MASTER OF TECHNOLOGY IN GEOTECHNICAL ENGINEERING

COMMON CURRICULUM AND SYLLABUS

COURSE STRUCTURE

1ST SEMESTER

Theory:

Sl No	Paper Code	Paper	Contacts periods Per weeks			Total Contact (hrs.)	Credits
			L	T	P		
1	GAM 101	Advanced Engineering Mathematics	3	1	0	4	4
2	GTE 102	Advanced Soil Mechanics	3	1	0	4	4
3	GTE 103	Advanced Foundation Engineering -I	4	0	0	4	4
4	GTE104-A/B/C	Elective I	4	0	0	4	4
5	GTE105-A/B/C	Elective II	4	0	0	4	4
		Total of Theory				20	20

Practical / Sessional:

Sl No	Paper Code	Paper	Contacts periods Per weeks			Total Contact (hrs.)	Credits
			L	T	P		
1	GTE 191	Geotechnical Laboratory -I	0	0	3	3	2
2	GTE 192	Computer Application in Engineering	0	0	3	3	2
3	GTE 181	Seminar I	0	0	3	3	2
		Total of Practical / Sessional				9	6
TOTAL OF SEMESTER			18	02	09	29	26

2ND SEMESTER

Theory:

Sl No	Paper Code	Paper	Contacts periods Per weeks			Total Contact (hrs.)	Credits
			L	T	P		
1	GTE 201	Theoretical Soil Mechanics	3	1	0	4	4
2	GTE 202	Dynamics of soil and foundation	3	1	0	4	4
3	GTE 203	Advanced Foundation Engineering -II	3	1	0	4	4
4	GTE204 A/B	Elective III	4	0	0	4	4
5	GTE205 A/B	Elective IV	4	0	0	4	4
		Total of Theory				20	20

Practical / Sessional:

Sl No	Paper Code	Paper	Contacts periods Per weeks			Total Contact (hrs.)	Credits
			L	T	P		
1	GTE 291	Geotechnical Investigation Practice	0	0	3	3	2
2	GTE 292	Geotechnical Laboratory -II	0	0	3	3	2
3	GTE 281	Seminar II	0	0	3	3	2
		Total of Practical / Sessional				9	6
TOTAL OF SEMESTER			17	03	09	29	26

3RD SEMESTER

Theory:

Sl No	Paper Code	Paper	Contacts periods Per weeks			Total Contact (hrs.)	Credits
			L	T	P		
1	GBM 301	Project Planning Management	4	0	0	4	4
2	GTE302-A/B	Elective V	3	1	0	4	4
		Total of Theory				8	8

Sessional:

Sl No	Paper Code	Paper	Contacts periods Per weeks			Total Contact (hrs.)	Credits
			L	T	P		
1	GTE 381	Pre-submission Defense of Dissertation	0	0	0	0	4
2	GTE 382	Dissertation (Part – I)	0	0	0	20	10
		Total of Sessional	0	0	0	20	14
TOTAL OF SEMESTER			7	1	0	28	22

4TH SEMESTER

Sessional:

Sl No	Paper Code	Paper	Contacts periods Per weeks			Total Contact (hrs.)	Credits
			L	T	P		
1	GTE 481	Dissertation (Completion)	0	0	0	24	14
2	GTE 482	Post-submission Defense of Dissertation	0	0	0	0	8
4	GTE 282	Comprehensive Viva-Voce	0	0	0	0	4
Total of Sessional			0	0	0	24	26
TOTAL OF SEMESTER			0	0	0	24	26

LIST OF ELECTIVES

Sl No.	Subject Code	Name of the Subject
Elective I		
01	GTE 104A	Structural Design of Foundation and Retaining structure
02	GTE 104B	Finite Element Methods in Geotechnical Engineering
03	GTE 104C	Flow through Porous Media
Elective II		
01	GTE 105A	Reinforced Earth
02	GTE 105B	Rock Mechanics
03	GTE 105C	Geotechnical Exploration & Measurement Technique
Elective III		
01	GTE 204A	Ground Improvement Techniques
02	GTE 204B	Design of Road Pavements
Elective IV		
01	GTE 205A	Earth and Earth Retaining Structures
02	GTE 205B	Environmental Geotechnology
Elective V		
01	GTE 302A	Geotechnical Earthquake Engineering

