REVISED SHCEME

For

POST GRADUATE PROGRAMME

(Master of Technology)

IN

GEOTECHNICAL ENGINEERING

(EFFECTIVE FROM: 2021 BATCH)

DEPARTMENT OF CIVIL ENGINEERING

NATIONAL INSTITUTE OF TECHNOLOGY SRINAGAR

HAZRATBAL, SRINAGAR, KASHMIR, J&K, INDIA - 190006

POST GRADUATE PROGRAMME

M. Tech. (Master of Technology)

IN

GEOTECHNICAL ENGINEERING

JUSTIFICATION / OBJECTIVES OF THE REVISED SCHEME

The revised P.G. programme of 2-years duration and as per the guidelines of AICTE is intended to emphasize on the research-oriented requirements of cold and high altitude hilly regions particularly the state of J&K. This course is offered to both in-service engineers from MES, PWD, NHPC etc. and fresh graduates. The programme is run by the geotechnical engineering section of the civil engineering department. The initiation of this PG programme will a go a long in establishing a sound base for the development of a research culture in this area and as such contribute to the development of this region in particular ant the country in general.

INTAKE: Proposed Annual Intake (Gen., OBC, ST/SC etc) = 10 + 3 + 5 = 18

DEPARTMENT OF CIVIL ENGINEERING
NATIONAL INSTITUTE OF TECHNOLOGY SRINAGAR, J&K - 190006

COURSE STRUCTURE AND SYLLABUS
FOR
M.TECH. IN GEOTECHNICAL ENGINEERING

SEMESTER – I: AUTUMN SESSION

Sr. No.	Subjects	L	T	P	Credit
Core Courses					
CGE-101	Engineering Behavior of soils	3	1	-	3
CGE-102	Analysis & Design of Shallow Foundations	3	1	-	3
CGE-103	Geotechnical Exploration and Measurement Techniques	3	1	-	3
CGE-104	Soil Engineering Laboratory-I	-	-	3	1
Elective 1 (any one)					
CGE-111: E1	Behavior & Testing of Unsaturated Soils	3	1	-	3
CSE-112: E1	Advanced Bridge Engineering	3	1	-	3
CGE-113: E1	Rock Mech. & Tunnel Engineering	3	1	-	3
CWE-111: E1	Programming for Civil Engineers	3	1	-	3
Elective 2 (any one)					
CSE-115: E2	Construction Techniques and Management	3	1	-	3
CGE-116: E2	Geosynthetics in Geotechnical Engineering	3	1	-	3
CGE-117: E2	Soil Dynamics and Machine Foundations	3	1	-	3
Total					16

SEMESTER – II: SPRING SESSION

Sr. No.	Subjects	L	T	P	Credit
Core Courses					
CGE- 201	Ground Improvement Techniques	3	1	-	3
CGE -202	Advanced Foundation Engineering	3	1	-	3
CGE- 203	Applied Soil Mechanics	3	1	-	3
CGE -204	Soil Engineering Laboratory-II	-	-	3	1
CGE -205	Seminar	-	-	2	1
Elective-3 (any one)					
CGE- 211: E3	Critical State Soil Mechanics	3	1	-	3
CGE- 212: E3	Soil Structure Interaction	3	1	-	3
CWE- 211: E3	GIS, GPS & Remote Sensing Applications	3	1	-	3
CTE- 201: E3	Pavement Analysis & Design	3	1	-	3
Elective-4 (any one)					
CGE- 213: E4	Environmental Geotechnology	3	1	-	3
CGE- 214: E4	Earthquake Geotechnical Engineering	3	1	-	3
CSE- 215: E4	Finite Element Method in Civil Engg	3	1	-	3
Total					17

L – Lecture, T – Tutorial/Seminar, P – Practical/Studio work

SEMESTER – III: AUTUMN SESSION

Sr. No.	Subjects	L	T	P	Credit
Core Courses					
CGE-301	Advanced Soil Mechanics	3	1	-	3
CGE- 302	Strength & Deformation Behavior of Soil	3	1	-	3
CGE-303	Dissertation -1	-	-	8	6
Elective 5 (any one)					
CGE -311: E5	Landfill Engineering	3	1	-	3
CWE -312:E5	Hydraulic Structures	3	1	-	3
CGE -313: E5	Advanced Concrete Technology	3	1	-	3
Total					15

L – Lecture, T – Tutorial/Seminar, P – Practical/Studio work

SEMESTER – IV: SPRING SESSION

1Sr. No.	Subjects	L	T	P	Credit
CGE-401	Dissertation-II	-	-	20	12
Total					12

Grand Total of Credits = 60

Evaluation:

Attendance & Class performance : 10%

Mid-Term Exam : 30%

End-Term Exam : 60%

NOTE:

1. Each Elective Group contains at least one subject of inter-department or of other P.G. areas of the department in order to make the system more flexible and to meet the options of P.G. students of their interest area.
2. Examination of Practicals/Tutorials will be conducted by two internal examiners.
3. One external examiner & concerned internal examiners shall be conducting viva-voce examination in case of Dissertation at Semester IV.
4. Evaluation and examination system for seminar and dissertation will be at par with other P.G. programs of the department.
5. The dissertation involves a detailed study of a Transportation related, problem (actual field/ research) which a student has to carry out under the supervision of one of the faculty members of the Department. The dissertation work can also be of interdisciplinary nature with transportation element involved.
6. Part-time students will be eligible to take up the 3rd semester regular in their 5th semester, only when they have successfully completed the 1st and 2nd semesters.

Existing Faculty in Geotechnical Engineering Division, NIT Srinagar

1. Prof. B. A. Mir, Professor M.E. (Geotechnical Engineering) IISc Bangalore, Ph. D. IIT Bombay
2. Prof. F. A. Mir, Associate Professor, M. Tech. (Geotechnical Engineering) IIT Delhi
3. Prof. M. Y. Shah, Associate Professor, M. Tech. (Geotechnical Engineering) IIT Delhi, Ph.D. IIT Roorkee
4. Dr. Majid Hussain, Assistant Professor, B. Tech NIT Srinagar, Ph.D. (Geotechnical Engineering) IIT Gandhinagar
5. Dr. Rajesh P. Shukla, Assistant Professor, M. Tech (Geotechnical Engineering) IIT Kanpur, Ph.D. IIT Roorkee
6. Dr. Ritesh S. Ingale, Assistant Professor, M. Tech (Geotechnical Engineering) S.V. NIT Surat, Ph.D. V. NIT Nagpur
7. Er. Falak Zahoor, Trainee Teacher, B. Tech NIT Srinagar, Ph.D (Geotechnical Engineering) IIT Delhi (pursuing)

****

NATIONAL INSTITUTE OF TECHNOLOGY, SRINAGAR
SYLLABUS FOR M. TECH IN GEOTECHNICAL ENGINEERING

1ST SEMESTER

A: CORE COURSES

1. CGE -101: ENGINEERING BEHAVIOUR OF SOILS

SEMESTER: 1ST	**L**	**T**	**P**	**C**	**Dr. B. A. Mir**
COURSE NO. CGE - 102	**0**	**0**	**3**	**1**	

1. Subject Area : **Civil Engineering**
2. Subject Title : **Engineering Behavior of Soils**
3. Subject Code : CGE-101
4. Contact Hours : L-T-P:: 2-2-3 [L: Lecture, T: Tutorial & P: Practical]
5. Credits : 3
6. Semester : Autumn Session
7. Examination Duration (Hrs) : Mid-Term Exam = 1.5 hr; End-Term Exam = 3 hrs
8. Evaluation Weightage (Marks) : C. P. =10%; End-Term = 30% & End-Term = 60%
   [C. P. = Class performance, which includes attendance, Assignments and interaction in the class]
9. Pre-requisite : **Geotechnical Engineering**
10. Objective: To impart understanding of Application of Soil Mechanics Theories in the field of Civil Engg.
11. Course Details -as in tabular form below:

Unit No.	Course Contents	Contact Hours
Unit -1	• Origin and nature of Soils, Mineralogy, Distribution of soils, Clay – water - electrolytes system. Soil fabric, soil structure and Engg. Classification of soils. • Engineering Behavior of Soils of India: Black cotton soils, alluvial silts and sands, Aeolian deposits, Laterites, Marine clays, collapsible and sensitive soils. • Description of state of stress and strain at a point; Development of rheological models and equations of state for soils; Stress distributions, problems in elastic half-space, Distribution of contract pressure.	12
Unit – 2	• Strength Behavior: Effective stress principle: Triaxial tests and applications. Shear strength parameters.	

