

BIKANER TECHNICAL UNIVERSITY, BIKANER

बीकानेर तकनीकी विश्वविद्यालय, बीकानेर



COURSE SCHEME AND SYLLABUS

M. TECH. GEOTECHNICAL ENGINEERING

M. Tech.
Geotechnical Engineering
Teaching and Examination Scheme
1stYear –I Semester

THEORY											
		Course		Contact hrs/ week			Marks				Cr
S N	Category	Code	Title	L	T	P	Exam Hrs	IA	ETE	Total	
1	PCC	1CEMGE1-01	Advanced Soil Mechanics	3	-	-	3	20	80	100	3
2		1CEMGE1-02	Geotechnical Exploration	3	-	-	3	20	80	100	3
3		1CEMGE1-03	Advanced Foundation Engineering	3	-	-	3	20	80	100	3
4	PEC-I	1CEMGE2-04	Ground Improvement Techniques	3	-	-	3	20	80	100	3
		1CEMGE2-05	Soil Structure Interaction								
		1CEMGE2-06	Geo Environmental Engineering								
		1CEMGE2-07	-----								
5	PEC-II	1CEMGE2-08	Probability and Statistical Methods	3	-	-	3	20	80	100	3
		1CEMGE2-09	Geosynthetics								
		1CEMGE2-10	Finite Element Method in Geotechnical Engineering								
		1CEMGE2-11	-----								
6	OES	1CEMGE3-12	Human Values and Professional Ethics	2	-	-	3	20	80	100	2
		Sub Total		17						600	17
PRACTICAL & SESSIONAL											
7	PCC	1CEMGE1-13	Geotech Lab- I	-	-	2	-	60	40	100	2
8	FW	1CEMGE4-14	Field Work	-	-	2	-	60	40	100	2
9	AC	1CEMGE5-15	Human Values Practice School	-	-	2	-	30	20	-	-
		Sub- Total				6				200	4
		TOTAL OF I SEMESTER		17		6				800	21

L: Lecture, **T:** Tutorial, **P:** Practical, **Cr:** Credits, **ETE:** End Term Exam, **IA:** Internal Assessment

PCC: Program Core Courses

PEC: Program Elective Courses

Electives Courses (3-4Nos.) should be relevant to the chosen specialization/branch

OES: Other Emerging Subjects: (i) Human Values and Professional Ethics
(ii) Research Methodology

It is decided common for all branches.

FW: Field Work

Student is required to work in the organization/industry concerned with his/her course.

AC: Audit Course

It is mandatory to pass the audit course. However, credit shall not be awarded.

M. Tech.
Geotechnical Engineering
Teaching and Examination Scheme
1stYear –I Semester

THEORY											
S N	Cate gory	Course		Contact hrs/week			Marks				C r
		Code	Title	L	T	P	Exam Hrs	IA	ETE	Total	
1	PCC	2CEMGE1-01	Rock Mechanics	3	-	-	3	20	80	100	3
2		2CEMGE1-02	Soil Dynamics	3	-	-	3	20	80	100	3
3		2CEMGE1-03	Slope Staibility Analysis	3	-	-	3	20	80	100	3
4	PEC-I	2CEMGE2-04	Pavement Analysis and Design	3	-	-	3	20	80	100	3
		2CEMGE2-05	Foundation on Expansive Soil								
		2CEMGE2-06	Geotechnical Earthquake Engineering								
		2CEMGE3-07	-----								
5	PEC-II	2CEMGE2-08	Earth Pressure and Earth Retaining Structure	3	-	-	3	20	80	100	3
		2CEMGE2-09	Disaster Mitigation and Management								
		2CEMGE2-10	Ground Water Hydrology								
		2CEMGE2-11	-----								
6	OES	2CEMGE3-12	Research Methodology	2	-	-	3	20	80	100	2
		Sub Total		17						600	17
PRACTICAL & SESSIONAL											
7	PCC	2CEMGE1-13	Geotech Lab- II	-	-	2	-	60	40	100	2
8	FW	2CEMGE4-14	Field Work	-	-	2	-	60	40	100	2
		Sub- Total				4				200	4
		TOTAL OF II SEMESTER		17		4				800	21

M. Tech.
Geotechnical Engineering
Teaching and Examination Scheme
2ndYear – III Semester

PRACTICAL & SESSIONAL											
SN	Category	Course		Contact hrs/week			Marks				Cr
		Code	Title								
				L	T	P	Exam Hrs	IA	ETE	Total	
1	PSD	3MEMMD6-16	Industrial/Field Project	-	-	28	-	360	240	600	14
2	PSD	3MEMMD6-17	Seminar	-	-	4	-	60	40	100	2
		TOTAL OF III SEMESTER				32				700	16

PSD: Industrial/Field Project, Seminar, Dissertation

M. Tech.
Geotechnical Engineering
Teaching and Examination Scheme
2ndYear – IV Semester

PRACTICAL & SESSIONAL											
SN	Categor y	Course		Contact hrs/week			Marks				Cr
		Code	Title								
		L	T	P	Exam Hrs	IA	ETE	Total			
1	PSD	4MEMPE6-18	Dissertation	-	-	32	-	420	280	700	16
		TOTAL OF IV SEMESTER				32				700	16

M. Tech.
Geotechnical Engineering
Syllabus

1CEMGE1-01: ADVANCED SOIL MECHANICS

Compressibility of soils: consolidation theory (one, two, and three dimensional consolidation theories), consolidation in layered soil and consolidation for time dependent loading, determination of coefficient of consolidation (Casagrande method and Taylors method)

Strength behavior of soils; Mohr Circle of Stress; UU, CU, CD tests, drained and undrained behavior of sand and clay, significance of pore pressure parameters; determination of shear strength of soil; Interpretation of triaxial test results.