02	GTE 302B	Remote Sensing and Its Application in Geotechnical Engineering.

DETAILED SYLLABUS

SEMESTER - I

GAM 101: Advanced Engineering Mathematics

Set Theory: Definition of set, Subsets and supersets. Set operations, finite and infinite set, Cardinality, Venn diagram, Cartesian product, Fuzzy sets– basic properties, Simple problems. Recurrence Relation and Generating Functions : Formation of recurrence relation, Solution of linear and nonlinear recurrence relation, Properties of generating function and solve the recurrence relation using the generating function and related problems. Numerical analysis: Introduction to interpolation, Newton's Forward and Backward interpolation(Statement only), Lagrange and Divided interpolation(Statement only), Simple problems. Numerical differentiation for equal and unequal interval. Matrix Eigen value and eigen vactor by power metods, simple problems. Curve fitting and problems.

Statistics: Analysis of Bivariate data. Correlation Analysis – Meaning of correlation;

Scatter Diagram; Karl Pearson's coefficient of linear correlation. , Linear regression, Properties of regression and related problem.

Optimisation Technique: Linear programming problem(LPP) Formation of LPP, Graphical Method and related problems. Transportation Problems, assignment problem.,

Queuing Theory- Basic Structure, Exponential distribution, Birth-and-Death Model, M/M/I

Queue.

Text Books

1. Mott, Kandel & Baker, *Discrete Mathematics for Comp. Scientists & Mathematicians*, PHI
2. C.L.Liu, *Discrete Mathematical Structure*, TMH
3. Dutta & Jana, *Introductory Numerical Analysis*.
4. J.B.Scarborough, *Numerical Mathematical Analysis*.
5. Jain, Iyengar & Jain, *Numerical Methods (Problems and Solution).*
6. V.K. Kapoor, *Operation Research*.
7. Paneer Selvam, *Operation Research*, PHI
8. Hillier & Lieberman, *Operations Research*, TMH
9. Kalavati, *Operations Research*, VIKAS
10. R.I.Levin & D.S. Rubin, *Statistics for Management*, Pearson Education
11. Amir D. Aczel & Jayavel Sounderpandian, *Complete Business Statistics*, Tata McGraw- Hill
12. R.S Bhardwaj, *Business Statistics*, Excel Books.
13. Balagurusamy: Numerical Methods,
14. Scitech.Operation Research,Humdy Taha,PHI
15. Statistics,Random Process & Queuing Theory, Prabha, Scitech
16. S P Gupta & M.P. Gupta, *Business Statistics*, Sultan Chand & Sons
17. G. C. Beri, *Statistics for Management*, Tata McGraw- Hill
18. A.M Goon, M.K Gupta & B, Dasgupta, *Basic Statistics*, World Press

GTE-102: Advanced Soil Mechanics

One and three dimensional consolidation theories and applications, Immediate settlement, Methods of determination, Estimation of Pre-consolidation pressure, Secondary consolidation.

Shear strength parameters of cohesion less and saturated cohesive soils, Principles of Effective stress condition, Effect of rate of stress on shear parameters, Stress- Strain relationship, Skempton's Pore pressure coefficients, Hvorslev's true shear parameters, Effect of over consolidation on shear parameters.

Stability analysis of slope -effective vs. total stress analysis, Stability Analysis of Slope: Effective and total stress approach, shape of slip surface, methods of slices, graphic methods, location of critical slip circle, wedge analysis method, stability during critical conditions.

Earth pressure – Rankine, Columb and Graphical Methods, Retaining walls structures, Gravity cantilever and counter fort retaining walls: Stability checks and design:

Sheet Pile Structures: Cantilever sheet piling, Anchored sheet piling: Free and fixed earth support methods of Analysis, Braced excavations.