	• Factors affecting Strength: Structure and texture, porosity, confining pressure, Stress history, Degree of saturation, Anisotropy, Intermediate principal stress. • Introduction to Critical State Soil Mechanics.: Stress paths and p-q plots, Rendulic Henkel plot, Taylor's plot, Hvorslev's parameters.	12
Unit - 3	• Fundamental concepts of consolidation: Primary and secondary compression; One, two- and three-dimensional problems • Determination of preconsolidation pressure; Consolidation of partially saturated soils; Settlement computations. • Influence of test parameters on results, Consolidation test, Triaxial consolidation, Anisotropic, K consolidation, Radial consolidation, Layered system	12
	Total	36

COURSE TEXTBOOK: Some useful resources are:

1 Kasmalkar, B. J. (1997). Geotech. Engineering. Pune Vidyarthi Griha Prakashan-1786, Sadashiv Peth, Pune-411030.
2 Kasmalkar, B. J. (1997). Foundation. Engineering. Pune Vidyarthi Griha Prakashan-1786, Sadashiv Peth, Pune-411030.
3 Murthy, V. N. S. (2013). Soil Mechanics & Foundation Engg, CBS publishers & distributors, 4819/XI, 24 Ansari Road, Daryaganj, New Delhi-002
4 J K Mitchal & Kenichi Soga (2005). Fundamentals of Soil Behavior, *John* Wiley & Sons, New York
5 Das, Braja M. (1999). Advanced Soil Mechanics. PWS Publishing, Pacific Grove, Calif.
6 Karl Terzaghi, Theoretical Soil Mechanics, Chapman and Hall
7 Karl Terzaghy, Ralph B. Pech & Gholamreza Mesri (1996). Soil Mechanics in Engg. Practice, *John* Wiley & Sons, New York
8 R.F. Scott, Principles of Soil Mechanics, Addison Wesley, World Student Edition
9 M.G.Sprangler, Soil Engineering
10 Proceedings of the International Conferences on Soil Mechanics and Foundation Engineering on Shear Strength of soils (1963).
11 Gopal Ranjan & ASR Rao (2000). Basic ans Applied Soil Mechanics, New Age Int`l Publishers New Delhi 002
12 Arpad Kezdi (1974). Handbook of Soil Mechanics, Vol. 1 & 2, Elsevier, Newyark
13 David F. McCarthy (2007). Essentials of Soil Mechanics & Foundations: Basic Geotechnics (7/E), Prentice-Hall, New Jersey, Columbus, Ohio
14 Roy E. Hunt (1986). Geotechnical Engg Analysis & Evaluation, McGraw-Hill, New Delhi
15 K. H. head (2006). Manual of Soil Laboratory Testing: Vol-1, Whittles Publishing, CRC Press, UK

****

2. CGE – 102: Analysis & Design of Shallow Foundations

SEMESTER: 1ST	**L**	**T**	**P**	**C**	**Dr. B. A. Mir**
COURSE NO. CGE - 102	**0**	**0**	**3**	**1**	

1. Subject Area : **Civil Engineering**

2. Subject Title : **Analysis & design of Shallow Foundations**

3. Subject Code : CGE-102

4. Contact Hours : L-T-P:: 2-2-3 [L: Lecture, T: Tutorial & P: Practical]

5. Credits : 3

6. Semester : Autumn Session

7. Examination Duration (Hrs) : Mid-Term Exam = 1.5 hr; End-Term Exam = 3 hrs

8. Evaluation Weightage (Marks) : C. P. =10%; End-Term = 30% & End-Term = 60%

[C. P. = Class performance, which includes attendance, Assignments and interaction in the class]

9. Pre-requisite : **Geotechnical Engineering**

10. Objective: To impart understanding of various aspects related to Foundations in the field of Civil Engg.

11. Course Details -as in tabular form below:

Unit No.	Course Contents	Contact Hours
Unit -1	**a. Introduction to Foundation Engineering:** • Construction materials, engineered structures, foundation materials. • Load transfer device/interfacing element, superstructures, foundation structures/sub-structures, Need for load transfer device, objectives. • Principles of foundation Engineering, challenging problems. • Design requirements/ information needed for foundation design. • Classification of foundations (Flexible, rigid, shallow and deep foundations). **b. Terminology involved in Foundation Analysis and Design:** Gross bearing capacity, ultimate bearing capacity, net-ultimate bearing capacity, safe bearing capacity, net safe bearing capacity, safe bearing pressure, allowable bearing pressure. **c. Design Criteria for Foundation Design:** Location and depth criteria, shear failure criteria (safe bearing capacity criteria), settlement criteria (safe bearing pressure criteria).	6 2 2 2

	d. Factors for Selection of Type of Foundation: Function of the structure and the loads it must carry, sub-surface condition of the soil, cost of super-structure.	
Unit - 2	**Basic Design parameters for safe foundation design:** • service loads (DL, LL, WL, EQL, SL,etc and their combination and reduction factors) • safe bearing capacity • size of footing (structural design by limit state design as in case of other RC members) • soil pressure on foundation • conventional analysis of foundations subjected to vertical loads and moments • thickness of footing and its requirements • minimum reinforcement requirement (IS:456) **Bearing Capacity of Shallow foundations** 1. Bearing capacity based on the classical earth pressure theory of Rankine 2. Semi-empirical solutions based on theory of plasticity (a). Prandtl's theory (b). Terzaghi's theory (c). Meyerhof's theory (d). Brinch Hansen's theory (e). Vesic's theory (f). Balla's theory (g). Skempton's theory (h). Caquot & Kerisel's theory (i). Frochlicl's theory 3. Exact methods based on theory of plasticity: (a). Sokolovski's theory (1960) (b). KO etal's (1973) Non-dimensional sol. 4. Semi-graphical methods of: (a). Fellinius for clay soils, and (b). Button, Brown, Meyerhof and Vesic for two layer Stratified deposits. 5. Penetration Tests (in-situ-tests): (a). SPT- Standard penetration test, (b). SCPT- Static cone penetration test (c). DCPT- Dynamic cone penetration test (d). PMT- pressure meter test. (e). VST- vane shear test. (f). PLT- plate load test (In-situ- test).	6 8
Unit - 3	• Principles of foundation design • Need for Raft foundations and design methods • Foundations on problematic soils • Settlement of shallow foundations	12
	Total	**38**

Books Recommended:

1. Kasmalkar, J.B. (1997). Foundation Engineering, Pune Vidyarthi Graha Prakashan-1786, Pune-411030.
2. Bowels, Joseph E.(1996). Practical Foundation Engineering Handbook. 5th edition, McGraw-Hill, New York.

3. Das, Braja M. (1999). Principles of foundation Engineering, 4th edition, PWS publishing, Pacific Grov. Calif.
4. Peck, Ralph B., Hansen, Walter E., and Thornburn, Thomas H. (1974). Foundation Engineering. John Wiley & Sons, New York.
5. Praksh, Shamsher, and Sharma, Hari D. (1990). Pile foundation in Engineering Practice, John Wiley & Sons, New York.
6. Som, N.N., and Das, S.C. (2003). Foundation Engineering: Principles and Practice. Prentice –Hall of India Pvt. Ltd. New Delhi-001.
7. Varghese, P.C. (2005). Foundation Engineering Prentice –Hall of India Pvt. Ltd. New Delhi
8. Tomlonson, Michael J. (1995). Foundation Design and Construction. 6th edition. John Wiley & Sons, New York.

