INSTITUTE OF INFRASTRUCTURE TECHNOLOGY RESEARCH AND MANAGEMENT
Civil Engineering Department
Annexure-I
Curriculum of M. Tech. Geotechnical Engineering (Civil Engineering)

Semester I

Course	Teaching Scheme & Credits (L-T-P-C)
Advanced Soil Mechanics	3-1-0-4
Geotechnics for Ground Modification	3-1-0-4
Soil-Structure Interaction	3-1-0-4
Elective-I	3-0-0-3
Elective-II	3-0-0-3
Total Credits = 18	

Semester II

Course	Teaching Scheme & Credits (L-T-P-C)
Research Methodology	2-0-0-2
Soil Dynamics & Geotechnical Earthquake Engg	3-1-0-4
Advanced Foundation Engineering	3-1-0-4
Experimental Geotechnics	1-1-2-3
Elective III	3-0-0-3
Elective IV	3-0-0-3
Total Credits = 19	

Semester III

Course	Teaching Scheme & Credits
Seminar	0-0-0-2
Thesis – I	0-0-0-22
Total Credits = 24	

Semester IV

Course	Teaching Scheme & Credits
Thesis - II	0-0-0-24
Total Credits = 24	

Total Minimum Credits of Programme = 85*

***These credits may change depending on the credit of elective subjects

Options for Electives	
1. Environmental Geotechnology	2. Rock Mechanics
3. Transportation Geotechnics	4. Structural Dynamics
5. Design of Underground Structures	6. Finite Element Method
7. Foundations on Difficult Soils	8. Optimization Techniques
9. Physical Modelling in Geotechnics	10. Remote Sensing
11. Geographic Information System	12. Solid Waste Management
13. Forensic Geotechnical Engineering	14. Unsaturated Soil Mechanics

Compulsory Courses

Course Title	Advanced Soil Mechanics
Credits	L T P Cr 3 1 0 4
Prerequisites	Soil Mechanics/Geotechnical Engineering

Course Contents:

Introduction

One and three dimensional consolidation theories and applications, Shear strength parameters of cohesion less and saturated cohesive soils, Principles of Effective stress condition, creep effect, introduction to soil constitutive modelling

Mohr's Circle and Stress paths

Stress-Strain relationship, failures states in soils, different stress paths with drainage and loading variation

Consolidation and Shear Strength

Immediate and consolidation settlement evaluation, Estimation of Pre-consolidation pressure, Secondary consolidation, , Effect of rate of stress on shear parameters, Skempton's Pore pressure coefficients, Effect of over consolidation on shear parameters

Introduction to Critical State Soil Mechanics

Introduction to the elasto-plastic modeling of soils, Critical state concept. Behavior of normally/overconsolidated clays, and loose/dense sands. Critical state and constant volume. Stress-dilatancy.

Introduction to Unsaturated Soil Mechanics

Concept of unsaturated soil behavior, suction in soil, soil-water characteristics curve, applications of unsaturated soil mechanics

Reference / Text Books

1. Knappett J. A. and Craig R. F., Craig's Soil Mechanics, Spon Press, Taylor and Francis Group, New York.
2. Scott R. F., Principles of Soil Mechanics, Addison-Wesley Publishing Company, Inc., USA.
3. Das, B.M., Advanced Soil Mechanics, Cengage Learning
4. Gopal Ranjan & A.S.R. Rao, Basic and Applied Soil Mechanics, New Age Publishers
5. Murthy, V.N.S., Soil Mechanics and Foundation Engineering, CRC Press 6. Recent technical literature on related topics

Any other Remarks:

Course Title	Geotechnics for Ground Modification
Credits	L T P Cr 3 1 0 4
Prerequisites	Soil Mechanics/Geotechnical Engineering

Course contents:

Introduction - Need for ground modification/improvement, State-of-the-art trends, Types of problematic soils, Classification and selection of ground modification methods.

Mechanical modification - Principles and methods of soil compaction, In-situ shallow compaction, Properties of compacted soil and compaction control, Deep compaction methods – dynamic compaction, blasting, vibro-compaction, vibro-replacement, stone columns.

Hydraulic modification - Preloading, Vertical drains, Vacuum consolidation, Dewatering methods, Electro-kinetic dewatering.

Physical and Chemical Modification - Admixtures, Grouting, Thermal modifications.

Other Innovative methods - Overview of ground improvement by inclusions and confinement. Ground improvement case studies.