Stress path; Drained and undrained stress path; Stress path with respect to different initial state of the soil; Stress path for different practical situations.

Critical state soil mechanics; Critical state parameters; Critical state for normally consolidated and over consolidated soil; Significance of Roscoe and Hvorslev state boundary surface; drained and undrained plane. critical void ratio; effect of dilation in sands; different dilation models.

Elastic and plastic deformations: elastic wall; introduction to yielding and hardening; yield curve and yield surface, associated and non-associated flow rule.

Suggested Readings:

1. Das, B.M. (2008). Advanced Soil Mechanics. Taylor and Francis Group, London, Second edition.
2. Helwany, S. (2007). Applied Soil Mechanics with ABAQUS Applications, John Wiley & Sons, INC, New Jersey, USA.
3. Wood, D.W. (2004). Geotechnical Modelling. Spon Press, Taylor and Francis Group, London, First edition.
4. Powrie, W. (2002). Soil Mechanics concepts and applications. Spon Press, Taylor and Francis Group, London, Second edition.
5. Terzaghi, K., Peck, R.B. and Mesri, G. (1996). Soil Mechanics in Engineering Practice.

1CEMGE1-02: GEOTECHNICAL EXPLORATION

GENERAL

Scopes and objectives of explorations – Planning a subsurface exploration – stages in sub surface exploration – Explorations for preliminary and detailed design – spacing and depth of exploration.

OPEN EXCAVATION AND BORINGS OF EXPLORATION

Pits and Trenches – Drifts and Shafts – Methods of boring – Auger Borings – Wash Borings – Rotary Drilling – Percussion Drilling – Core Drilling.

SOIL SAMPLES AND SAMPLERS

Types of soil samples – Disturbed samples – Undisturbed samples – Design Features affecting the sample Disturbance – Split spoon samplers – Scraper Bucket Samplers – Shell by Tubes and Thin walled Samplers – Piston Samplers – Denis Samplers – Preservation and handling of samples.

IN-SITU TESTING

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

GEOPHYSICAL METHODS

Geophysical methods-types-Seismic Methods – Electrical Resistivity Methods – Electrical Profiling Method –Electrical Sounding Method – seismic refraction method – Sub-soil Investigation Report.

Suggested Readings:

1. Analysis and Design of Foundations and Retainig Structures by ShamsheerPrakash, GopalRanjan and Swami Saran, SaritaPrakasham, Meerut.1979.
2. Geotechnical Engineering by C. Venkataramaiah, Wiley Eastern Ltd., New Delhi.
3. Foundation Engineering by S.P. Brahma, Tata McGraw Hill Publishing Company Limited, New Delhi, 1985.
4. Soil Mechanics & Foundation Engineering, Vol. 2 by V.N.S. Murthy, SaiKripa Technical Consultants, Bangalore.
5. Sub surface exploration and Sampling of soils for Civil Engineering Purpose by Hvorslev, M.J. Waterways Station, Vicksburg, Missispi, 1949.

1CEMGE1-03: ADVANCED FOUNDATION ENGINEERING

Soil Exploration: Planning of soil exploration for different projects, methods of subsurface exploration, methods of borings along with various penetration tests

Shallow foundation: Shallow foundations, requirements for satisfactory performance of foundations, methods of estimating bearing capacity, settlements of footings and rafts, proportioning of foundations using field test data, IS codes.

Deep Foundation: Pile foundations, methods of estimating load transfer of piles, settlements of pile foundations, pile group capacity and settlement, negative skin friction of piles, laterally loaded piles, pile load tests, analytical estimation of load- settlement behavior of piles, proportioning of pile foundations, lateral and uplift capacity of piles.

Well Foundation: Well foundation, IS and IRC codal provisions, elastic theory and ultimate resistance methods Unit V: Foundations on problematic soils: Foundations for collapsible and expansive soil

Dams and Uplift Pressure: Cofferdams, various types, analysis and design Foundations under uplifting loads

Suggested Readings:

1. Arora.,K.R.(2003).Soil Mechanics and Foundation Engineering,6th Edition ,Standard Publishers Distributors, Delhi.
2. Bowles. J.E., Foundation Analysis and Design, Tata McGraw-Hill International Edition, 5th Edn, 1997.

3. Das B.M., Shallow Foundations: Bearing capacity and settlement, CRC Press, 1999.
4. Tomlinson M.J., Pile design and construction Practice, Chapman and Hall Publication, 1994.
5. Poulos, H. G. and Davis, F. H., "Pile Foundation Analysis and Design", Wiley and Sons. 1980.

1CEMGE2-04: GROUND IMPROVEMENT TECHNIQUES

Introduction: situations where ground improvement becomes necessary

Mechanical modification: dynamic compaction, impact loading, compaction by blasting, vibro-compaction; pre-compression, stone columns; Hydraulic modification: dewatering systems, preloading and vertical drains, electro-kinetic dewatering

Chemical modification; modification by admixtures, stabilization using industrial wastes, grouting

Thermal modification: ground freezing and thawing.

Soil reinforcement: Reinforced earth, basic mechanism, type of reinforcements, selection of stabilisation/improvement of ground using Geotextiles, Geogrid, geomembranes, geocells, geonets, and soil nails.

