, models, General L.R Formulation, Simplex

Techniques, Sensitivity Analysis, Inventory Control Models

**UNIT II - LINEAR PROGRAMMING (09)**

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

**UNIT III - NON LINEAR PROGRAMMING (09)**

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

**UNIT IV - INVENTORY MODELS (09)**

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

**UNIT V - NETWORK MODELS (09)**

Competitive Models,Single and Multi-channel Problems, Sequencing Models, Dynamic

Programming, Flow in Networks, Elementary Graph Theory, Game Theory Simulation

**TOTAL:45hrs**

***REFERENCES 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 India 2010

6. Harvey M Wagner, Principles of Operations Research: Prentice Hall of India 2010

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| *CO3* | *H* |  |  |  |  |  |  |  |  | *M* |  |
| *CO4* | *H* |  |  | *M* |  | *M* |  |  |  |  |  |
| *CO5* | *H* |  |  | *M* |  |  |  |  |  | *M* | *L* |

**18GEOE03 COST MANAGEMENT OF ENGINEERING PROJECTS**

**L T P C**

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**COURSE OBJECTIVE**

To get an idea on cost management of engineering projects in various aspects like costing, project formulation, management and scheduling.

**COURSE OUTCOME**: -Students will be able:

CO1. To study elements of project formulation and appraisal

CO2. To study the costing and financial aspects of projects

CO3. To study the implications of private sector participation inconstruction projects

CO4. To know about the various tools in cost management

CO5. To investigate about the various hindrances in project scheduling

**UNIT 1 COSTING (09)**

Introduction and Overview of the Strategic Cost Management Process, Cost 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 FORMULATION (09)**

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 nontechnical activities.Detailed Engineering activities. Pre project execution main clearances and documents Project team: Role of each member. Importance Project site: Data required with significance.

**UNIT 3 CONTRACTS AND COMMISSIONING (09)**

Project contracts.Types and contents. Project execution Project cost control. Bar charts and Network diagram. Project commissioning: mechanical and process

Cost Behavior and Profit Planning Marginal Costing; Distinction between Marginal Costing andAbsorption Costing; Break-even Analysis, Cost-Volume-Profit Analysis. Various decision-making problems.Standard Costing and Variance Analysis. Pricing strategies: Pareto Analysis.

**UNIT 4 COST MANAGEMENT (09)**

Target costing, Life Cycle Costing. Costing of service sector.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.

**UNIT 5 PROJECT SCHEDULING (09)**

Measurement of Divisional profitability pricing decisions including transfer pricing.

Quantitative techniques for cost management, Linear Programming, PERT/CPM, Transportationproblems, Assignment problems, Simulation, Learning Curve Theory.

**TOTAL:45hrs**

***REFERENCES BOOKS****:*

1. Cost Accounting A Managerial Emphasis, Prentice Hall of India, New Delhi

2. Charles T. Horngren and George Foster, Advanced Management Accounting

3. Robert S Kaplan Anthony A. Alkinson, Management & Cost Accounting

4. Ashish K. Bhattacharya, Principles & Practices of Cost Accounting A. H. Wheeler publisher

5. N.D. Vohra, Quantitative Techniques in Management, Tata McGraw Hill Book Co. Ltd.