Text/Reference Books:

1. D.T. Bergado, L.R. Anderson, N. Muira and A.S. Balasubramaniam, Soft Ground Improvement in Low Land and Other Environment, ASCE Press.
2. M.P. Mosely and K. Kirsch, Ground Improvement, Spon Press.
3. Manfred R. Hausmann, Engineering Principles of Ground Modification, McGraw-Hill.
4. N.R. Patra, Ground Improvement Techniques, Vikas Publishing.
5. P. Purushothama Raj, Ground Improvement Techniques, Laxmi Publications.
6. P.G. Nicholson, Soil Improvement and Ground Modification Methods, Elsevier.
7. P.P. Xanthakos, L.W. Abramson and D.A. Bruce, Ground Control and Improvement, John Wiley and Sons.

Additional Remarks (if any): ---

Course Title	Soil Structure Interaction
Credits	L T P Cr 3 1 0 4
Prerequisites	Soil Mechanics/Geotechnical Engineering

Course Contents:

Introduction to Soil-structure interaction:
Importance of soil-structure interaction, factors affecting soil-structure interaction, examples of soil-structure interaction problems, concept of rigid and flexible foundations, contact pressure, settlement and differential settlement, theory of modulus of subgrade reaction

Soil-structure interaction problems
Soil-rigid foundation interaction in clay and sand, soil-flexible foundation interaction in clay and sand, soil-pile interaction, soil-piled-raft interaction, earth pressure distribution on rigid wall, reinforced earth structure and sheet pile, braced excavation, arching in soil, analysis of rigid and flexible conduits, soil-foundation interaction for special structures such as tanks, chimneys and silos

Soil-structure interaction models
Winkler's model, beams and plates on elastic foundation, elastic continuum models, finite difference and finite element solutions for soil-structure interaction problems, laterally loaded piles supported on elastic medium

Dynamic soil-structure interaction
Vibration of single and multiple degree of freedom systems, dynamic soil properties, wave propagation mechanism, seismic soil-foundation-structure interaction, examples of dynamic soilstructure interaction problems, numerical modelling of dynamic soil-structure interaction

Recent advancements
Recent research advancements in soil structure interaction studies

Reference / Text Books

1. Bowles, J. E., Foundation Analysis and Design, McGraw Hill International Ed.
2. Desai C. S. and Christian J. T., Numerical Methods in Geotechnical Engineering, McGraw Hill Book Co. New York.
3. Wolf J. P, Dynamic Soil structure interaction, Prentice – Hall
4. Potts D. M and Zdravkovic L., Finite Element Analysis in Geotechnical Engineering: Theory, Thomas Telford Publishers, London.
5. Potts D. M and Zdravkovic L., Finite Element Analysis in Geotechnical Engineering: Application, Thomas Telford Publishers, London.
6. Das, B.M., Principles of Foundation Engineering, Cengage Learning
7. Tomlinson M and Woodword J, Pile Design and Construction Practice, Taylor and Francis
8. Das, B. M. and Ramana, G. V, Principles of Soil Dynamics, Cengage Learning
9. Gopal Ranjan & A.S.R. Rao, Basic and Applied Soil Mechanics, New Age Publishers 10. Recent technical literature on related topics

Any other Remarks:

Course Title	Research Methodology
Credits	L T P Cr 2 0 0 2
Prerequisites	Nil

Course Contents:

Introduction to engineering research: Definition, characteristics and types, basic research terminology, qualities of a researcher, research methods vs methodology, overview of engineering research methods, role of Information and Communication Technology (ICT) in research, research ethics, intellectual property rights and scholarly publishing.

Research formulation: Defining and formulating the research problem, selecting the problem, necessity of defining the problem, literature survey – significance in defining a problem, various sources, critical review, identifying gap areas from literature review and research databases, development of working hypothesis.

Research design and data analysis: Research design – basic principles, need of research design, features of good design, important concepts relating to research design, observation and facts, laws and theories, method validation, observation and collection of data, methods of data collection, sampling methods, data processing and analysis, hypothesis testing, generalization and interpretation.

Technical writing: Types (thesis, report, journal papers etc.), qualities, structure and components of good technical document, use of software tools (Word processing, latex, etc.), illustrations and tables, bibliography, referencing and footnotes. Oral presentation – planning, software tools, creating and making effective presentation, use of visual aids, importance of effective communication.