Application of soil reinforcement: shallow foundations on reinforced earth, design of reinforced earth retaining walls, reinforced earth embankments structures, wall with reinforced backfill, analysis and design of shallow foundations on reinforced earth, road designs with geosynthetics

Suggested Readings:

1. Selvadurai, A.P.S, Elastic Analysis of Soil-Foundation Interaction, Elsevier, 1979.
2. Poulos, H.G., and Davis, E.H., Pile Foundation Analysis and Design, John Wiley, 1980.
3. Scott, R.F., Foundation Analysis, Prentice Hall, 1981.
4. Structure Soil Interaction - State of Art Report, Institution of Structural Engineers, 1978.
5. ACI 336. (1988), Suggested Analysis and Design Procedures for combined footings and Mats, American Concrete Institute.

1CEMGE2-05: SOIL STRUCTURE INTERACTION

Introduction: Critical Study of Conventional Methods of Foundation Design, Nature and Complexities of Soil Structure Interaction.

Finite Element Method: Application of Advanced Techniques of Analysis such as FEM and Finite Difference Method.

Interaction Evaluation: Relaxation and Interaction for the Evaluation of Soil Structure Interaction for Different Types of Structure under various Conditions of Loading and Subsoil Characteristics.

Interaction Problem: Preparation of Comprehensive Design Oriented Computer Programs for Specific Problems, Interaction Problems based on Theory of Sub Grade Reaction Such as Beams, Footings, Rafts Etc.

Analysis of Structure: Analysis of Different Types of Frame Structures Founded on Stratified Natural Deposits with Linear and Non-Linear Stress-Strain Characteristics.

Suggested Reading:

1. Gulhati, S. K. And Datta, M. J. Geotechnical Engineering, Tata McGraw-Hill Publ. Co. Ltd., New Delhi, 2005.
2. Venkatramaiah, C. Geotechnical Engineering, (3rd edn.) New Age International Publishers, New Delhi, 2006.
3. Kurian, N. P. Design of Foundation Systems –Principles and Practices (3rd edn.) Narosa Publishing House, New Delhi, Alpha Science International, U.K.,2005.
4. Kurian, N. P. An Introduction to Modern Techniques in Geotechnical and Foundation Engineering, Narosa Publishing House, New Delhi, Alpha Science International, U. K., 2013.
5. Kurian, N. P., Shell Foundations –Geometry, Analysis, Design and Construction, Narosa Publishing House, New Delhi, Alpha Science International, U.K.,2006.

1CEMGE2-06: GEO ENVIRONMENTAL ENGINEERING

Soil as a multiphase system; Soil-environment interaction; Properties of water in relation to the porous media; Water cycle with special reference to soil medium.

Soil mineralogy; significance of mineralogy in determining soil behavior; Mineralogical characterization.

Mechanisms of soil-water interaction: Diffuse double layer models; Force of attraction and repulsion; Soil-water-contaminant interaction; Theories of ion exchange; Influence of organic and inorganic chemical interaction.

Concepts of waste containment; Sources, production and classification of wastes, Environmental laws and regulations, physico-chemical properties of soil, ground water flow and contaminant transport, desirable properties of soil; contaminant transport and retention; contaminated site remediation

Soil characterization techniques; volumetric water content; gas permeation in soil; electrical and thermal properties; pore-size distribution; contaminant analysis. contaminated site characterization, estimation of landfill quantities, landfill site location, design of various landfill components such as liners, covers, leachate collection and removal, gas generation and management, ground water monitoring, end uses of landfill sites, slurry walls and barrier systems, design and construction, stability, compatibility and performance, remediation technologies, stabilization of contaminated soils and risk assessment approaches.

Suggested Readings:

1. Mitchell, J.K and Soga, K., Fundamentals of Soil Behavior, John Wiley and Sons Inc., 2005.
2. Fang, H-Y., Introduction to Environmental Geotechnology, CRC Press, 1997.
3. Daniel, D.E, Geotechnical Practice for Waste Disposal, Chapman and Hall, 1993.
4. Rowe, R.K., Quigley, R.M. and Booker, J.R., Clay Barrier Systems for Waste Disposal Facilities, E & FN Spon, 1995.
5. Rowe, R.K, Geotechnical and Geo-environmental Engineering Handbook, Kluwer Academic Publishers, 2001.
6. Reddi, L.N. and Inyang, H.F, Geo-environmental Engineering - Principles and Applications, Marcel Dekker Inc, 2000.

7. Sharma, H.D. and Lewis, S.P, Waste Containment Systems, Waste Stabilization and Landfills: Design and Evaluation, John Wiley & Sons Inc., 1994.

1CEMGE2-08: PROBABILITY AND STATISTICAL METHODS

Single Random variables and probability distributions: Random variables - Discrete and continuous. Probability distributions, mass function/ density function of probability distribution. Mathematical Expectation, Moment about origin and moment about any point Central moments, Skewness, Kurtosis, Moment generating function of probability distribution. Binomial, Poisson & Normal distributions and their mean, variance and moment generating function.

Multiple Random variables: Joint probability distributions- Joint probability mass/ density function, Marginal probability mass / density functions. Correlation: Correlation coefficient, rank correlation coefficient. Regression: Regression coefficient, the lines of regression and multiple correlation & regression.

Sampling Distributions and Testing of Hypothesis: Sampling: Definitions of population, sampling, statistic and parameter. Types of sampling, Expected values of Sample mean and variance, sampling distribution, Standard error, Sampling distribution of mean and sampling distribution of variance.

Parameter Estimations - likelihood estimate, interval estimations. Testing of hypothesis: Null hypothesis, Alternate hypothesis, type I, & type II errors - critical region, confidence interval, Level of significance, Once sided test, Two sided test,

Large sample tests and Small sample tests: Student t-distribution, its properties; Test of significance difference between sample mean and population mean; difference between means of two small samples Snedecor's F-distribution and it's properties. Test of equality of two population variances. Chi-square distribution, it's properties, Chi-square test of goodness of fit.