****

3. CGE – 103: Geotechnical Exploration and Measurement Techniques

SEMESTER: 1ST	**L**	**T**	**P**	**C**	**Prof. F. A. Mir**
COURSE NO. CGE - 103	**2**	**2**	**0**	**3**	

Course Details

General principles of exploration; Methods of exploration; Boring: Different types of borings; Sampling methods: Surface sampling, sampling from boreholes and core boring in soils; Boring and sampling records, Soil profile. Pore pressure measuring devices for laboratory and field use; Earth pressure cells; Instrumentation for measurement of movements in dams; Vibration-meters, Pickups and generators for vibration study of machine foundations; Load measuring devices; Settlement measurements in field.

References:

1. Bowles, J. E, Physical and Geotechnical Properties of Soil, McGraw-Hill Book Company, 1985.
2. Bowles, J. E, Foundation Analysis and Design, McGraw-Hill International edition, 1997.
3. Dunnicliff, J. and Green, G. E, Geotechnical Instrumentation for Monitoring Field Performance, John Wiley & Sons, 1982.
4. Gopal Ranjan and Rao, A. S. R, Basic and Applied Soil Mechanics, Wiley Eastern Limited, 1991.
5. Lunne, T., Robertson, P. K. and Powell, J. J. M, Cone Penetration Testing in Geotechnical Practice, Blackie Academic & Professional, 1997.
6. Compendium of Indian Standards on Soil Engineering Parts 1 and II 1987 - 1988.

4. CGE - 104: SOIL ENGG. LAB-I

SEMESTER: 1ST	**L**	**T**	**P**	**C**
COURSE NO. CGE - 104	**0**	**0**	**3**	**1**

B: ELECTIVE COURSES (any two)

E-1. CGE-111: Behavior & Testing of Unsaturated Soils

SEMESTER: 1ST	**L**	**T**	**P**	**C**	**Dr. B. A. Mir**
COURSE NO. CGE - 111	**2**	**2**	**0**	**3**	

1. Subject Area : **Civil Engineering**

2. Subject Title : **Behavior and testing of unsaturated soils**

3. Subject Code : CGE-111

4. Contact Hours : L-T-P:: 2-2-3 [L: Lecture, T: Tutorial & P: Practical]

5. Credits : 3

6. Semester : Spring Session

7. Examination Duration (Hrs) : Mid-Term Exam = 1.5 hr; End-Term Exam = 3 hrs

8. Evaluation Weightage (Marks) : C. P. =10%; End-Term = 30% & End-Term = 60%
[C. P. = Class performance, which includes attendance, Assignments and interaction in the class]

9. Pre-requisite : **Geotechnical Engineering**

10. Objective: To impart understanding of various aspects related to unsaturated soil Engineering practice in the field of Civil Engg.

11. Course Details -as in tabular form below:

Unit No.	Course Contents	Contact Hours
Unit -1	• **Introduction to Unsaturated Soil Mechanics** • Theory to Practice of Unsaturated Soil Mechanics • Nature and Phase Properties of Unsaturated Soil • State Variables for Unsaturated Soils • Measurement and Estimation of State Variables	12
Unit - 2	• Soil-Water Characteristic Curves for Unsaturated Soils • Ground Surface Moisture Flux Boundary Conditions • Theory of Water Flow through Unsaturated Soils • Solving Saturated/Unsaturated Water Flow Problems • Air Flow through Unsaturated Soils • Heat Flow Analysis for Unsaturated Soils	12
Unit - 3	• Shear Strength of Unsaturated Soils • Shear Strength Applications in Plastic and Limit Equilibrium • Stress-Deformation Analysis for Unsaturated Soils • Solving Stress-Deformation Problems with Unsaturated Soils • Compressibility and Pore Pressure Parameters • Consolidation and Swelling Processes in Unsaturated Soils	12
	Total	**36**

Books Recommended:

1. Kasmalkar, J.B. (1997). Geotechnical Engineering, Pune Vidyarthi Graha Prakashan-1786, Pune-411030.
2. D. G. Fredlund, H. Rahardjo, M. D. Fredlund (2012). Unsaturated Soil Mechanics in Engineering Practice, John Wiley & Sons, Inc
3. G.E. Blight and E.C. Leong (1997). Mechanics of Residual Soils, CRC Press Taylor & Francis Group.
4. Azad Koliji (2008). Mechanical Behavior of Unsaturated Aggregated Soils
5. Jhon, D. and Miller, D. J. (1992). Expansive soils-Problems and practice in foundation and pavement Engineering, John Wiley & Sons, Inc

****

E-1. CSE-112: Advanced Bridge Engineering

SEMESTER: 1ST	**L**	**T**	**P**	**C**
COURSE NO. CGE - **112**	**2**	**2**	**0**	**3**

1. Name of the Department: Department of Civil Engineering
2. Subject Code: CSE-302/CGE-112 Course Title: Ad. Bridge Engineering
3. Contact Hours: L: 3 T: 0 P: 0
4. Examination Duration (Hrs) : Mid-Term Exam = 1.5 hr; End-Term Exam = 3 hrs
5. Evaluation Weightage (Marks) : C. P. =10%; End-Term = 30% & End-Term = 60%
6. Credits: 3
7. Semester: 3rd (Autumn)
8. Pre-requisite: Nil
9. Course Details -as in tabular form below:

Sr. No.	Contents	Contact Hours
1	Introduction and selection of type of Bridges, loads and forces on bridges.	4
2	Theories of Lateral Load distribution.	6
3	Design of Super-Structure.	6
4	Grillage Analogy: concepts of grillage analogy; Grillage analogy technique for Slab bridges and Girder type bridges; Orthogonal and skew type.	4
5	Design of Composite Bridges (Steel and Conc.) subjected to Standard IRC loading	4
6	Box girder bridges in concrete. Design concepts	4
7	Design of Abutments, Piers and their foundations.	6
8	Design of Bearings.	2

Books recommended:

1. Concrete Bridge Design by Rowe, R.E
2. Design of Bridges by Victor Johnson
3. Concrete Bridge Practice Analysis,
4. Design and Economics by Raina V.K.

****

E-1. CGE-113: Rock Mech. & Tunnel Engineering

SEMESTER: 1ST	L	T	P	C
COURSE NO. CGE - 113	2	2	0	3

Course Details

Geological formation of rocks, Structural Geology, Classification of rocks, Physicomechanical & Engineering properties of rocks, Laboratory and field tests, Stress-strain behaviour, Failure criteria for intact rock and rock masses, Fracture mechanism.

Introduction to Tunnel Engineering, Need for Tunnels, Tunnel Surveys & alignment Control, Geotechnical Investigations of Tunnels, Analysis and Design of Tunnels, Tunnel Construction Techniques, Tunnel Stabilization & Lining, Cut & Cover Tunnel Structures, Tunneling in difficult Ground, Tunnel Rehabilitation.