Soil Anchors: Inclusions and Installation Techniques, Design of Soil Anchors, Application Criteria: Advantages and Limitations:

Text Books:

1. B M Das, *Advanced Soil Mechanics*, Taylor and Francis
2. R F Scott, *Principles of Soil Mechanics*, Addison & Wesley.
3. R.O. Davis and A.P.S. Selvadurai, *Elasticity and Geomechanics*, Cambridge University Press, New York.
4. Mitchell, James K, *Fundamentals of Soil Behaviour*, John Wiley and Sons
5. D.M. Wood, *Soil Behaviour and Critical State Soil Mechanics*, University of Glasgow

GTE-103: Advanced Foundation Engineering- I

Shallow Foundation: Terzaghi's bearing capacity equation, General bearing capacity equation, different bearing capacity theories, I.S. Code method, Effect of foundation shape, eccentricity and inclination of load, Influence of soil compressibility and water table, Footing pressure for settlement on sand, Soil pressure at a depth, Boussinesq's & Westergaard methods,

Raft Foundation: Settlement and Bearing Capacity analysis, Analysis of flexible and rigid raft as per IS 2950.

Computation of settlements (Immediate & Consolidation); Permissible settlements, Allowable total and differential settlement of structures.

Proportioning of footing, Inclined & Eccentric loads. Settlement of footings on stratified deposits. Influence of adjacent footings.

Bearing Capacity from SPT and SCPT and Plate load Test data, Proportioning of footing based on settlement criteria.

Foundations on Problematic soils: Problems and Remedies.

Text Books:

1. B. M Das, *Principles of Foundation Engineering*, Thomson Brooks/Cole
2. J. E. Bowles, *Foundation Analysis and Design*, McGraw-Hill Book Company

3. N.P. Kurien, *Design of Foundation Systems : Principles & Practices*, Narosa, New Delhi 1992

4. H. F. Winterkorn and H Y Fang, *Foundation Engineering Hand Book*, Galgotia Booksource

ELECTIVE (I & II)

GTE 111: Structural Design of Foundation & Retaining Structures

Building foundation design: Design of footing, isolated footing and steel grillage, combined footings of rectangular, Trapezoid cantilever types. Mat or raft foundation of dry and saturated soil floating foundations,

Design of Piles, Pile caps and pile foundations buildings,

Design of retaining structures, Design of retaining walls with surcharge loads. Retaining walls resting on piles,

Design of bridge abutments, Design of foundation for transmission towers: - Design of basement walls,

Bridges structures Analysis and Design : Design of wells foundation and caissons of different types, Design of bridge pairs resting on piles.

Text Books:

1. Swami Saran, *Analysis and Design of Sub structures*, Oxford and IBH Publishing Co. PVT. Ltd, New Delhi.

2. Tomlinson, *Foundation Design and Construction*, Prentice Hall Publication.

GTE 112: Finite Element Methods in Geotechnical Engineering

Finite element: Potential Energy, shape function, linear, triangular and rectangular element, fundamentals for one-dimensional, two dimensional structure, isoparametric formulation, simple two dimensional problems related to Geotechnical Engineering.

Text Books:

1. David M Potts. And Lidija, Zdravkovic, *Finite Element Analysis in Geotechnical Engineering*, Vol 1 & 2. Thomas Telford, London.

2. J.N.Reddy, *Elementary Finite Element Method*, Tata Mc Graw Hill, New Delhi.

3. Bathe, *Finite Element Procedure*, Prentice Hall.

GTE 113: Flow through Porous Media

Dercy's law, Permeability of soils, Laboratory and field determination, pumping in and pumping out tests.

Fundamentals of ground water flow, general hydro-dynamic equations. Velocity potential and stream function, equiprnent function, Flownets - properties and uses.

Confined and unconfined flow of water. Flow through earth dam, under hydraulic structures and foundation structures.

Numerical and similitude methods of solution for confined flow problems.

Radial flow of water and seepage from canals and ditches.