Suggested Readings:

1. R. D. Yates and D. J. Goodman, Probability and Stochastic Processes, Wiley, 1999.
2. Leon-Garcia, Probability, Statistics, and Random Processes for Electrical Engineering, Third Edition, Prentice-Hall, 2008.
3. S. Ross, First Course in Probability, Sixth Edition, Prentice-Hall, 2002. R. E. Ziemer, Elements of Engineering Probability and Statistics, Prentice Hall, 1997.
4. M. B. Pursley, Random Processes in Linear Systems, Prentice-Hall, 2002.
5. H. Stark and J W. Woods, Probability and Random Processes with Applications to Signal Processing, Third Edition, Prentice-Hall, 2002.

1CEMGE2-09: GEOSYNTHETICS

Types and manufacturing: Geosynthetics: types and functions; materials and manufacturing processes; testing and evaluations.

Designing of Geosynthetics: principles of soil reinforcement; design and construction of geosynthetic reinforced soil retaining structures, walls and slopes.

Application of Geosynthetics: Geosynthetics in pavements: geosynthetics in roads and railways; separations, drainage and filtration in road pavements and railway tracks design and construction; relevant guidelines.

Drainage and filtration applications of geosynthetics: Different filtration requirements, filtration in different types of soils and criteria for selection of geotextiles, estimation of flow of water in retaining walls, pavements, etc. and selection of geosynthetics.

Geosynthetics in pollution control: liners for ponds and canals; covers and liners for landfills material aspects and stability considerations.

Suggested Readings:

1. Koerner, R.M. "Designing with Geosynthetics", Prentice Hall, New Jersey, USA, 4th edition, 1999.
2. Jewell, R.A., "Soil Reinforcement with Geotextiles", Special Publication No. 123, CIRIA, Thomas Telford. London, UK, 1996.
3. Geosynthetics - New Horizons, Eds. G.V. Rao, PK Banerjee, J.T. Shahu, G.V. Ramana, Asian Books Private Ltd., New Delhi, 2004.

1CEMGE2-10: FINITE ELEMENT METHOD IN GEOTECHNICAL ENGINEERING

Stress-deformation analysis: One dimensional, Two dimensional and Three-dimensional formulations.

Discretization of a Continuum: Elements, Strains, Stresses, Constitutive, Relations, Hooke's Law, Formulation of Stiffness Matrix, Boundary Conditions, Solution Algorithms.

Principles of discretization: element stiffness and mass formulation based on direct, variational and weighted residual techniques and displacements approach, Shape functions and numerical integrations, convergence.

Displacement formulation: for rectangular, triangular and isoparametric elements for two dimensional and axisymmetric stress analysis. Unit V: 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

Suggested Readings

1. O.C. Zienkiewicz and R.L. Taylor, Finite element methods Vol I & Vol II, McGraw Hill, 1989, 1992.
2. K.J. Bathe, Finite element procedures, PHI Ltd., 1996.
3. David M Potts and Lidija Zdravkovic, "Finite Element Analysis in Geotechnical Engineering Theory and Application", Thomas Telford. 1999.

Need, Basic Guidelines, Content And Process For Value Education:

Understanding the need, basic guidelines, Self Exploration - its content and process; 'Natural Acceptance' and Experiential Validation, Continuous Happiness and Prosperity- Human Aspirations, Right understanding, Relationship and Physical Facilities, Understanding Happiness and Prosperity correctly- A critical appraisal of the current scenario. Method to fulfill the above human aspirations: understanding and living in harmony at various levels

Understanding Harmony in the Human Being - Harmony in Myself:

Understanding human being as a co-existence of the sentient 'I' and the material 'Body'
Understanding the needs of Self ('I') and 'Body' - Sukh and Suvidha
Understanding the Body as an instrument of 'I', Understanding the characteristics and activities of 'I' and harmony in 'I'
Understanding the harmony of I with the Body: Sanyam and Swasthya; correct appraisal of Physical needs, meaning of Prosperity in detail, Programs to ensure Sanyam and Swasthya.

Understanding Harmony in the Family and Society- Harmony in Human-Human Relationship:

Understanding harmony in the Family, Understanding values in human-human relationship; meaning of Nyaya and program for its fulfillment to ensure Ubhay-tripti; Trust (Vishwas) and Respect (Samman) , meaning of Vishwas; Difference between intention and competence, meaning of Samman, Difference between respect and differentiation; the other salient values in relationship, harmony in the society , Samadhan, Samridhi, Abhay, Sah-astitva as comprehensive Human Goals ,Visualizing a universal harmonious order in society- Undivided Society (AkhandSamaj), Universal Order (SarvabhaumVyawastha)- from family to world family.

Understanding Harmony in the Nature and Existence - Whole Existence as Coexistence:

Understanding the harmony in the Nature. Interconnectedness and mutual fulfillment among the four orders of nature- recyclability and self-regulation in nature. Understanding Existence as Co-existence (Sah-astitva) of mutually interacting units in all pervasive Space. Holistic perception of harmony at all levels of existence

Implications of the Above Holistic Understanding of Harmony on Professional Ethics - Natural Acceptance of Human Values:

Definitiveness of Ethical Human Conduct. Basis for Humanistic Education, Humanistic Constitution and Humanistic Universal Order. Competence in Professional Ethics: a) Ability to utilize the professional competence for augmenting universal human order, b) Ability to identify the scope and characteristics of people-friendly and eco-friendly production systems, technologies and management models. Strategy for transition from the present state to Universal Human Order: At the level of individual: as socially and ecologically responsible engineers, technologists and managers. Case studies related to values in professional life and individual life.