Text/Reference Books:

1. Blessing, L.T.M., Chakrabarti, A., DRM, a Design Research Methodology, Springer, 2009
2. Chandra, S., Sharma, M.K., Research Methodology, Narosa Publishing House, 2013
3. Cohen, L., Manion, L., Morrison, K., Research Methods in Education, Routledge (Taylor and Francis Group), 2011
4. Goddard, W., Melville, S., Research Methodology – an Introduction, Juta and Company Ltd., 2004
5. Kothari, C.R., Garg, G., Research Methodology – Methods and Techniques, New Age International, 2014

Additional Remarks (if any): ---

Course Title	Soil Dynamics and Geotechnical Earthquake Engineering
Credits	L T P Cr 3 1 0 4
Prerequisites	Soil Mechanics/Geotechnical Engineering

Course contents:

Introduction – Scope and objectives, nature and types of dynamic loading and importance

Vibration theory and Wave Propagation – Vibration of elementary systems, degrees of freedom, undamped and damped free and forced vibrations, types of forced vibrations, multi degrees of freedom systems, response spectra, elastic response of continuum

Dynamic Soil Properties – Stiffness, damping and plasticity parameters of soil and their determination (laboratory testing, intrusive and non-intrusive in-situ testing), Correlations of different soil parameters, Liquefaction (basics, evaluation and effects)

Engineering Seismology – Basics, causes of earthquake, elastic rebound theory, plate tectonics, earthquake prediction, theory of continental drift, earthquake hazards

Strong Ground Motion and wave propagation – Magnitude and intensity of earthquake, seismic energy correlations, attenuation relationships, Methods to locate earthquake's epicentre

Seismic Hazard and Site Response Analysis – deterministic seismic hazard analysis (DSHA), probabilistic seismic hazard analysis (PSHA), earthquake source characterization

Seismic Analysis and Design of Various Geotechnical Structures – Pseudo-static method, Pseudo dynamic method, seismic analysis of various geotechnical structures, codal provisions/guidelines for seismic design of geotechnical structures.

Text/Reference Books:

1. Shamsher Prakash, "Soil Dynamics", McGraw-Hill Book Company.
2. Braja M. Das, "Principles of Soil Dynamics", PWS-KENT Publishing Company.
3. Steven L. Kramer, "Geotechnical Earthquake Engineering", Prentice Hall Inc.
4. D. D. Barkan, "Dynamics of Bases and Foundations", McGraw-Hill Book Company.
5. E. E. Richart et al. "Vibrations of Soils and Foundations", Prentice Hall Inc.
6. Robert W. Day, "Geotechnical Earthquake Engineering Handbook", McGraw Hill, New York.
7. Ikuo Towhata, "Geotechnical Earthquake Engineering", Springer-Verlag Heidelberg.
8. Kenji Ishihara, "Soil Behaviour in Earthquake Geotechnics", Oxford University Press, USA.
9. IS 1893, Indian Standard Criteria for earthquake resistant Design of Structures. 10. Recent relevant literature

Additional Remarks (if any): ---

Course Title	Advanced Foundation Engineering
Credits	L T P Cr 3 1 0 4
Prerequisites	Soil Mechanics/Geotechnical Engineering

Course Contents:

Stress distribution in soils

Pressure bulb, Boussinesq's and Westergaard theories, contact pressure distribution, arching in soils

Combined and Raft Foundations

Proportioning of foundation for equal settlement, modulus of subgrade reaction, rectangular combined foundation, trapezoidal combined foundation, strap foundation, design of rigid raft foundation, design of flexible raft foundation, construction aspects for combined and raft foundations

Pile Foundations

Types, function, selection of piles; end-bearing and friction piles, vertical and lateral load carrying capacity of single pile, group action of piles, negative skin friction, settlement of pile groups, pile load tests, construction aspects for pile foundation, concept of piled-raft foundation

Machine Foundations

Types, design criteria, spring mass analogy, dynamic soil-spring constants, free and damped vibrations, degrees of freedom of block foundation, cyclic plate load test, down hole test, cross hole test, codal provisions for machine foundations, vibration isolation

Special Foundations

Foundations for tank, chimney and silo; caissons and well foundations, underwater construction aspects, recent advancements in foundation design and construction

Reference / Text Books

1. Bowles, J. E., Foundation Analysis and Design, McGraw Hill International Ed.
2. Das, B.M., Principles of Foundation Engineering, Cengage Learning
3. Tomlinson M and Woodword J, Pile Design and Construction Practice, Taylor and Francis
4. Das, B. M. and Ramana, G. V, Principles of Soil Dynamics, Cengage Learning
5. Prakash S and Puri V. K, Foundations for Machines: Analysis and Design, John Wiley and Sons
6. Gopal Ranjan & A.S.R. Rao, Basic and Applied Soil Mechanics, New Age Publishers
7. Murthy, V.N.S., Soil Mechanics and Foundation Engineering, CRC Press
8. Relevant Standards / Codes
9. Recent technical literature on related topics

Any other Remarks: