Kandula Srinivasa Reddy Memorial College of Engineering (Autonomous)
Kadapa 516003 AP
(Affiliated to JNTUA, Anantapuramu, Accredited By NBA, Accredited By NAAC)
(An ISO 9001-2000 Certified Institute)

Regulations, Curriculum and Syllabus for

M. Tech(Geotechnical Engineering)

(Approved on 25-08-2014)

KSRM College of Engineering, Kadapa-516003, AP

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Regulations for PG Programs in Engineering (R14PG)

1.0 Nomenclature

1.1 *Academic Term*: Extent of time during which academic instructions are initiated and completed

1.2 *Academic Year*: Academic Term of, approximately, one year duration that usually starts in June/July and ends in April/May next

1.3 *Semester*: Either of two Academic Terms that make up an Academic Year

1.4 *Major*: A specific field of study

1.5 *Minor*: An area outside of, or complementary to, a Major

1.6 *Subject*: An area of knowledge that is studied as part of a Course

1.7 *Core*: A subject that is mandatory for a Major course of study

1.8 *Elective*: A subject that is selected for study to suit one's individual needs

1.9 *Audit Subject*: A subject that is studied to meet certain requirements but has no credits assigned to it

1.10 *Self-Study Subject*: A subject that is learnt by a student on own under the guidance of a Faculty member

1.11 *Humanities*: Subjects that describe and interpret human achievements, problems and historical changes at individual and societal levels covering the disciplines of literature, history, and philosophy

1.12 *Social Sciences*: Subjects that describe the mental and behavioural activities of individuals, groups, organizations, institutions, and nations covering the disciplines of anthropology, economics, linguistics, political science, and psychology

1.13 *Exam*: A test to measure one's progress, knowledge, or ability in a subject

1.14 *Credit*: A numerical weight given to a subject

1.15 *Grade*: A numerical or alphabetic designation measuring the level of achievement in an exam

1.16 *Attendance*: Physical presence of oneself in a classroom/laboratory for purpose of a scheduled academic instruction

1.17 *Course*: A series of subjects that constitute a Major field of study

1.18 *Branch*: Same as Course

1.19 *Program*: Same as Course

1.20 *Specialization*: Same as branch

1.21 *Degree*: An academic title conferred to honour distinguished achievement

2.0 Short Title and Application

2.1 These rules and regulations may be called as R14PG and come into force from Academic Year 2014-15 and exist until superseded by new regulations

2.2 These rules and regulations are applicable to all post graduate courses in engineering and technology leading to Master's Degree in Technology (M. Tech)

2.3 The Specializations offered, at present, are:

2.3.1 Geotechnical Engineering

2.3.2 Electrical Power Systems

2.3.3 CAD & CAM

2.3.4 Digital Electronics and Communication Systems

2.3.5 Computer Science and Engineering

2.4 The Institute may offer new Specializations in future to which these rules and regulations will be applicable

3.0 Suspension and Amendment of Rules

3.1 Academic Council has the authority to suspend a rule temporarily

3.2 Academic Council has the authority to amend a rule

3.3 For affirmative action on any suspension or amendment of a rule, an affirmative vote of three-fifths of the members present and voting shall be required in Academic Council

4.0 Requirements for Admission

4.1 At present, admissions into first semester of various Specializations are governed by Government and the Affiliating University. The eligibility criteria and procedure for admission are prescribed by Government and Affiliating University

4.2 A student is not allowed change of Specialization after admission

4.3 A student must fulfil medical standards required for admission

4.4 The selected students are admitted into first semester after payment of the prescribed fees

5.0 Structure of the M. Tech course

5.1 Duration: The duration of M. Tech degree course is four semesters

5.2 Working Days: Calendar for any semester shall be announced at least four weeks before its commencement. Minimum number of working days is90 per semester

5.3 Curriculum: Each Specializationshall havecore, elective and audit subjects.The curriculum for each Specialization shall be approved by its corresponding Board of Studies and then by the Academic Council

5.4 Credits: All subjects that are assessed for marks have credits assigned to them. The credits assigned to subjects shall be given in curriculum. The total

number of credits for entire course is seventy for all Specializations. The distribution of total credits semester-wise is given in Table 1

Table 1 Semester-wise Total Credits

Semester	Total Credits
First Semester	26
Second Semester	26
Third Semester	2
Fourth Semester	16
Total for entire course	70

5.5 The curriculum and syllabus is given in Annexure-1 and Annexure-2 respectively

5.6 Responsibility and Advising: It is the responsibility of the student to understand and know the regulations and requirements to earn the degree. Each student admitted in to the degree programs is assigned to a Faculty Advisor who assists the student in designing an effective program of study. Students should consult their Faculty Advisors for selection of electives and for general advice on academic program