Suggested Readings:

1. R. R. Gaur, R Sangal, G P Bagaria, A Foundation Course in Human Values and Professional Ethics, Excel Books, 2009. ISBN: 978-9-350-62091-5
2. R. Subramanian, Professional Ethics includes Human Values, Oxford Univ. Press.
3. A. N. Tripathy, 2003, Human Values, New Age International Publishers.

4. M Govindrajran, S Natrajan & V.S. Senthil Kumar, Engineering Ethics (including Human Values), Eastern Economy Edition, Prentice Hall of India Ltd.
5. B P Banerjee, 2005, Foundations of Ethics and Management, Excel Books.
6. B L Bajpai, 2004, Indian Ethos and Modern Management, New Royal Book Co., Lucknow. Reprinted 2008.

1CEMGE1-13: GEOTECH LAB- I

List of Practical's:

1. Grain Size Distribution Analysis and Hydrometer Analysis
2. Atterberg Limits (Liquid Limit, Plastic limit, Shrinkage limit)
3. Standard proctor compaction test
4. modified proctor compaction test
5. Falling head permeability test
6. Constant head permeability test
7. Consolidation test
8. Determination Field Density of Soil
 - a) Core Cutter Method
 - b) Sand Replacement Method

1CEMGE4-14: FIELD WORK

Student is required to work in the organization/industry concerned with his/her course.

1CEMGE5-15: AUDIT COURSE: HUMAN VALUES & PRACTICE SCHOOL

This practice school in first semester will have two parts -

I. Industry Interaction

In this, students will start his industry interaction in the very first semester of the M.Tech. Course. He/ She has to visit an organization for 3 hours /week in any industry finalized/selected by competent authority. This interaction will give him feel and insight to the real time working.

- A. This 3 hours /work will be after the classroom studies
- B. Selection criteria of organisation-
 1. Have turnover more than 20 lakhs
 2. Have more than 20 employees
- C. During these hours, student will observe following points in the organisation:
 1. Organisational structure and hierarchy
 2. Different kind of jobs/works done by the employees at all levels in the company
 3. Working of different departments
 4. Types of skills require to work in an organisation
 5. Ways of internal and external communication
 6. Formal dressing and attitude
 7. Coordination and team work

II. Social Responsibility

To make students understand his role and responsibility in society & nature and co-existence as whole, student has to take an initiative towards contribution in any relevant social and environmental issue.

- A. This work will be performed after the time of regular classes
- B. Student will perform one or more of the following activities after the approval of mentor and HOD:
 - 1. Making contribution in increasing the income of any street vender or any needy person from under privileged section
 - 2. Cleanliness Campaign
 - 3. Donation of his/her belongings which is of no use to him/her to needy ones
 - 4. Plantation and care for nature (soil, natural resources, plants and animals)
 - 5. Girl child and women safety, education and empowerment.
 - 6. Blood donations and help of needy people at hospitals
 - 7. Helping the under – privileged section of the society
 - 8. Educating the street children or in schools when and where needed.
 - 9. Nukkad Natak on any topic of social or environmental concern.
 - 10. Any other relevant activities.

2CEMGE1-01: ROCK MECHANICS

Rock: Formation of rocks, Physical properties, Classification of rocks and rock masses, Elastic constants of rock; In-situ stresses in rock

Rock Testing: Laboratory and Field tests

Discontinuities in Rock Masses: Discontinuity orientation, Effect of discontinuities on strength of rock;

Strength Behavior: Compression, Tension and Shear, Stress-Strain relationships, Rheological behavior;

Strength/ Failure Criterion: Mohr-Coulomb, Griffith theory, Hoek and Brown, strength and other strength criteria. Stresses in rock near underground openings;

Application of rock mechanics in Civil Engineering: Rock tunneling, rock slope stability, bolting, blasting, grouting and rock foundation design. Modern modelling techniques & analyses in rocks.

Suggested Readings:

- 1. Hudson J.A. and J.P. Harrison. Engineering Rock Mechanics: an Introduction to the Model Curriculum of Engineering & Technology PG Courses [Volume -II] [58] Principles, 1997. Elsevier, Oxford
- 2. Goodman, R.E. Introduction to Rock Mechanics, John Wiley & Sons. • Ramamurthy, T., “Engineering in Rocks”, PHI Learning Pvt. Ltd.
- 3. Jaeger, J.C. and Cook, N.G.W, Fundamentals of Rock Mechanics, Chapman and Hall, 1976

4. Wyllie, D.C., Foundations on Rock, E & FN Spon. 2nd Edition, 1992.

2CEMGE1-02: SOIL DYNAMICS

Vibration Theory: Fundamentals of vibrations: single, two and multiple degree of freedom systems, vibration isolation, vibration absorbers, vibration measuring instruments

Waves Characteristics : Wave propagation: elastic continuum medium, semi-infinite elastic continuum medium, soil behaviour under dynamic loading.

Dynamic Soil Properties: Liquefaction of soils: liquefaction mechanism, factors affecting liquefaction, studies by dynamic tri-axial testing, oscillatory shear box, shake table and blast tests, assessment of liquefaction potential.

Dynamic elastic constants of soil: determination of dynamic elastic constants, various methods including block resonance tests, cyclic plate load tests, wave propagation tests, oscillatory shear box test.

Machine foundations: Design criteria for machine foundations; Elastic homogeneous half space and lumped parameter solutions, analysis and design of foundations for reciprocating and impact type machines, turbines, effect of machine foundation on adjoining structures.