References:

1. Goodman, R. E, Introduction to Rock Mechanics, John Wiley & Sons, 1989.
2. Brown, E. T, Rock Characterization, Testing and Monitoring, Pergamon Press, 1986.
3. Herget, G, Stresses in Rock, Balkema, 1988
4. Hoek, E. and Brown, E. T, Underground Excavation in Rock, Institution of Mining and Metallurgy, 1982.
5. Bieniawski, Z. T, Engineering Rock Mass Classification, John Wiley and Sons, 1989.
6. Wyllie, D. C, Foundations on Rock, E & FN Spon. 2nd Edition, 1992.
7. Champion, D., Metje, N. and Stark, A., Introduction to Tunnel Construction.
8. Bickel, J. O, Kuesel, T. R. and King, E. H., Tunnel Engineering Handbook
9. K.Szechy, The Art of Tunnelling, Tesa, 1960

****

E-1. CWE-111: Programing for Civil Engineers

SEMESTER: 1ST	**L**	**T**	**P**	**C**
COURSE NO. CWE - 111	**2**	**1**	**0**	**3**

1. Name of the Deptt.: Civil Engineering Department
2. Subject Code: **CWE-111**
   Course Title: Programming for Civil Engineers (E-1)
3. Contact Hours: L: 3 T: 0 P: 0
4. Examination Duration (Hrs) : Mid-Term Exam = 1.5 hr; End-Term Exam = 3 hrs
5. Evaluation Weightage (Marks) : C. P. =10%; End-Term = 30% & End-Term = 60%

   [C. P. = Class performance, which includes attendance, Assignments and interaction in the class]
6. Credits: 3
7. Semester: 1st (Autumn)
8. Pre-requisite: Nil
9. Objective: To impart the understanding of a computer programming language and preparation of algorithms.
10. Details of the course

S. N	Contents	Contact Hours
1.	R (Use R!): Introduction to RStudio: Installing RStudio, overview, packages, getting Help	2
2.	Data Types: R Objects and attributes, vectors and lists, matrices; factors; data frames, dates and times; reading tabular data; Sub-setting and Operations. Some practical applications	6
3.	Control Structures - Introduction; choices and loops, Loop functions: lapply; mapply; tapply; Some examples	5
4.	Functional Programming: Introduction, scoping Rules; coding standards; piping; Practical applications; Some packages for Civil Engineers	7
5.	Debugging: Introduction; general techniques, locating errors, interactive and non-interactive debugging	2
6.	Python: Introduction: installation Anaconda and overview, libraries, and getting help.	1
7.	Data types and structures: strings, scalers, vectors, matrices, lists, reading tabular data, Numpy and Pandas	4
8.	Control structures: Introduction, choices and loops; Some examples	3
9.	Functional Programming: functions, scoping, and classes; Some libraries for Civil Engineers; Debugging rules and ideas	5
10.	Introduction to Matlab	1
	Total	36

Suggested Books

1. Lafore, Robert . Object Oriented Programming with C++
2. Panday, S.K. Object Oriented Programming with C++

****

E-2. CSE- 115: Construction Techniques & Management

SEMESTER: 1ST	**L**	**T**	**P**	**C**
COURSE NO. CGE - 115	**2**	**2**	**0**	**3**

1. Name of the Deptt.
2. Subject Code: **CSE - 115**
   Course Title: Construction Techniques and Management (E-2)
3. Contact Hours: L: 3 T: 0 P: 0
4. Examination Duration (Hrs.): Mid-Term 1.5 Hr; End-Term3.0 Hr
5. Relative Weightage: Minor-I:20; Mid-Term 30%; End-Term 60% Class Perf.:10%
6. Credits: 3
7. Semester: 2nd (Spring)
8. Pre-requisite: Nil
9. Course Details -as in tabular form below:

Sr. No.	Topic/contents	Contact hours
1	Construction planning-Construction facilities, Schedules, Layout of Plant utilities.	6
2	Construction methods: Excavation and handling of Earth and rock.	6
3	Production and handling of Aggregates and Concrete.	4
4	Temperature problems in concreting, Cooling of concrete in dams.	4
5	Drainage treatment of aquifers/sub-terrainean reservoirs.	4
6	Tunneling, Tunneling in soft rocks-Grouting, chimney formation, etc.	6
7	Construction control and management-CPM/PERT, Human Factors, Organization.	6

References:

1. Peurifoy, R.L. and Ledbetter, W.B.; Construction Planning ,Equipment and Methods, McGraw Hill Singapore, 1986.
2. Robertwade Brown; Practical Foundation Engineering Handbook, McGraw Hill Publications , 1995.
3. Joy, P.K.; Total Project Management- The Indian Context, New Delhi, MacMillan India Ltd., 1992.
4. Uliman, John.E, et al; Handbook of Engineering Management, Wiley, New York , 1986.
5. Neville, A.M.; Properties of Concerte, Pitman Publishing Ltd.,London, 1978.

****

E-2. CGE-116: Geosynthetics in Geotechnical Engineering

SEMESTER: 1ST	**L**	**T**	**P**	**C**
COURSE NO. CGE - 116	**2**	**2**	**0**	**3**

Course Details

Geosynthetics – Definitions and classification, Basic functions and selection, Historical development, Raw materials and manufacturing processes, Properties and test methods, Standards and Codes of Practice; Soil-geosynthetic interaction; Application areas – retaining walls, Embankments, Shallow foundations, Unpaved roads, Paved roads, Airport, Railway tracks, Slopes, Landfills, Earth dams, Containment ponds, Reservoirs, Ponds, Canals, Pipeline and drainage systems, Tunnels; Seismic aspects of geosynthetic applications; Quality control and *in-situ* monitoring; Cost analysis; Case Histories

References:

1. Clayton, C. R. I., Milititsky, J. and Woods, R. I., Earth Pressure and Earth Retaining Structures, Blackie Academic & Professional, 1993.
2. Ingold, T, Reinforced Earth, Thomas Telford Ltd., 1982.
3. Jones, C. J. F. P, Earth Reinforcement and Soil Structures, Butterworth, 1985.
4. Koerner, R. M, Designing with Geosynthetics, Prentice Hall, 1993.

****

E-2. CGE-117: Soil Dynamics and Machine Foundations

SEMESTER: 1ST **L T P C**

COURSE NO. CGE - 117 **2 2 0 3**

1. Name of the Deptt. Department of Civil Engineering
2. Subject Code CGE-117
3. Course Title: **Soil-Dynamics and Machine Foundation**
4. Contact Hours: L: 3 T: 0 P: 0
5. Examination Duration (Hrs.): **Mid-Term=1.5 Hrs End-Term =3.0 Hrs**
6. Relative Weightage: **Mid-term = 30%; End-Term =60%: CA =10%**
7. Credits: 3
8. Semester: 2nd (Spring)
9. Pre-requisite: **Nill**
10. Details of Course-as in tabular form below:

S. No.	Topic/contents	Contact hours
1	Introduction: Comparison of Soil mechanics and Soil Dynamics, Nature of Dynamic loads, Stress conditions on soil element under earthquake loading, seismic force for pseudo static analysis as per IS Code Theory of Vibration: Definitions, Harmonic motion, free and forced Vibration of a single degree freedom system with and without damping, Theory of vibration, Vibration measuring Instruments. Vibration isolation, spectral response	12
2	Dynamic Bearing Capacity of Shallow Foundation: Criteria for satisfactory action of footing. Pseudo static analysis, bearing capacity of footings. Dynamic analysis of horizontal and vertical loads.	07
3	Principles of Machine Foundation Design: Typical machine and foundations. General requirements of machine foundation; Permissible amplitude, allowable soil pressure. Modes of vibration of a rigid foundation block, Methods of analysis, Linear elastic weightless spring method, Elastic half space method Design procedure for block foundation, IS code practice. Behaviour and design of Machine foundations, Reciprocating Machines, Hammer foundations, Introduction to T.G. foundations	12
4	Vibration Isolation: Force Isolation – Motion Isolation – use of spring and damping materials – vibration control of existing machine foundation – screening of vibration – open trenches – Pile Barriers – salient construction aspects of machine Foundations.	10

References:

1. Dynamics of bases and foundations : D. D. Barken
2. Soil Dynamics and Machine Foundations : Swami Saran.
3. Arya S. D, O'Neil, M. and Pincus, G., Design of structures and foundations for vibrating machines, Gulf Publishing Co., 1979.
4. Prakash, S. and Puri, V. K., Foundation for machines: Analysis and Design, John Wiley Sons, 1998
5. Prakash, S., Soil Dynamics, McGraw Hill, 1981.
6. Kameswara Rao, N. S. V., Vibration analysis and foundation dynamics, Wheeler Publication Ltd., 1998
7. Major, A., Dynamics in Civil Engineering: Analysis and Design Vol. I-III, Akademiai Kiado, 1980.
8. Richart, F. E. Hall J. R and Woods R. D., Vibrations of Soils and Foundations, Prentice Hall Inc., 1970.