Text Books:

1. D.K.Todd, *Groundwater Hydrology*, John wiley and Sons

2. H.M. Raghunath, *Ground Water*, Willy Eastern Ltd.

3. M.E. Harr, *Ground Water and Seepage*, McGraw-Hill, 1962.

4. C.Fitts, *Ground Water Science*, Elsevier Publications, U. S. A.

5. P. P. Raj, *Geotechnical Engineering*, Tata McGraw-Hill

GTE 114: Principles and Design of Reinforced Earth

Reinforced Earth: Introduction; Mechanism and concept - the andsobropis cohesion concept, the LCPC cohesion theory, the NSW cohesion theory, the sigma model, the tau model. The enhanced confining pressure concept the Greneble study, the UCLA study. Randomly reinforced soil, the limitation of laboratory studies. Application.

Reinforced Earth Structure - design and construction soil-reinforcement bend.

Geosynthetics: Introduction; Geotextile, Geojute, Geomembrane, Geogrid etc. Application of Geosynthetics in Civil Engineering, testing of geotextile.

Text Books:

1. Geo-textiles and Geo-membranes in Civil Engg. Gerard P.T.M. Van Santvrot A. A. Balkema, Oxford and IBH publishing company, New Delhi.

2. Reinforced Soil and Geo-textiles- J. N. Mandal, proceedings FIGC- 1988, Oxford and IBH publishing company private Ltd., New Delhi.

3. Geosynthetics: Applications, Design and construction- R. J. Tarmat, proceedings First Europian Geosynthetics Conference, Netherland A. A. Balkema, publisher-Brookfield, U.S.A.

4. Geosynthetics World. – J. N. mandal, Willey Eastern Limited, New Delhi.

5. Geotextiles. N.W.M. John, Blackie, Glasgow and London.

6. R. M. Korner, *Design with Geosynthetics*, Prentice Hall, New Jersy, 3rd Edn. 2002

GTE 115: Rock Mechanics and Tunneling

Composition of rocks, Engineering classification and Limitation of Geologic classification of rocks, rocks structure and perespans in rock.

Rock coming, various methods of obtaining rock cores, Engineering Properties of rock, stress - strain relations, elastic theory application to design in rock.

Strength and failure of rocks, Uniaxial and triaxial strength of rocks, other shear tests and application in Civil Engineering problems, failure theoretics of rocks and propagation of cracks, Griffith Chack theory - Water in rock, Structural feature of mass rocks and their effects on engineering properties.

Measurement of stresses - rock mass, various types of measuring devices, evaluation of properties of rocks in the field.

Design of structure in rocks, Basic design principles of tunnels in rock. Principle of design of rock slopes.

Text Books:

1. W. Farmer, *Engineering Behavior of Rocks*, Chapman and Hall Ltd.
2. R. E. Goodman, *Introduction to Rock Mechanics*
3. P.R. Sheorey, *Empirical Rock Failure Criteria*, Balkema, Rotterdam, 1997
4. K.G.Stagg and O.C.Zienkiewicz, Rock Mechanics in Engineering Practice, John Wiley and Sons, London.
5. V.S. Vutukuri and R D Lama, *Hand Book on Mechanical Properties of Rocks*
6. B.P Verma, *Rock Mechanics for Engineers*

GTE-116: Geotechnical Exploration & Measurement Technique

Introduction: Necessity and Importance of soil exploration, Method of sub surface exploration Test pits, Trenches, Caissons, Tunnels and drifts, Wash boring, Percussion drilling , Rotary drilling, Factors affecting the selection of a suitable method of boring. Extent of boring, Factors controlling spacing and depth of bore holes, Spacing and depth of various Civil engineering structures.

Indirect method of exploration, Seismic method, Electrical resistivity, Resistivity sounding and profiling, Qualitative and quantitative interpretation of test results, Comparison of resistivity and seismic surveys, Shortcomings. Stabilization of bore holes, Different method of stabilization of the bore holes, their relative merits and demerits. Ground water Observation: Different method of ground water observation: Time lag in observation, sampling of ground water.

Sampling: Source of disturbance and their influence. Type of sampler, Principle of design of sampler, Representative and undisturbed sampling in various types of soils. Surface sampling, Amount of sampling, Boring and sampling record, Preservation and shipment of sample preparation of bore log.