Bearing capacity of foundation under Earthquake: Introduction to bearing capacity of dynamically loaded foundations, such as those of water towers, chimneys and high rise buildings, response of pile foundations.

Suggested Readings:

1. Das, B.M., "Fundamentals of Soil Dynamics", Elsevier, 1983.
2. Steven Kramer, "Geotechnical Earthquake Engineering", Pearson, 2008.
3. Prakash, S., Soil Dynamics, McGraw Hill, 1981.
4. Kameswara Rao, N.S.V., Vibration analysis and foundation dynamics, Wheeler Publication Ltd., 1998.

2CEMGE1-03: SLOPE STABILITY ANALYSIS

Slopes: Types and causes of slope failures, mechanics of slope failure, failure modes.

Stability analysis: infinite and finite slopes with or without water pressures; concept of factor of safety, pore pressure coefficients, Mass analysis, Wedge methods, friction circle method ; Method of slices, Bishop's method, Janbu's method, Morgenstern and Price, Spencer's method

Stability analysis in the presence of seepage: two dimensional flow – Laplace equation and it's solution, graphical method, determination of phreatic line, flow nets in homogeneous and zoned earth dams under steady seepage and draw-down conditions, seepage control in earth dams, influence of seepage on slope stability stability analysis of dam body during steady seepage

Strengthening measures: stabilization of slopes by drainage methods, surface and subsurface drainage, use of synthetic filters, retaining walls, stabilization and strengthening of slopes, shot-creting, rock bolting and rock anchoring, instrumentation and monitoring of slopes, slope movements, warning devices, maintenance of slopes

Suggested Readings:

1. Abramson L. W, Lee T. S , Sharma S and Boyce G M , “ Slope Stability and Stabilization Methods”, Willey Interscience publications,1996
2. Das B M,“Principles of Geotechnical Engineering”, Thomson Books, 2004
3. Lambe T W. and Whitman R V, “Soil Mechanics”, John Wiley & sons ,2008 5. Murthy V. N. S , “Principles of Soil Mechanics and Foundation Engineering”, UBS Publishers Private Ltd. , 2002
4. Zaruba Q and Mencl V., “ Land slides and their control”, Developments in Geotechnical Engineering, Vol 31, Elsevier Scientific publishing company, 1982.

2CEMGE2-04: PAVEMENT ANALYSIS AND DESIGN

Introduction: Philosophy of design of flexible and rigid pavements,

Strength Analysis: analysis of pavements using different analytical methods,

Affecting Parameters : selection of pavement design input parameters – traffic loading and volume, Unit IV: material characterization, drainage, failure criteria, reliability,

Designing : design of flexible and rigid pavements using different methods

Overlay Analysis: comparison of different pavement design approaches, design of overlays and drainage system,IRC Provision.

Suggested Readings:

1. Yang and H. Huang, Pavement Analysis and Design, Pearson Prentice Hall, 2004.
2. Yoder and Witzech, Pavement Design, McGraw-Hill, 1982.
3. Sharma and Sharma, Principles and Practice of Highway Engg., Asia Publishing House, 1980.
4. Teng, Functional Designing of Pavements, McGraw- Hill, 1980.

2CEMGE2-05: FOUNDATION ON EXPANSIVE SOIL

GENERAL PRINCIPLES: Origin of expansive soils – Physical properties of expansive soils – Mineralogical composition – Identification of expansive soils – Field conditions that favour swelling – Consequences of swelling.

SWELLING CHARACTERISTICS Swelling characteristics – Laboratory tests – Prediction of swelling characteristics – Evaluation of heave.

TECHNIQUES FOR CONTROLLING SWELLING Horizontal moisture barriers – Vertical moisture barriers – Surface and subsurface drainage – Pre-wetting – Soil replacement – Sand cushion techniques – CNS layer technique.

FOUNDATIONS ON EXPANSIVE SOILS Belled piers – Bearing capacity and skin friction – Advantages and disadvantages – Design of belled piers – Under reamed piles – Design and construction.

MODIFICATION OF SWELLING CHARACTERISTICS Lime stabilization – Mechanisms – Limitations – Lime injection – Lime columns – Mixing – Chemical stabilization – Construction.

Suggested Readings:

1. Basic and applied Soil Mechanics (Revised Edition) – Gopal Rajan and Rao A.S.R. (New Age, New Delhi.1998)
2. J. Michael Duncan and Stephen G. Wright, Soil Strength and Slope Stability, John Wiley & Sons, Inc., New Jersey 2005
3. Peck,R.B., Hanson (W.E. and Thornburn. W.H. Johan Wiley, New York 1976).
4. Soil Engineering in Theory and Practice (Vol. – II) – Alam Singh (Asia Publishing House, New Delhi, 1981).

2CEMGE2-06: GEOTECHNICAL EARTHQUAKE ENGINEERING

ELEMENTS OF EARTHQUAKE SEISMOLOGY AND DYNAMICS

Introduction to engineering seismology, seismic risks and hazards, causes and strength of earthquakes, social and economic consequences,

GROUND MOTION CHARACTERISTICS

Theory of dynamic and seismic response, the nature and attenuation of earthquake magnitude, ground motion, determination of site characteristics, local geology and soil condition, determination of design earthquake, response spectra and accelerograms.