6.0 Registration and Enrolment

6.1 Prior to opening of each semester, every student shall register for all the credit-bearing and audit subjects listed in curriculum of the term. Excepting first semester, the registration for a semester shall be done during a specified week after end examinations of previous semester. In first semester, the registration shall be done within six working days from date of opening. Recommendation of Faculty Advisor is needed for registration

6.2 A student can also register optionally for one self-study subject per semester that does not carry any credits. A student can take any subject of any specialization as self-study subject on the recommendation of concerned Faculty Advisor

6.3 Late registration will be permitted with a fine, decided from time to time, up to six working days from the last date specified for registration

6.4 A student will be eligible for registration for a semester if she or he i) is promoted to that semester, ii) has cleared all fees to the Institute, library and hostel of previous term, and iii) is not disqualified for registration by a disciplinary action of the Institute

6.5 A student will be enrolled and allowed to attend the classes on successful registration and payment of necessary fees to Institution, library, and hostel

6.6 Registration and enrolment will be controlled by the Office of the Controller of Examinations

7.0 Assessment Procedure – Internal Tests and End Examinations

7.1 Performance of students in all subjects is assessed continuously through internal assessment tests and an End examination

7.2 Allocation of internal assessment and End examination marks

7.2.1 For theory subjects, the allocation is 40 marks for internal assessment and 60 marks for End examination totalling 100 marks

7.2.2 For laboratory/drawing/project work subjects, the allocation is 50 marks for internal assessment and 50 marks for End examination totalling 100 marks

7.2.3 For seminar/viva voce/industrial training subjects' total 100 marks are allocated for internal assessment. There shall be no end examination for these subjects

7.2.4 For all audit subjects the allocation is 40 marks for internal assessment and no allocation for End examination

7.3 Internal Assessment Examinations

7.3.1 Internal assessment means performance evaluation of students by faculty members who teach the subjects

7.3.2 For theory subjects, including audit subjects, the internal assessment shall be done by midterm tests. For each subject, two midterm tests will be conducted for 40 marks each and the internal assessment mark is the better of two marks. If any student abstains for any midterm test, she or he will be awarded zero marks for that midterm test.

7.3.3 For laboratory/practical/drawing subjects, the internal assessment will be based on regular laboratory work over full term. The assessment will be done by the faculty concerned. The students shall be informed sufficiently early of the procedure to be followed for internal assessment

7.3.4 For self-study subjects, the assessment is through assignments, quizzes, seminars and viva-voce. The students shall be informed sufficiently early of the procedure to be followed for assessment

7.3.5 For subjects like seminar, project-work, industrial training, and comprehensive viva-voce, the internal assessment will be done by a concerned Department Committee consisting of two senior faculty members and faculty guide of concerned student. The assessment procedure will be informed sufficiently early to the students

7.4 End examinations

7.4.1 End examinations shall be conducted after completion of coursework in each term

7.4.2 The question papers for theory subjects shall be set by faculty members outside of the Institute. The external faculty members for question paper setting will be selected by the Principal

7.4.3 Evaluation of answer scripts shall be done by faculty members from outside of the Institute selected by the Principal

7.4.4 For laboratory subjects, end examination shall be conducted by a committee consisting of two internal examiners. One examiner shall be recommended by Head of Department of concerned Major, and the other examiner shall be appointed by the Principal

7.4.5 For project work viva-voce, End examination shall be conducted by a committee consisting of one internal examiner, one external examiner, and the concerned guide of the student. Internal examiner shall be appointed by Head of Department of concerned Major, and the external examiner shall be appointed by the Principal

7.4.6 If a student abstains from End examination of any subject, for any reason, she or he shall be awarded zero marks in that subject

7.4.7 There is no end examination for self-study and audit subjects

8.0 Method of Assigning Letter Grades and Grade Points

8.1 For all credit-bearing subjects, performance of a student in a subject is indicated by a letter grade that corresponds to absolute marks earned in that subject. Each letter grade is assigned a numeric Grade Point that is used to compute Grade Point Average on a scale of 0 to 10

8.2 Performance of a student in both internal assessment and End examination will be considered for awarding grades for credit bearing subjects. Total marks earned in a subject is the sum of marks obtained in internal and End examinations in that subject

8.3 Pass grade A+ to D- is assigned to a subject based on total marks earned in that subject provided that a student earns at least i) 35% of marks in End examination marks and ii) 40% of marks in internal and End examination marks put together; otherwise fail grade F will be assigned to that subject