Penetration tests, Standard penetration tests, Dynamic cone penetration tests with and without bentonite slurry, Static cone penetration tests, factor affecting the penetration tests. Various corrections in the test results. Interpretation of test result for design and determination of modulus of deformation. Small size penetrometers. Correlation among various test results.

Text Books:

1. M. Hvorsler, *Subsurface exploration and sampling of soil for Civil Engg. Purpose*.

2. B. M Das, *Principles of Foundation Engineering*, Thomson Brooks/Cole

3. N.P. Kurien, *Design of Foundation Systems : Principles & Practices*, Narosa, New Delhi 1992

4. G.Ranjan and A S R Rao, *Basic and Applied Soil Mechanics*, New Age international Publishers.

5. H. F. Winterkorn and H Y Fang, *Foundation Engineering Hand Book*, Galgotia Booksource

6. Simon and Cayton, *Site Investigation*.

GTE 191: Geotechnical Laboratory-I

1. Determination of In-situ density by core cutter method.
2. Determination of In-situ density by sand replacement method
3. Determination of undrained shear strength of soil by vane shear test
4. Determination of shear parameter of soil by Triaxial test
5. Determination of compressibility characteristics of soil by Oedometer test.
6. Determination of CBR of a soil specimen as per IS code recommendation

Text Book

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

GTE192: Computer Application in Geotechnical Engineering

Application Programme:

For determination of

1. Soil particle size distribution (sand%, silt%, clay%)
2. Shear strength parameters of soil,
3. Co-efficient of permeability for flow through layered soil – (a) Parallel to layers, (b) Perpendicular to layers

4. Consolidation parameters of soil

And computation of

1. Settlement, safe and allowable bearing capacity of soil

Usage of standard Geotechnical software packages.

Text Books:

1. M.G.Salvadori and M.L.Baron, *Numerical Method in Engineering*.
2. Syal and Gupta, *Computer Programming and Engg. Analysis*.

SEMESTER - II

GTE 201: Theoretical Soil Mechanics

Equilibrium and Compatibility equations, Stresses in soils. Geostatic stresses, Stresses due to imposed and interior loadings. Method of characteristics, and limiting eyuilihrium concept. Formulation, Solution in the transformed plane, retrieval of the solution original problem space.

Typical applications in problems of stability, bearing capacity etc.

Text Books:

1. M.E. Harr, *Foundations of Theoretical Soil Mechanics*, McGraw-Hill Book, 1966.
2. K. Terzaghi, *Theoretical Soil Mechanics*, John Wiley and Sons
3. R. Jumikis, *Theoretical Soil Mechanics*, Van Nostrand Reinhold Company, New York.

GTE 202: Dynamics of soil and foundation

Theory of vibrations - Free and forced vibrations, damped and undamped, single and multi-degree freedom system, transmission, principles of measuring instruments.

Dynamic soil properties - wave propagation in elastic medium. Electric constants of soils -lab and field methods, liquifaction Dynamic bearing capacity.

Design of mechanic foundations - estimation of unbalanced forces, foundations for impact type machines. Dynamic response of embedded block foundation, piles under different modes of vibration. Frame foundation, vibration isolation, Construction aspects of machine lotindatioris.

Text Books:

1. S. Saran, *Soil Dynamics and Machine Foundations*, Galgotia Publications Private Ltd.1999

2. N. S. V. Kameswara Rao, *Vibration Analysis and Foundation Dynamics*, Wiley New Delhi, 1998

3. D.D. Barkan, Dynamics of Bases and Foundation, McGraw-Hill, New York, 1962.

4. B M Das, *Principles of Soil Dynamics*, Thomsons Engineering, 1992

5. K.G. Bhatia, *Foundations For Industrial Machines*, D-CAD Publishers , 2008

6. A Major, *Vibration Analysis and Design of Foundations for Machines and Turbines: Dynamical Problems*

GTE-203: Advanced Foundation Engineering- II

Deep Foundation: Modes of failure. Bearing capacity and settlement of pile foundation. Types of piles. Allowable load, Pile Load test. Dynamic and static formulae. Bearing Capacity factors. Pile group bearing capacity and settlement. Interference, Behavior of piles under lateral loading. Winkler's assumption. Pile resistance and deflection under lateral loads, elastic method, Broms method.