****

SEMESTER – II

1. CORE COURSES

1. CGE -201: Ground Improvement Techniques

SEMESTER: 2ND	**L**	**T**	**P**	**C**	**Dr. B. A. Mir**
COURSE NO. CGTE - 201	**2**	**2**	**0**	**3**	

1. Subject Area : **Civil Engineering**

2. Subject Title : GROUND IMPROVEMENT TECHNIQUES

3. Subject Code : CGE-201

4. Contact Hours : L-T-P: 2-2-0 [L: Lecture, T: Tutorial & P: Practical]

5. Credits : 3

6. Semester : Spring Session

7. Examination Duration (Hrs.): **Mid-Term=1.5 Hrs End-Term =3.0 Hrs**

8. Relative Weightage: **Mid-term = 30%; End-Term =60%: CA =10%**

9. Pre-requisite : **Geotechnical Engineering**

10. Objective: To impart understanding of Application of Engineering Principles of Ground Modification in the field of Civil Engg.

11. Course Details

Unit No.	Course Contents	Contact Hours
Unit -1	**INTRODUCTION** • Soil Types, Soil Investigation & Classification • Ground Modification/Stabilization • Need for Engineered Ground Improvement • Classification of Ground Improvement Techniques • Suitability, Feasibility and Desirability of Ground Improvement Techniques • Current & Future Developments	12

Unit – 2	**GROUND IMPROVEMENT TECHNIQUES** • **Mechanical Modification** Introduction to Mechanical Modification, Principles of Soil Densification, Properties of Compacted Soil, Compaction Control, Specification of Compaction Requirements, Types of Compaction Equipment • **Chemical Modification/Stabilization** Effect of various admixtures on Engineering Properties of Soils such as: Cement, Lime, Fly ash, Bitumen, Cement-Lime-Fly ash. Other chemical additives such as- NaCL, $CaCL_2$, CaSO4, $Ca(OH)_2$, NaOH etc., Grouting- Applications to Embankments, Foundations & Sensitive Soils, Admixtures in Pavement Design. • **Hydraulic Modification** Objectives & Techniques, Dewatering Systems, Soil-Water Relationships, Single & Multiple-Well Formulas, Drainage of Slopes, Filtration & Seepage Control, Pre-loading & Vertical Drains, Electrokinetic Dewatering & Stabilization	12
Unit - 3	**GROUND IMPROVEMENT TECHNIQUES (Contd....)** • **Modification by Inclusions, Confinement & Exclusion Techniques** Evolution of Soil Reinforcement, Applications of Geosynthetics Material in Civil Engineering, Granular piles, Soil Nailing, Soil Anchors, Soil Confinement by Formwork, Sheet Piles, Contiguous Bored Piles, Slurry Trenches, Diaphragm Walls, Compressed Air. • **Thermal Modification** Thermal Properties of Soils, Heat Treatment of Soils, Ground Freezing, Strength & Behavior of Frozen Ground. • Case histories	12
	Total	36

COURSE TEXTBOOK: **Some useful resources are:**

1. Kasmalkar, B. J. (1997). Geotech. Engineering. Pune Vidyarthi Griha Prakashan-1786, Sadashiv Peth, Pune-411030.
2. J K Mitchell & Kenichi Soga (2005). Fundamentals of Soil Behavior, *John* Wiley & Sons, New York.

3. Nelson, J. D. and Miller, D.J. (1992). Expansive Soils, John Wiley and Sons, Inc., New York, 1992.
4. J K Mitchell (1978). Improving soil conditions by durface and subsurface treatment methods-Overview, ASCE Metropolitan Section Foundation And Soil Mechanics Group Seminar, New York, USA.
5. P.P. Raj (1999). Ground 'Improvement Techniques, laxmi Publications (P) Ltd. New Delhi.
6. Ingles O.G. and Metcalf J.B. (1972). Soil Stabilization: Principles and Practice, Butterworths, London.
7. Bell F.G. (1975). Methods of Treatment of Unstable Ground, Newnes-Butterworths, London.
8. Moseley, M. P. (1993). Ground Improvement, Blackie Academic & Professional..
9. Koener R. M. (1985). Construction and Geotechnical Methods in Foundation Engineering, McGraw-Hill Pub. Co., New York.
10. Hausmann M. R. (1990). Engineering Principles of Ground Modification", McGraw-Hill Pub. Co. New York.
11. Koerner .R.M. (1994). Designing with Geosynthetics, Prentice-Hall Pub.
12. Jones. C. J. E. P. (1996). Earth Reinforcement and Soil Structures, Butterworth's, London.
13. Koerner. R. M. and Welsh. J. P. (1980). Construction and Geotechnical Engineering Using Synthetic Fabrics, Wiley Interscience, New York.
14. Bell. F.G. (1987). Ground Engineer's Reference Book, Butterworth's, London.

****

2. CGE - 202: Advanced Foundation Engineering

SEMESTER: 2ND **L** **T** **P** **C** **Dr. B. A. Mir**

COURSE NO. CGE **- 202** **2** **2** **0** **3**

1. Subject Code : **CGE-202**
2. Course Title : **Ad. Foundation Engineering**
3. Semester : M. Tech. 2ND Sem. Spring Session
4. Contact Hours : L = 2 T = 2 P = 0
5. Examination Duration (Hrs) : Mid-term = 1.5 Hr End-term = 3 Hrs
6. Evaluation Weightage (Marks) : C.P. = 10%, Mid-Term = 30%, End-Term = 60%
7. Credits : 3
8. Pre-requisite: Geotechnical Engineering
9. Objective: To impart understanding of various aspects related to Foundations in the field of Civil Engg.
10. Course Details -as in tabular form below:

Unit No.	Course Contents	Contact Hours
Unit -1	**a. Introduction to Foundation Engineering:** • Foundation, Types, Construction materials, Principles of foundation Engineering, challenging problems, Design requirements/ information needed for foundation design. • Design and Construction Terminology for Deep Foundations. • Terminology involved in Foundation Analysis and Design**,** Gross bearing capacity, ultimate bearing capacity, net-ultimate bearing capacity, safe bearing capacity, net safe bearing capacity, safe bearing pressure, allowable bearing pressure. **b. Pile Classifications & Load Transfer Principle** • **Situations in which deep foundations** • Classification of piles • Factors governing choice of type of pile • Load transfer mechanism • Piling equipments and methods • Effect of pile installation on soil condition – criteria for pile socketing - responsibility of engineer and contractor.	6 6
	Pile Capacity • **Axial Load Capacity of Piles and Pile Groups -** Allowable load of piles and pile groups – Static and dynamic methods – for cohesive and cohesionless soil – negative skin friction – group efficiency – pile driving formulae - limitation – Wave	6

Unit - 2	equation application – Interpretation of field test and pile load test results – Settlement of piles and pile group - codal provisions. • **Lateral and Uplift Load Evaluation of Piles -**Piles under Lateral loads – Broms method, elastic, p-y curve analyses – Batter piles – response to moment – piles under uplift loads – under reamed piles – Drilled shaft – Lateral and pull out load tests – codal provision – case studies. • **Caissons -**Necessity of caisson – type and shape - Stability of caissons – principles of analysis and design – tilting of caisson – construction - seismic influences - codal provision.	6 2
Unit - 3	**a. Settlement analysis of Piles** • t-z method, Pile load tests, Foundations on expansive and collapsible soils **b. Structural Design of Pile and Pile Groups** • Structural design of pile – structural capacity – pile and pile cap connection – pile cap design – shape, depth, assessment and amount of steel – truss and bending theory- Reinforcement details of pile and pile caps – pile raft system – basic interactive analysis – pile subjected to vibration – codal provision.	8 8
	Total	**42**

OUTCOME

- Students are able to select, analyze and design individual pile, group piles and caissons for different subsoil conditions.