8.4 Grade I will be assigned to a subject if a disciplinary action is pending and is not resolved before publication of results. Office of Controller of Examinations shall resolve the pending disciplinary action within six working days from the date of publication of results and change the grade to any of A+ to D- or F

8.5 Grade X will be assigned to a subject if a student abstains for End examination of that subject

8.6 The absolute marks and corresponding letter grade and grade points are given in Table2

Table 2 Letter Grades and Grade Points

Absolute Marks	Letter Grade	Grade Points	Remark
95-100	A+	10.0	Pass
90-94	A	9.5	Pass
85-89	A-	9.0	Pass
80-84	B+	8.5	Pass
75-79	B	8.0	Pass
70-74	B-	7.5	Pass
65-69	C+	7.0	Pass
60-64	C	6.5	Pass
55-59	C-	6.0	Pass
50-54	D+	5.5	Pass
45-49	D	5.0	Pass
40-44	D-	4.5	Pass
0-39	F	0.0	Fail
-	I	0.0	Result Withheld
-	X	0.0	Absent for End Exam

8.7 SGPA: Semester Grade Point Average indicates the performance of a student in all credit-bearing subjects of a term. SGPA is calculated as the weighted average of Grade Points of all subjects of the term with corresponding credits of subjects as weights. Audit and self-study subjects are not considered for SGPA calculation

8.8 CGPA: Cumulative Grade Point Average indicates the performance of a student in all terms up to and including the current term under consideration. CGPA is calculated as the weighted average of SGPAs with total credits in each term as the weights

8.9 Grade Card: All students shall be issued Grade Cards after the publication of results of a term. Grade Card is a statement of performance of a student in a term. It contains information about each registered subject: type of subject, allocated credits, and letter grade earned. SGPA and CGPA will also be indicated

9.0 Requirements for Completing Subjects

9.1 A student shall complete all credit-bearing and audit subjects successfully to be eligible for award of degree

9.2 Credit-bearing subjects: A student is considered to have completed a credit-bearing subject successfully and earned credits if she or he obtains a pass grade from A+ to D- in that subject. If a student receives fail grade F or X in

any subject, she or he must register for supplementary End examination for that subject as and when opportunity arises and improve grade to pass grade

9.3 Audit subjects: A student is considered to have successfully completed an audit subject if she or he earns at least 40% of marks in internal assessment marks. A student may request for makeup tests to satisfy this requirement by paying requisite fee

9.4 Self-study subjects: Based on internal assessment, the faculty guide concerned will certify whether a student has successfully completed the subject or not. Grade card will list successfully completed self-study subjects

10.0 Requirements for taking End Examinations

10.1 A student is eligible to take regular End Examinations of current semester if she or he full fills the attendance requirement

10.2 A student shall be promoted from current term to succeeding term on satisfying the attendance requirement

10.3 A student shall complete all credit-bearing and audit subjects successfully before taking End examination for project viva-voce

10.4 Attendance Requirement

10.4.1 Attendance of students shall be recorded for credit-bearing and audit subjects as per the workload indicated in curriculum

10.4.2 Total class-periods conducted shall be reckoned from beginning to end of a term as published in academic calendar

10.4.3 Aggregate Percentage of Attendance is calculated using total number of class-periods attended as numerator and total number of class-periods conducted for the concerned class as the denominator

10.4.4 A minimum aggregate attendance of 75% is required for promotion to succeeding term

10.4.5 A student can appeal to Academic Council for condoning deficiency in aggregate attendance if she or he gets 65% or more aggregate attendance presenting a valid reason for deficiency. Such a student will be granted promotion if Academic Council pardons the deficiency. Academic Council has the right to reject the appeal if it is not satisfied with the performance of the student or the reason cited for deficiency of the attendance

10.4.6 A student earning less than 65% aggregate attendance will be denied promotion. A student who is not promoted on basis of attendance shall be removed from the rolls and shall register for the same term when opportunity arises. The current term record of the student is cancelled automatically

10.5 A student can forego promotion and opt to repeat the current term on written request. Recommendation of the concerned Faculty Advisor is required for cancellation of promotion. This option shall be exercised before the commencement of the End examinations of the current term[$]

11.0 Revaluation of End Examination Scripts

11.1 Revaluation of End Examination scripts is allowed for theory subjects only by paying requisite fee

11.2 A Procedure for Revaluation: The current valuation is annulled and the script will be sent for revaluation by an external examiner appointed by the Principal. Marks obtained in the revaluation will be awarded for that subject