Well Foundation: Design and construction. Bearing capacity, settlement and lateral resistance. Tilts and shifts.

Drilled Shaft: Construction procedures, Design Considerations, Load Carrying Capacity and settlement analysis

Text Books:

1. B. M Das, *Principles of Foundation Engineering*, Thomson Brooks/Cole

2. J. E. Bowles, *Foundation Analysis and Design*, McGraw-Hill Book Company

3. H.G. Poulos, and E.H.Davis, Pile Foundation Analysis and Design, John Wiley and Sons, New York.

4. N.P. Kurien, *Design of Foundation Systems : Principles & Practices*, Narosa, New Delhi 1992

5. H. F. Winterkorn and H Y Fang, *Foundation Engineering Hand Book*, Galgotia Booksource

ELECTIVE (III)

GTE 211: Ground Improvement Techniques

Introduction: Need of Ground Improvement: Different methods of Ground improvement,

General Principal of Compaction: Mechanics, field procedure, quality control in field.

Ground Improvement in Granular Soil: In place densification by (i) Vibrofloatation (ii)Compaction pile (iii) Vibro Compaction Piles (iv) Dynamic Compaction (v) Blasting

Ground Improvement in Cohesive Soil: Compressibility, vertical and radial consolidation, preloading methods. Types of Drains, Design of vertical Drains, construction techniques. Stone Column: Function Design principles, load carrying capacity, construction techniques, settlement of stone column foundation.

Ground Improvement by Grouting and Soil Reinforcement: Grouting in soil, types of grout,desirable characteristics, grouting pressure, grouting methods. Soil Reinforcement: Mechanism, Types of reinforcing elements, reinforcement-soil interaction, Reinforcement of soil beneath the roads, foundation. Geosynthetics and their application.

Soil Stabilization: Lime stabilization-Base exchange mechanism, Pozzolanic reaction, lime-soil interaction, line columns, Design of Foundation on lime columns. Cement stabilization: Mechanism, amount, age and curing. Fly-ash - Lime Stabilization, Soil Bitumen Stabilization.

Text Books:

1. R. M. Korner, *Design with Geosynthetics*, Prentice Hall, New Jersy, 3rd Edn. 2002

2. P. Purushothama Raj, *Ground Improvement Techniques*, Tata McGrawHill, New Delhi, 1995.

3. Dr. B.C.Chattopadhyay and J.Maity, *Ground Control and Improvement Techniques*, PEEDOT, Howrah, 2011.

4. G. V. Rao and G. V. S. Rao, *Text Book On Engineering with Geotextiles,* Tata McGraw Hill

5. T. S. Ingold and K. S. Miller, *Geotextile Hand Book,* Thomas Telfrod, London

6. N. V. Nayak, *Foundation Design Manual*, Dhanpat Rai and Sons, Delhi.

7. M.P.Moasley, *Ground Improvement Techniques*,

GTE 212- Design of Road Pavements

General Consideration: Components of road pavement such as subgrade, Sub base, Base course and wearing course and their functions. Comparison of flexible and rigid pavements highway and air port pavements

Pavements Materials: Stabilizing base viz., Mechanical, Stabilized with admixture like cements, Bitumen lime and other chemicals.

Factor Affecting the Pavements Design: Traffic factor, Moisture and climate factors, Soil factor, Stress distribution factor

Design of Flexible pavements: General classification of various methods and their approach, Emperial methods using soil classification. Theoretical and semi theoretical methods. General observation and limitation of various methods.

Design Method of Rigid Pavements: Analysis of stresses in concrete pavements due to various wheel loads. Cyclic changes in temperature. Changes in moisture and volumetric change in subgrade and base course. Comparison of analysis of stress due to wheel loads on liquid and solids subgrade theorem. Thickness design methods such as P.C. A. design method F.A.A. methods etc. Design of distributed steel reinforcement, design of dowels, Design of spacing of joints.