Books Recommended:

1. Kasmalkar, J.B. (1997). Foundation Engineering, Pune Vidyarthi Graha Prakashan-1786, Pune-411030.
2. Bowels, Joseph E.(1996). Practical Foundation Engineering Handbook. 5th edition, McGraw-Hill, New York.
3. Das, Braja M. (1999). Principles of foundation Engineering, 4th edition, PWS publishing, Pacific Grov. Calif.
4. Peck, Ralph B., Hansen, Walter E., and Thornburn, Thomas H. (1974). Foundation Engineering. John Wiley & Sons, New York.
5. Praksh, Shamsher, and Sharma, Hari D. (1990). Pile foundation in Engineering Practice, John Wiley & Sons, New York.
6. Som, N.N., and Das, S.C. (2003). Foundation Engineering: Principles and Practice. Prentice –Hall of India Pvt. Ltd. New Delhi-001.
7. Varghese, P.C. (2005). Foundation Engineering Prentice –Hall of India Pvt. Ltd. New Delhi-001.
8. Tomlonson, Michael J. (1995). Foundation Design and Construction. 6th edition. John Wiley & Sons, New York.

****

3. CGE- 203: Applied Soil Mechanics

SEMESTER: 2ND	L	T	P	C
COURSE NO. CGE - 203	2	2	0	3

Course Details

Design of retaining walls: Lateral earth pressure coefficients; Rankine and Coulomb theories; Graphical constructions; Passive earth pressure with curved rupture surfaces, Plastic equilibrium in soils, Theory of arching in soils and its applications in tunnel, conduits, silos.

Braced excavations and open cuts, Sheet piles and Anchored bulkheads, Cofferdams and their design. Diaphragm walls, Bored pile walls and prestressed ground anchors. Slope stability analysis, Stability analysis and design of earth dams and embankments, various methods of computation of slope stability

.

References:

1. Kurian, N. P, Design of Foundation Systems – Principles and Practices, New Delhi, Narosa publishing House, 2nd Edn., 1994.
2. Kurian, N. P., Modern Foundations – Introduction to Advanced Techniques, New Delhi, Tata McGraw-Hill Publishing Company Limited, 1984.
3. Clayton, C. R. I., Milititsky, J. and Woods, R. I.,Earth Pressure and Earth Retaining Structures, Blackie Academic & Professional, 1993.
4. Terzaghi, K., Theoretical Soil Mechanics, Wiley, 1965.
5. Terzaghi, K and Peck, R. B, Soil Mechanics in Engineering Practice, Asia Publishing House, 1960.
6. Teng, W. C, Foundation Design, Prentice-Hall of India Pvt. Ltd.., 1965.
7. Bowles, J. W. Analysis and Design of Foundations, McGraw-Hill, 4th Ed., 1988.
8. Spangler, M. G and Handy, R. L, *Soil Engineering*, Harper & Row, 1982.

****

4. CGE- 204: Soil Engineering Lab. - II

SEMESTER: 2ND	L	T	P	C
COURSE NO. CGE - 204	0	0	3	1

****

2. ELECTIVE COURSES (any two)

E-3. CGE-211: Critical State Soil Mechanics

(Stress Path- Constitutive Modeling of Soils)

SEMESTER: 2ND	**L**	**T**	**P**	**C**	**Dr. B. A. Mir**
COURSE NO. CGE-212	**2**	**2**	**0**	**3**	

1. Name of the Deptt. Department of Civil Engineering
2. Subject Code: CGE -211
3. Course Title: Critical State Soil Mechanics (E-I)
4. Contact Hours: L: 3 T: 1 P: 0
5. Examination Duration (Hrs.): Mid-Term 1.5; End-Term 3
6. Relative Weightage: Mid-Term 30%; End-Term 60%; Class Perf.:10%
7. Credits: 3
8. Semester: 2ND (Spring)
9. Pre-requisite: Nil

11. Course Details - below:

Course Details

An introduction to Engineering Soils, Stresses and strains in soils, State of Stress and Strain in soils, Reconstituted soil samples, Shear testing of soils, Critical State Models, Elasto-Plastic Models, Stress and Strain Paths and Invariants, The Critical State line and Roscoe Surface, Cam Clay Model, Behavior of Overconsolidated Soil Samples-Hvorslev Surface, The Behavior of Soils Before Failure, Soil Parameters for Design.

References:

1.Atkinson, J. H., The Mechanics of Soils: AN introduction to Critical State Soil Mechanics. McGraw Hill

2.Parry, R. H. G., Mohr Circles, Stress Paths and Geotechnics. Spon Press, London.

3.Wood, D. M., Soil Behavior and Critical State Soil Mechanics. New York.

4.Ortigao, J. A. R., Soil Mechanics in the Light of Critical State Theories: An Introduction. Balkema, The Netherlands.

5.Bishop, A. W. and Henkel, D. J., The Triaxial Test. Edward Arnold, London

6.Schofield, A. N., Critical State Soil Mechanics. McGraw-Hill London

7.Atkinson, J. (2009). The Mechanics of Soils & Foundations. Taylor and Francis, New York

****

E-3. CGE-212: Soil-Structure Interaction

SEMESTER: 1ST **L T P C**

COURSE NO. CGE -113 **2 2 0 3**

1. Name of the Deptt. Department of Civil Engineering
2. Subject Code **CGE -311**/CSE-206 Course Title: **Soil-Structure Interaction (E-I)**
3. Contact Hours: L: 3 T: 0 P: 0
4. Examination Duration (Hrs.): Mid-Term **1.5 Hr; End-Term 3.0 Hr**
5. Relative Weightage: Mid-Term **=30% ;End-Term =60% Class Perf.:10**
6. Credits: 3
7. Semester: 2nd (Spring)
8. Pre-requisite: **Nil**

9. Course Details -as in tabular form below:

Sr. No.	Topic/contents	Contact hours
1	Soil-Foundation Interaction: Introduction to soil-foundation interaction problems, Soil behavior, Foundation behavior, Interface behavior, Scope of soil foundation interaction analysis,;	10
2	soil response models, Winkler, Elastic continuum, Two parameter elastic models, Elastic plastic behavior, Time dependent behavior Beam on Elastic Foundation- Soil Models: Infinite beam, Two parameters, Isotropic elastic half space, Analysis of beams of finite length, Classification of finite beams in relation to their stiffness. Plate on Elastic Medium: Thin and thick plates,	12
3	Elastic Analysis of Pile: Elastic analysis of single pile, Theoretical solutions for settlement and load distributions, Analysis of pile group, Interaction analysis, Load distribution in groups with rigid cap ; Laterally Loaded Pile: Load deflection prediction for laterally loaded piles,	12
4	Subgrade reaction and elastic analysis, Interaction analysis, Pile-raft system, Solutions through influence charts.	7

References:

1. N.P. Kurien, *Design of Foundation Sytems : Principles & Practices*, Narosa, New Delhi 1992,
2. E.S. Melerski, *Design Analysis of Beams, Circular Plates and Cylindrical Tanks on Elastic Foundation*, Taylor and Francis, 2006.
3. L.C. Reese, *Single piles and pile groups under lateral loading*, Taylor & Francis, 2000
4. G. Jones, *Analysis of Beams on Elastic foundation*, Thomas Telford, 1997.
5. Selva durai, A. P. S, Elastic Analysis of Soil-Foundation Interaction, Elsevier, 1979.
6. Poulos, H. G., and Davis, E. H.,Pile Foundation Analysis and Design, John Wiley,1980.
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. (1988), Suggested Analysis and Design Procedures for combined footings and Mats, American Concrete Institute, 1988.

****

E-3. CWE 211: GIS, GPS & Remote Sensing Applications

SEMESTER: 2ND	L	T	P	C
COURSE NO. CGE-211/WRE-211	2	2	0	3

Course Details

Principles of GIS, GPS and Remote Sensing:

Basic concepts of GIS & GPS, introduction to remote sensing, remote sensing system, electromagnetic spectrum, black body, atmospheric windows, spectral characteristics of earth's surface, range of sensing system.

GPS:

Basic concepts, components, factors affecting, GPS setup, accessories, segments- satellites & receivers, GPS applications, Case studies

Platforms, Sensors and Data Products:

Ground aircraft, Spacecraft platforms, photographic sensors, scanners, radiometers, radar and mission planning, data types and format, scale and legend.