11.3 A student can apply for revaluation in a subject only once

12.0 Supplementary End Examinations

12.1 Students are eligible to take Supplementary examinations in subjects with fail grade F or X only

12.2 Supplementary examinations for even semester subjects will be conducted with regular examinations of odd semester subjects and vice versa

12.3 A student will be allowed to improve grade in any theory subject provided she or he has completed coursework of all terms but before award of provisional/final degree[$]

13.0 Requirements for Award of M. Tech degree

13.1 Time Limit for completion of requirements for award of degree is four calendar years from the date of admission. A student who could not complete all the requirements in this time limit shall forego admission and will be removed from the rolls of the Institute

13.2 A student shall be eligible for award of degree provided she or he has:

- 13.2.1 Registered and successfully completed all required credit-bearing and audit subjects with a total of 70 credits
- 13.2.2 Secured a CGPA of 4.5 or more
- 13.2.3 Cleared all dues to the Institute, library and hostel
- 13.2.4 No disciplinary action is pending against her or him
- 13.2.5 Satisfied any other stipulation of the affiliating University

13.3 Award of Class: Each student will be given class in degree based on CGPA as given in Table 3

Table 3 Class of Degree

Class of Degree	Range of CGPA
Pass Class	>= 4.5 but <5.5
Second Class	>= 5.5 but <6.5
First Class	>= 6.5 but <7.5
First Class with Distinction	>= 7.5

13.4 Consolidated Grade Card and Degree will issued under the seal of affiliating University

14.0 Transitory Regulations

14.1 A student who initially joins the Institute in a previous Regulation and has to rejoin in an academic-term of the present Regulations, due to any reason, shall be bound by the rules of the current Regulations. Board of Studies of the concerned Major will specify, extra or otherwise, academic coursework to be undertaken by such students who rejoin the current Regulations

[$]Decision is pending on this clause

Annexure-1 Curriculum for M. Tech (Geotechnical Engineering)

	First Semester						
Code	Subject	L	T	P	IM	EM	CR
14511101	Numerical Methods	3	1	0	40	60	4
14511102	Experimental Geo-Mechanics	3	1	0	40	60	4
14511103	Shallow Foundations	3	1	0	40	60	4
14511104	Ground Improvement Techniques	3	1	0	40	60	4
14511105 14511106 14511107	Elective-1 1. Project Planning and Management 2. Soil Structure Interaction 3. Environmental Geo-Technology	3	1	0	40	60	4
14511108 14511109 14511110	Elective-2 1. Advanced Engineering Geology 2. Disaster Management 3 Geotechnical Instrumentation	3	1	0	40	60	4
14511111	Geotechnical Engineering Lab	0	0	3	50	50	2
	Total	21	7	3	290	410	26
	Second Semester						
	Subject	L	T	P	IM	EM	CR
14511201	Earth Retaining Structures	3	1	0	40	60	4
14511202	Deep Foundations	3	1	0	40	60	4
14511203	Construction Practices in Expansive Soils	3	1	0	40	60	4
14511204	Soil Dynamics and Machine Foundations	3	1	0	40	60	4
14511205 14511206 14511207	Elective-3 1. Finite Element Method 2. Design with Geo-synthetics 3. Pavement Design	3	1	0	40	60	4
14511208 14511209 14511210	Elective-4 1. Remote Sensing and Applications 2. Geotechnical Earthquake Engineering 3. Project Safety Management	3	1	0	40	60	4
14511211	Computer Geotechnical Applications Lab	0	0	3	50	50	2
	Total	21	7	3	290	410	26
	Third Semester						
	Subject	L	T	P	IM	EM	CR
14512101	Seminar	-	-	-	100	-	2
	Total	-	-	-	100	-	2
	Fourth Semester						
	Subject	L	T	P	IM	EM	CR
14512201	Project work	-	-	-	50	50	16
	Total	-	-	-	50	50	16

Legend: L-Lecture Periods/week; T-Tutorial Periods/week; P-Lab/Drawing Periods per week; IM-Internal Assessment Marks; EM-End Examination Marks; CR-Credits

Semester-wise Summary of Marks and Credits

Term	IM	EM	CR
First Semester	290	410	26
Second Semester	290	410	26
Third Semester	100	-	2
Fourth Semester	50	50	16
Total	730	870	70
	1600		

Annexure-2: Syllabus

Code	Subject	L	T	P	IM	EM	CR
14511101	Numerical Methods	3	1	0	40	60	4

Unit – I
The calculus of the finite differences : Differences, Differences formulae, Difference table, operator E, Properties of the operators E and Δ, Leibnitz rule- Interpolation with equal intervals, unequal intervals, Central difference interpolation formulae – Inverse interpolation