Pavement Evaluation and Strengthening: Method of pavement evaluation including LCN method for airport, Design of various types of overlays for flexible and rigid pavements, Mechanics of pumping and blowing, Factor affecting pumping, preventive measures.

Pavements Performance: Pavements performance, Road Mechanic and their applications, The AASHO road test. Evaluation of performance of the flexible and rigid pavements. Analysis of results from flexible and rigid pavements.

Text Books:

1. S.K.Khurana, *Principles, Practice and Design of Highway Engineering*,
2. E.J.Yodar and M.W.Witczac, Principles of Pavement Design, 2nd Edition, John Wiley and Sons, New York.
3. C.A. O'Flaherty, *Highways*, Butterworth Heinemann.
4. Khanna and Justo, Highway Engineering, Nem Chand & Bros. Roorkee.

ELECTIVE (IV)

GTE 213: Earth and Earth Retaining Structures

Earth pressure, introduction, earth pressure as a stability problems, concept of strain dependence of developed stresses, active, at rest and passive conditions, plastic equilibrium, various theories related with E.P. Distillation, Rankine, Coulomb and Hansen theoretical derivation and graphical construction with different geometric and boundary conditions.

Retaining wall - types, material, method of construction, nature of forces acting. Comparison of different earth pressure theories and application in retaining wall. Stability analysis and design aspects, application of theory of elasticity in analysis of earth pressure distribution.

Sheet pile and cofferdam. Type, material, method of construction, distribution of earth pressure and related approximation. Distinction between Sheet Pile and Retaining wall, analysis and design.

Earth - structure - Definition, Features of an earth dam, stability analysis of slope, total - vs. - effective stress analysis, limit equilibrium method of slices based on circular failure surfaces, introduction to analysis based on general failure surfaces, introduction to analysis based on general failure surfaces. Stability of earth dams during different stages - during and at end of construction, steady seepage, sudden draw down, estimation of pore water pressure - use of stability charts.

Text Books:

1. J.L.Sherard, R.J.Woodward, S.F.Gizienski, and W.A. Clevenger, *Earth and Earth –Rock Dams Engineering Problems of Design and Construction*, John Wiley and Sons, New York, 1963.
2. R F Craig, *Soil Mechanics*, Chapman and Hall(ELBS)
3. C. Justin and Hinds, *Engineering for Dams* Vol. 2 & 3.
4. S. Leliavsky, '*Design of Dams for Percolation and Erosion'*, Chapman and Hall.

GTE 214- Environmental Geotechnology

Soil and ground water pollutants - their sources, nature, composition and polluting effects. The physico-chemical aspects of soils contaminated by various pollutants. Effects of environment and wastes on the properties of soils.

Solid and liquid wastes disposal method and management. land treatment systems.

Man made changes in geotechnical environment - mining, embankments, pumping, reservoir, land fills and reclamation effects and control.

Control of contamination with use of clay barriers, geosynthetics, cut-off walls, leachate collection systems.

Stabilization - different materials and techniques in control of ground pollution and treatment.

Text Books:

1. Lakshmi N. Reddy, Hilary. I. Inyang – *Geo-Environmental Engineering – Principles and Applications* – Makcel Dekker Ink, 2000
2. D.E.Daniel, *Geotechnical Practice for Waste Disposal*, Chaman & Hall, London.

GTE 291: Geotechnical Investigation Practice

1. Field Investigation by Auger Boring
2. Bored Pile installation in field
3. Plate load test
4. SPT test
5. Static Cone Penetration test
6. Dynamic cone Penetration test
7. Soil test Repots

GTE 292: Geotechnical Laboratory-II

1. Determination of Relative density
2. Determination of Different Geotextile Properties

(a) Thickness test

(b) Sieve test

(c) Tensile strength test

(d) Tear resistance test

(e) Puncture test

(f) Cone drop test

Text Book

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

SEMESTER - III

GBM 301: Project Planning Management

Introduction: Construction project management and its relevance, Parties / stakeholders of construction project and their responsibilities,

Project Organization: Forms of Business organization, Organization structure of a construction company, Management levels, Important traits of project manager, Ethical conduct for Engineer.