Interpretation and Analysis Techniques:

Multi-spectral, multi-temporal, multi-sensoral, multistage concepts, photo interprétation techniques for aerial photo and satellite imagery, interprétation elements, false colour composition, etc.

Photogrammetry:

Photogrammetry- Basic application, applications of aerial photo interpretation to water resources engineering.

Digital Analysis:

Preprocessing and processing, image restoration/enhancement procedures, pattern recognition concepts, classification algorithms, post processing procedures.

Structure of GIS:

Cartography, Geographic mapping process, transformations, map projections, Geographic Data Representation, Storage, Quality and Standards, database management systems, Raster data representation, Vector data representation, Assessment of data quality, Managing data errors, Geographic data standards.

GIS Data Processing, Analysis and Modeling:

Raster based GIS data processing – Vector based GIS data processing – Queries – Spatial analysis – Descriptive statistics – Spatial autocorrelation – Quadrant counts, and nearest neighbor analysis – Network analysis – Surface modeling – DTM.

Application in Civil Engineering:

River drainage and flood flow, watershed delineation and characteristic studies, command area mapping, drought assessment, groundwater inventory, soil moisture study, water quality assessment and monitoring, Land use data acquisition, disaster management.

References:

1. Thomas, M. Lillisandand R.W.Kiefer; Remote Sensing and Image Interpretation, John Wiley, 1987.
2. Sabins and Floyd, F.J.R; Remote Sensing Principles and Interpretation, W.H. Freeman, Sanfrancisco, 1978.
3. Elachi; Introduction to Physics and Techniques of Remote Sensing, New York Wiley,

1987.
4. Phillip, H. Swain and Shirley, M. Davis; Remote Sensing- The Quantitative Approach, McGraw Hill Publications, 1978.
5. Johnson, R. Jenson; Introductory Digital Image Processing, Prentice hall, 1986.
6. Ian Heywood, S. Cornelius and S. Carver, An Introduction to Geographical Information Systems, Pub. By Pearson Education (Singapore) Pvt. Ltd., Printed in Replica Press Pvt. Ltd., India, 2001
7. Agarwal, N. K., Essentials of GPS, Spatial Networks Pvt. Ltd., Hyderabad, 2004

****

E-4. CGE- 213: Environmental Geotechnology

SEMESTER: 2ND	L	T	P	C
COURSE NO. CGE - 213	2	2	0	3

Course Details

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 behaviour; 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. Introduction to unsaturated soil mechanics; water retention property and soil-water characteristic curve; flow of water in unsaturated soil. Concepts of waste containment facilities; desirable properties of soil; contaminant transport and retention; contaminated site remediation. Introduction to advanced soil characterization techniques; volumetric water content; gas permeation in soil; electrical and thermal properties; pore-size distribution; contaminant analysis.

References:

1. Mitchell, J. K and Soga, K Fundamentals of Soil Behavior, John Wiley and Sons Inc.,
2. 2005.
3. Fang, H-Y, Introduction to Environmental Geotechnology, CRC Press, 1997.
4. Daniel, D. E, Geotechnical Practice for Waste Disposal, Chapman and Hall, 1993.
5. Rowe, R. K., Quigley, R. M. and Booker, Clay Barrier Systems for Waste Disposal Facilities, J. R., E & FN Spon, 1995.
6. Rowe, R. K, Geotechnical and Geoenvironmental Engineering Handbook, Kluwer Academic Publishers, 2001.
7. Reddi, L. N. and Inyang, H. F, Geoenvironmental Engineering - Principles and Applications, Marcel Dekker Inc, 2000.
8. Sharma, H. D. and Lewis, S. P, Waste Containment Systems, Waste Stabilization and
9. Landfills: Design and Evaluation, John Wiley & Sons Inc., 1994.

****

E-4. CGE- 214: Earthquake Geotechnical Engineering

SEMESTER: 2ND	**L**	**T**	**P**	**C**	**Prof. Majid Hussain**
COURSE NO. CGE - 214	**2**	**1**	**0**	**3**	

1. Name of the Deptt. Department of Civil Engineering
2. Subject Code: **CGE - 214** Course Title: **Earthquake Geotechnical Engineering**
3. Contact Hours: L: 3 T: 0 P: 0
4. Examination Duration (Hrs.): Mid-Term **1.5; End-Term 3.0**
5. Relative Weightage: Mid-Term **=30% ;End-Term =60% Class Perf.:10**
6. Credits: 3
7. Semester: 2nd (Spring)
8. Pre-requisite: Basic Soil Mechanics

Sr. No.	Topic/contents	Contact hours
1	**Earthquakes:** Causes and characteristics (magnitude, intensity, accelerograms), response spectra, attenuation of ground motion. Estimation of seismic hazards (deterministic and probabilistic)	4
2	**Introduction to vibratory motion:** Waves in Elastic Medium**;** Dynamics of Discrete: Systems, Vibration of single and multiple degree of freedom systems. Free and forced vibrations (regular and irregular excitation)	6
3	**Dynamic properties of soils:** Determination of site characteristics, local geology and soil condition, site investigation and soil test, Laboratory and in-situ tests; Site response to earthquake. Seismic Microzonation	8
4	**Liquefaction of soils:** Fundamental concept of liquefaction, assessment of liquefaction susceptibly from SPT and CPT; Seismic response of soil structure system, seismic bearing capacity of shallow foundation, design of pile foundation in liquefiable ground.	4
5	**Pseudo-static analysis and design** of earth retaining structures and soil slopes. Estimation of earthquake-induced deformation	8
6	**Course project:** Finite Element Analysis of Geotechnical Structures using FE based software eg PLAXIS	6

References

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
3. Ansal, Recent Advances in Earthquake Geotechnical Engineering and Microzonation, Springer, 2006.
4. I. Towhata, *Geotechnical Earthquake Engineering*, Springer, 2008.

E-4. CSE-215: Finite Element Method in Civil Engg

SEMESTER: 2ND	**L**	**T**	**P**	**C**
COURSE NO. CSE - 215	**2**	**2**	**0**	**3**

1. Name of the Deptt. Department of Civil Engineering
2. Subject Code: **CSE - 115** Course Title: **FEM in Civil Engg**
3. Contact Hours: L: 3 T: 0 P: 0
4. Examination Duration (Hrs.): Mid-Term **1.5;End-Term 3.0**
5. Relative Weightage: Mid-Term **=30% ;End-Term =60%** **Class Perf.:10**
6. Credits: 3
7. Semester: 2nd (Spring)
8. Pre-requisite: Nil
9. Course Details -as in tabular form below:

Sr. No.	Topic/contents	Contact hours
1	Introduction to Finite Element Method. Brief History of the Development. Advantages & Disadvantages of Finite Element Method. Finite Element Method- The Displacement Approach.	4
2	Foundations of the FEM- Energy Principles.	6
3	One Dimensional Finite Elements. Stiffness Matrix for the basic Bar & Beam Element Representation of Distributed Loading. The Assembly Process within the PMPE Approach. Element Stresses.	8
4	Shape Functions & Interpolation Polynomials. Refined One Dimensional Elements.	4
5	Finite Elements for Two Dimensional Planar Bodies. Triangular Elements for Plane Stress or Strain Conditions. Higher Order Triangular Elements. Rectangular Elements for Plane Stress or Strain Conditions. Higher Order Rectangular Elements : Lagrange Element Family.	10
6	Serendipity Rectangles & Hexahedra. The Isoparametric Concept. Properties of Isoparametric Elements. Numerical Integration.	8

Books recommended:

1. Matrix & Finite Element Displacement Analysis of Structures: D.J.Dawe.
2. Matrix Finite Element Computer & Structural Analysis: M.Mukhopadhyay.
3. Finite Element Structural Analysis: T.Y.Yang.
4. Concepts & Applications of Finite Element Analysis: Robert D.Cook.