GROUND RESPONSE ANALYSIS - LOCAL SITE EFFECTS AND DESIGN GROUND MOTION

Site response to earthquake site investigation and soil test; dynamic behaviour of soils, liquefaction phenomena, analysis of pore pressure development,

SEISMIC STABILITY ANALYSIS

Laboratory and in-situ testing for liquefaction, analysis and design of slopes, embankments, seismic response of soil structure system,

EARTHQUAKE HAZARD MITIGATION

Seismic risk vulnerability and hazard - Percept of risk - risk mapping - scale - hazard assessment - Maintenance and modifications to improve hazard resistance - Different type of foundation and its impact on safety

Suggested Readings:

1. D. D.Barkan,“Dynamics of Bases and Foundations”, McGraw-Hill Book Company.
2. Ikuo Towhata,“Geotechnical Earthquake Engineering”,Springer-Verlag Heidelberg.
3. Kenji Ishihara,“Soil Behaviour in Earthquake Geotechnics”, Oxford University Press, USA.

4. Milutin Srbulov, "Geotechnical Earthquake Engineering: Simplified Analyses with Case Studies and Examples", Springer-Verlag.
5. IS 1893, Indian Standard Criteria for earthquake resistant Design of Structures.
6. Shamsheer Prakash, "Soil Dynamics", McGraw-Hill Book Company.
7. Steven L. Kramer, "Geotechnical Earthquake Engineering", Prentice Hall Inc
8. Robert W. Day, "Geotechnical Earthquake Engineering Handbook", McGraw Hill, New York.

2CEMGE2-08: EARTH PRESSURE AND EARTH RETAINING STRUCTURE

Earth Pressure: Rankine and Coulomb theories, active, passive and pressure at rest; concentrated surcharge above the back fill, earth pressure due to uniform surcharge, earth pressure of stratified backfills, saturated and partially saturated backfill.

Retaining walls: Proportioning of retaining walls, stability of retaining walls, mechanically stabilized retaining walls/reinforced earth retaining walls

Sheet Pile wall: free earth system, fixed earth system

Bulkheads: bulkheads with free and fixed earth supports, equivalent beam method, Anchorage of bulkheads and resistance of anchor walls, spacing between bulkheads and anchor walls, resistance of anchor plates

Tunnel and Conduit: Stress distribution around tunnels, Types of conduits, Load on projecting conduits; Arching and Open Cuts: Arching in soils,

Braced excavations: Earth pressure against bracings in cuts, Heave of the bottom of cut in soft clays

Suggested Readings:

1. Das, Braja M., "Principles of Foundation Engineering", PWS Publishing. 1998
2. Bowles. J.E., Foundation Analysis and Design, Tata McGraw-Hill International Edition, 5th Edn, 1997.
3. Koerner, R.M., Design with Geosynthetics (Third Edition), Prentice Hall, 1997
4. Militisky, J. and Woods, R., Earth and Earth retaining structures, Routledge, 1992
5. Rowe, R.K., Geotechnical and Geoenvironmental Engineering Handbook, Kluwer Academic Publishers, 2001
6. Winterkorn, H.F. and Fang, H.Y., Foundation Engineering Handbook, Galgotia Booksource, 2000.

2CEMGE2-9: DISASTER MITIGATION AND MANAGEMENT

Understanding Disasters: Understanding the Concepts and definitions of Disaster, Hazard, Vulnerability, Risk, Capacity – Disaster and Development, and disaster management

Types, Trends, Causes, Consequences and Control of Disasters: Geological Disasters (earthquakes, landslides, tsunami, mining); Hydro-Meteorological Disasters (floods, cyclones, lightning, thunder-storms, hail storms, avalanches, droughts, cold and heat waves) Biological Disasters (epidemics, pest attacks, forest fire); Technological Disasters (chemical, industrial, radiological, nuclear) and Manmade Disasters (building collapse, rural and urban fire, road and rail accidents, nuclear, radiological, chemicals and biological disasters) Global Disaster Trends – Emerging Risks of Disasters – Climate Change and Urban Disasters

Disaster Management Cycle and Framework : Disaster Management Cycle – Paradigm Shift in Disaster Management Pre-Disaster – Risk Assessment and Analysis, Risk Mapping, zonation and Microzonation, Prevention and Mitigation of Disasters, Early Warning System; Preparedness, Capacity Development; Awareness During Disaster – Evacuation – Disaster Communication – Search and Rescue – Emergency Operation Centre – Incident Command System – Relief and Rehabilitation – Post-disaster – Damage and Needs Assessment, Restoration of Critical Infrastructure – Early Recovery – Reconstruction and Redevelopment; IDNDR, Yokohama Strategy, Hyogo Framework of Action

Disaster Management in India : Disaster Profile of India – Mega Disasters of India and Lessons Learnt Disaster Management Act 2005 – Institutional and Financial Mechanism National Policy on Disaster Management, National Guidelines and Plans on Disaster Management; Role of Government (local, state and national), Non-Government and Inter Governmental Agencies

Applications of Science and Technology for Disaster Management: Geo-informatics in Disaster Management (RS, GIS, GPS and RS) Disaster Communication System (Early Warning and Its Dissemination) Land Use Planning and Development Regulations Disaster Safe Designs and Constructions Structural and Non Structural Mitigation of Disasters S&T Institutions for Disaster Management in India

Suggested Readings:

1. Coppola D P, 2007. Introduction to International Disaster Management, Elsevier Science (B/H), London. Manual on natural disaster management in India, M C Gupta, NIDM, New Delhi
2. An overview on natural & man-made disasters and their reduction, R K Bhandani, CSIR, New Delhi
3. World Disasters Report, 2009. International Federation of Red Cross and Red Crescent, Switzerland
4. Encyclopedia of disaster management, Vol I, II and III. Disaster management policy and administration, S L Goyal, Deep & Deep, New Delhi, 2006
5. Encyclopedia of Disasters – Environmental Catastrophes and Human Tragedies, Vol. 1 & 2, Angus M. Gunn, Greenwood Press, 2008.
6. Disasters in India Studies of grim reality, Anu Kapur & others, 2005, 283 pages, Rawat Publishers, Jaipur Management of Natural Disasters in developing countries, H.N. Srivastava & G.D. Gupta, Daya Publishers, Delhi, 2006, 201 pages.