Contracts:

Definition and salient features of contract, Classification of contracts,

Bidding process,

Construction Planning:

Types of project plan, Work breakdown structure, Bar chart, Network diagram (CPM, PERT), Comparative discussion. Construction equipment.

Financial Management:

Economic decision making,Cash-flow diagram, Accounting process, Cashbook, working capital, Trading account, Profit and loss account, Balance sheet.

Claims, Disputes, and Project closer:

Sources of claims, Claim management, Causes of disputes, Arbitration a its resolution, Closer of contract and Financial closer.

Text Books:

1. Bratish Sengupta and Himadri Guha, *'Construction Management and Planning'*, Tata McGrwHill.

ELECTIVE (V)

GTE 311: Geotechnical Earthquake Engineering

Introduction, Seismology and earthquakes, continental drift and plate tectonics, elastic Rebound theory, location and size of earthquakes.

Strong Ground Motion -Strong motion measurement, ground motion parameters & their estimation.

Seismic Hazard Analysis - Deterministic and Probabilistic.

Wave Propagation - Waves in a Semi- infinite body, layered body. Attenuation of stress waves.

Ground Response Analysis - one, two and three dimensional ground response analysis.

Liquefaction - various phenomena, evaluation of liquefaction hazards, liquefaction susceptibility initiations and effect of liquefaction.

Seismic Slop Stability.

Seismic Design of Retaining Walls.

Soil Improvement for remediation of Seismic hazards.

Text Books:

1. S.L. Kramer, *Geotechnical Earthquake Engineering*, Pentice Hall, international series, Pearson Education (Singapore) Pvt. Ltd., 2004.
2. S.Saran, *Soil Dynamics and Machine Foundation*, Galgotia publications Pvt. Ltd., New Delhi 1999.
3. Ansal, *Recent Advances in Earthquake Geotechnical Engineering and Microzonation*, Springer, 2006.
4. Towhata, *Geotechnical Earthquake Engineering*, Springer , 2008.

GTE 312: Remote Sensing and Its Application in Geotechnical Engineering.

Definitions and introduction to remote sensing, components of remote sensing system. Spectral windows and spectral signatures and their significance in remote sensing. Radiometric quantities used in the collection of spectral signatures. Remote sensing satellite orbits, image acquisition process, repeativity, row/path and ground swath and coverage. Various remote sensing platforms. Passive and active remote sensors: Radar, Lidar and SAR. Spectral and spatial resolution of

various remote sensors with special relevance to Indian Remote Sensing satellites. Different types of remotely sensed data products.

Characteristics of photographic images, colour, tone and texture, photo-interpretation keys, techniques of photo-interpretation. Digital image classification techniques and extraction of thematic information.

Global Positioning System (GPS): Introduction & components of GPS, Space segment, control segment and user segment, Elements of Satellite based surveys –Map datums, GPS receivers, GPS observation methods and their advantages over conventional methods.

Geographic Information System (GIS) – Definition of GIS, Geographical concepts and terminology, Components of GIS, Data acquisition, Raster and vector formats, scanners and digitizers. Advantages of GPS and GIS in the storage thematic information extracted from remotely sensed images.

Role of remote sensing and GIS in terrain investigation and advantages over conventional mapping techniques. Extraction of topographic information from remotely sensed data and generation of digital terrain model from stereo pairs of images. Resource mapping for engineering project: selection of sites for construction materials, water resources, soil, buildings, railways, and highways etc. using remotely sensed data.

Geological mapping for the geotechnical investigation of soil strata. Monitoring of areas prone to landslides using remote sensing, digital model and GIS. Application of visible, infra-red and microwave remote sensing for the identification of soil types, grain size and moisture studies.

Text Books:

1. Lillesand T.M. and Kiefer R. W., *Remote Sensing and image interpretation,* John Wiley and Sons. New York.
2. J. B. Campbell, *Introduction to remote sensing* , Taylor & Francis, London.
3. J. R.Jensen, *Introductory Digital Image Processing,* Prentice Hall International Ltd., London.
4. Kennie, T. J. M. and Matthews M. C., *Remote Sensing in Civil Engineering,* Surrey University Press, Glasgow.