****

SEMESTER – III

A. CORE COURSES

1. CGE-301: Advanced Soil Mechanics

SEMESTER: 3RD	**L**	**T**	**P**	**C**
COURSE NO. CGE **- 301**	**2**	**2**	**0**	**3**

Course Details

Concepts of stress and strain-elastic equilibrium; Principal stresses and strains; Invariants; Octahedral stresses and strains; Mohr's diagrams; Plane state of stress and Plane state of strain; Stress strain relations for linearly elastic solids; Stresses and displacements in soil-2D & 3D problems, Basic solutions of Boussinesq, Cerutti, Mindlin and Westergaard. Application of fundamental solutions for problems of practical interest in geotechnical engineering: foundations, stress applied to surface of a circular opening, Inclusions in infinite regions, surface loads in a semi-infinite region.

References:

1. Harr, M. E, Foundations of Theoretical Soil Mechanics, McGraw-Hill Inc., 1996.
2. Das, B. M, Advanced Soil Mechanics, McGraw-Hill Book Co., 1987..
3. Poulos, H. G. and Davis, E. H , Elastic Solutions for Soil and Rock Mechanics, Wiley, 1974.

2. CGE- 302: STRENGTH AND DEFORMATION BEHAVIOUR OF SOIL

SEMESTER: 2ND	**L**	**T**	**P**	**C**
COURSE NO. CGE – 212	**3**	**1**	**0**	**3**

Course Details

Introduction: Physico-Chemical aspects, Failure theories, Yield criteria, Elastic and Plastic analysis of soil, Mohr's diagram.; Stresses in Soil: Description of state of stress and strain at a point, stress distribution problems in elastic half pace. Boussinessqu, Westergard Mindlin and Kelvin problems.

Distribution of contact pressure. Analysis of Elastic settlement. Soil Plasticity, Shear Strength of Soils, Experimental determination of shear strength, Types of tests based on drainage conditions and their practical significance, Skempton's and Henkel's pore water pressure coefficients, Stress path, Shear strength of unsaturated soils, Row's stress dilatancy theory. Constitutive Models: Constitutive Models in Soil Mechanics: Isotropic Elastic, Anisotropic Plasticity and Viscous Models. Representing Soil Behavior using these Models. Advances in Constitutive models.

References

1. A.P.S. Selvadurai, *Plasticity& Geomechanics*, Cambridge University Press, 2002
2. W.F. Chen, *Limit Analysis & Soil Plasticity*, Elsevier Scientific, 1975.
3. S. Desai and J. T. Christian, *Numerical Methods in Geotechnical Engineering*, McGrew Hill, New York.
4. R. F. Scott, *Principles of Soil Mechanics*, Addison & Wesley

****

B. ELECTIVE COURSES (any one)

****

E5. CGE-311: LANDFILL ENGINEERING

SEMESTER: 3RD	**L**	**T**	**P**	**C**	**Dr. B. A. Mir**
COURSE NO. CGTE - 312	**2**	**2**	**0**	**3**	

PART-I : EVOLUTION OF SOLID WASTE

- Solid Waste-Sources and Types
- Properties of Solid waste
- Waste Handling and Separation, Storage & Processing at Source
- Disposal & Residual Matter
- Planning, Sitting & Permitting of Waste management Facilities

PART –II : LANDFILL ENGINEERING

- **Introduction**

  Need for Landfills, Types of Landfills, Physical Characteristics of Landfills.
- **Barrier Systems**

  Concept of Barrier Systems & Engineering Design, Transport Mechanism, Filter Criteria
- **Appraisal of EPA Regulations, Property characterization of Landfill Components.**
- **Landfill Liners**

  Types of Landfill Liners, Engineering Properties, Analysis, design & Construction of Liners, Leachete Collection Pipes.
- **Landfill Covers**

  Basic Concepts for Cover Systems, Components, Assessment, Advantages & Disadvantages, Protection Layer, Barrier Layer.
- **Landfills & Impoundments**

  Objectives of Waste Disposal Facilities, Siting of Landfills, Containment Technology, Disposal Unit & Operations.
- **Water Balance for Landfills**
- **Stability of Landfills**
- **Evaluation of Landfill Performance**

  Evaluation of Landfill Performance Using HELP Software & Economic evaluation & Risk Assessment of Landfills,, Role of GIS, Construction Details & Performance Monitoring.

Recommended Books:

- Geotechnics of Landfills :GermanTechnical Regulations.
- Integrated Solid Waste Management:
  Engg. Principles & Management Issues : Tchobanoglous, George, Hilary Theisen & samuel Vigil.
- Geotechnical Practice for Waste Disposal : David E. Daniel
- Soil Stabilization : Ingles, O. G. & Metcalf, J. B.

E-5. CGE-312: Hydraulic Structures

SEMESTER: 3RD **L** **T** **P** **C**

COURSE NO. CWE-**311** **2** **2** **0** **3**

1. Name of the Deptt. Department of Civil Engineering
2. Subject CodE: CWE-**311** Course Title: **Hydraulic Structures (E-I)**
3. Contact Hours: L: 3 T: 0 P: 0
4. Examination Duration (Hrs.): Mid-Term **1.5; End-Term 3.0**
5. Relative Weightage: Mid-Term **=30% ;End-Term =60% Class Perf.:10%**
6. Credits: 3
7. Semester: 3RD (Autumn)
8. Pre-requisite: Nil
9. Course Details -as in tabular form below:

Sr. No	Contents	Contact Hours
1	**Storage Structures**: Types of Selection of Type Earth Dams- Causes of failure, Element of Earth dam, Seepage Stability Gravity Dams- Site Selection, Forces on gravity Dam, Stability Analysis, Elementary and Practical profile, Design.	10
2.	**Flow Control Structures**: Spillways, Outlets Types and Design Features.	6
	Reservoirs Investigations for Reservoir Planning, Reservoir Sedimentation, Operation of Reservoir, Reservoir Flood Routing.	6
	Hard Works Types of Head Works, Components f Diversion Head Works, Types of Weirs, Design of Weirs, Canal Head Regulator, Theory of Seepage Blight's Creep Theory, Method of Independent Variable of Khosla.	
	Cross Drainage Works Types of Cross-Drainage Works, Design of Cross-Drainage works, causeways, culverts , bridges, estimation of design	

Books recommended:

1. R.S. Varshney, S.C. Gupta and R.L. Gupta; Theory and Design of Irrigation Structures, Nemchand & Brothers ,Roorkee, 1992.
2. R.k. Sharma; Irrigation Engineering and Hydraulic Structures, Oxford and IBH Publishing Co., New Delhi, 1984.
3. Arora, K.R. " Irrigation water power and Water Resources Engineering", Standard Publishers Distributors, Delhi,2002.

****

E-5. CGE-313: ADVANCED CONCRETE TECHNOLOGY

SEMESTER: 3RD	**L**	**T**	**P**	**C**
COURSE NO. CSE - 314	**2**	**2**	**0**	**3**

Course Details

Concrete Making Materials: Aggregates – Classification, IS specifications, Properties, Grading, Methods of combining aggregates, specified gradings, Testing of aggregates.
Cement: Chemical compoisition, Hydration of cement, structure of hydrated cement, special cements, water chemical admixtures.
Concrete: Properties of fresh concrete, Hardened concrete, Strength, Elastic properties, Creep and Shrinkage, Variability of concrete strength.
Mix Design: Principles of concrete mix design, Methods of concrete mix design, Testing of concrete.
Special Concretes: Light weight concrete, Fibre reinforced concrete, Polymer concrete, Super plasticized concrete, Properties and applicatons.
Concreting Methods: Process of manufacturing of concrete, Methods of Transportation, placing and curing. Extreme weather concreting, Special concreting methods.

References:

1. Neville, A.M. and Brookes, J.J. “Concrete Technology”, Pearson Publishers,New Delhi,1994.

2. Neville, A.M. “Properties of Concrete” Pearson Publishers,New Delhi, 2004.

3. Shetty,M.S. “Concrete Technology”, S.Chand & Company, New Delhi,2002.

4. Gambhir, M.L. “Concrete Technology”, Tata McGraw Hill New Delhi, 1995.

5. Rudhani,G.”Light Weight Concrete”, Academic Kiado Publishing Home of Hungarian Academy of Sciences,1963.

****