2CEMGE2-10: GROUND WATER HDROLOGY

INTRODUCTION

Characteristic of ground water, Global distribution of water, Role of groundwater in water resources system and their management, groundwater column, aquifers, classification of aquifers. Hydrogeological cycle, water level fluctuations, Groundwater balance

MOVEMENT OF GROUNDWATER

Darcy's Law, Hydraulic conductivity, Aquifer transmissivity and storativity, Dupuit assumptions Storage coefficient - Specific yield Heterogeneity and Anisotropy, Direct and indirect methods for

estimation of aquifer parameters. Governing equation for flow through porous medium - Steady and unsteady state flow - Initial and boundary conditions, solution of flow equations.

WELL HYDRAULICS

Steady and unsteady flow to a well in a confined and unconfined aquifer - Partially penetrating wells - Wells in a leaky confined aquifer - Multiple well systems - Wells near aquifer boundaries - Hydraulics of recharge wells.

GROUNDWATER MANAGEMENT

Dynamic equilibrium in natural aquifers, groundwater budgets, management potential of aquifers, safe yield, seepage from surface water, stream-aquifer interaction, artificial recharge.

Suggested Readings:

1. Bear J., Hydraulics of Groundwater, McGraw-Hill International, 1979.
2. Todd D.K., Ground Water Hydrology, John Wiley and Sons, 2000.
3. Driscoll, F., Groundwater and Wells, St. Paul, Minnesota, II Ed., 1986.
4. Raghunath H.M., Ground Water Hydrology, Wiley Eastern Ltd., Second reprint, 2000.
5. Willis, R. and W.W.G. Yeh, Groundwater Systems Planning and Management, Prentice-Hall, 1987.
6. Bear J., Dynamics of fluids in porous media, American Elsevier publishing co., inc, 1972.
7. C. Walton, Groundwater Resources Evaluation, McGraw Hill, 1970.
8. O.D.L. Strack, Groundwater Mechanics, Prentice Hall, 1989.
9. S.P. Garg, Groundwater and Tube Wells, Oxford & IBH Publishing Co., 1993.

2CEMGE3-12: RESEARCH METHDOLOGY

Research Methodology: Objectives and Motivation of Research, Types of Research, Research Approaches, Significance of Research, Research Methods verses Methodology, Research and Scientific Method, Important of Research Methodology, Research Process, Criteria of Good Research, Problems Encountered by Researchers in India, Benefits to the society in general. Defining the Research Problem: Definition of Research Problem, Problem Formulation, Necessity of Defining the Problem, Technique involved in Defining a Problem.

Literature Survey: Importance of Literature Survey, Sources of Information, Assessment of Quality of Journals and Articles, Information through Internet. Literature Review: Need of Review, Guidelines for Review, Record of Research Review.

Research Design: Meaning of Research Design, Need of Research Design, Feature of a Good Design Important Concepts Related to Research Design, Different Research Designs, Basic Principles of Experimental Design, Developing a Research Plan, Design of Experimental Set-up, Use of Standards and Codes.

Data Collection: Collection of primary data, Secondary data, Data organization, Methods of data grouping, Diagrammatic representation of data, Graphic representation of data. Sample Design, Need for sampling, some important sampling definitions, Estimation of population, Role of Statistics for Data Analysis, Parametric V/s Non Parametric methods, Descriptive Statistics,

Measures of central tendency and Dispersion, Hypothesis testing, Use of Statistical software. Data Analysis: Deterministic and random data, Uncertainty analysis, Tests for significance: Chisquare, student's t-test, Regression modeling, Direct and Interaction effects, ANOVA, F-test, Time Series analysis, Autocorrelation and Autoregressive modeling.

Research Report Writing: Format of the Research report, Synopsis, Dissertation, Thesis its Differentiation, References/Bibliography, Technical paper writing/Journal report writing, making presentation, Use of visual aids, Intellectual property, Plagiarism. Research Proposal Preparation: Writing a Research Proposal and Research Report, Writing Research Grant Proposal.

Suggested Readings:

1. C.R Kothari, Research Methodology, Methods & Technique, New Age International Publishers, 2004.
2. R. Ganesan, Research Methodology for Engineers, MJP Publishers, 2011.
3. Ratan Khananabis and Suvasis Saha, Research Methodology, Universities Press, Hyderabad, 2015.
4. Y. P. Agarwal, Statistical Methods: Concepts, Application and Computation, Sterling Publs., Pvt., Ltd., New Delhi, 2004.
5. Vijay Upagade and Aravind Shende, Research Methodology, S. Chand & Company Ltd., New Delhi, 2009.
6. G. Nageswara Rao, Research Methodology and Quantitative methods, BS Publications, Hyderabad, 2012.
7. Naval Bajjai, Business Research Methods, Pearson 2011.
8. Prahalad Mishra, Business Research Methods, Oxford 2016.

2CEMGE1-13: GEOTECH LAB- II

List of Practicals:

1. Unconfined compression test
2. Direct shear test
3. Tri-axial compression test – UU, CU, CD tests
4. Laboratory vane shear test
5. CBR test
6. Swelling Pressure test
7. Differential Swelling Index
8. Standard Penetration Test
9. Dynamic Load Testing

2CEMGE4-14: FIELD WORK

Student is required to work in the organization/industry concerned with his/her course.