Unit – II
Numerical Differentiation and Integration: First order and second order derivatives – Maximum and minimum values of a tabulated function- Newton Cote's quadrature formula- Trapezoidal rule, Simpson's rules, Romberg's method – Gaussian quadrature formulae

Unit – III
Simultaneous linear algebraic equations – Methods of solution using the inverse of the matrix, method of successive elimination- Iterative methods – Gauss - Siedel method and Relaxation method

Unit – IV
Numerical solution of ordinary differential equations: Picard's method of successive approximations – Euler's modified method -Runge- Kutta method of fourth order – Predictor – Corrector methods - Milne's method and Adam's Moulton method

Unit – V
Introduction to Finite Element Analysis: Various steps in solving a problem by finite Element Method (displacement approach) - Two dimensional method elements - Formulation of the finite element method using (i)Principle of virtual work(ii) Minimization of total potential energy of a system - Discrete Element Method

Textbooks
1. Introductory methods of Numerical Analysis – S.S.Sastry, PHI
2. Numerical methods for Engineers & Scientists – Chapra, Tata McGraw Hill

Reference Books
1. Calculus of Finite Difference Method & Numerical Analysis - Gupta, Malik
2. Applied Numerical Analysis by Curtis F. Gerald, Partick.O.Wheatly, Addison – Wesley, 1989

Code	Subject	L	T	P	IM	EM	CR
14511102	Experimental Geo-Mechanics	3	1	0	40	60	4

Unit – 1
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

Unit – 2
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

Unit – 3
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

Unit – 4
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

Unit – 5
Geophysical Methods: Types–Electrical Resistivity Methods – Electrical Profiling Method –Electrical Sounding Method – Seismic Methods – Seismic refraction method – Sub-soil Investigation Report

Mechanical Wave Measurements: Crosshole Tests (CHT), Downhole Tests (DHT), Spectral Analysis of Surface Waves, Seismic Refraction, Suspension Logging::Electromagnetic Wave Techniques: Ground Penetrating Radar (GPR), Electromagnetic Conductivity (EM), Surface Resistivity (SR), Magnetometer Surveys (MT)

Textbooks

1. S.P. Brahma, Foundation Engineering, TMHl Publishing Company Limited, New Delhi, 1985
2. ShamsherPrakash, GopalRanjan and Swami Saran, SaritaPrakasham,Analysis and Design of Foundations and Retaining Structures, Meerut.1979
3. V.N.S. Murthy,Soil Mechanics & Foundation Engineering, Vol. 2, SaiKripa Technical Consultants, Bangalore
4. C. Venkataramaiah, Geotechnical Engineering, Wiley Eastern Ltd., New Delhi

Reference Books

1. Hvorslev, MJ, Sub Surface Exploration and Sampling of Soils for Civil Engineering Purpose, Water-ways Station, Vicksburg, Mississippi, 1949.
2. Noel Simons, Bruce Menzies and Marcus Matthews, A Short Course in geotechnical Site Investigation, Thomas Telford.
3. AraArman and NareshSamtani, Sub Surface Investigations, Federal Highway Administration, Arlington, Virginia.
4. SP36- Compendium of Indian Standards on Soil Engineering - Part –II
5. Dobrine,Geophysical methods
6. D.K.Todd,Ground water Hydrology

Code	Subject	L	T	P	IM	EM	CR
14511103	Shallow Foundations	3	1	0	40	60	4

Unit – 1
Introduction: Developments – Need of Foundation Engineering – Responsibility of Foundation Engineer – Classification of Foundations – General requirements – Additional considerations–Selection of foundation –Hostile environment –Structural integrity – Economy

Unit – 2
Bearing Capacity Estimation: Bearing capacity of shallow foundations – Homogeneous and Layered soils – Sloping grounds – Soft and Hard Rocks – Evaluation of bearing capacity from in-situ tests –Partial safety factor approach – Bearing capacity of sloping soils – IS Code Recommendations

Unit – 3
Settlement Evaluation: Settlement analysis – Immediate and consolidation settlement in homogeneous, layered soils and rocks – Construction period correction – Evaluation from in-situ tests –IS Code recommendations

Unit – 4
Interactive Analysis of Foundations: Analysis of foundation –Strip, individual, combined footings – Mat foundations, conventional and elastic approaches –Soil structure interaction: principles, soil structure interaction problems, contact pressure, distribution, factors influencing contact pressure distribution beneath rigid and flexible footings, concentrically and eccentrically loaded cases – Idealized soil behavior – Foundation behavior, Interface behavior, Analytical techniques – Foundation interaction analysis

Unit – 5
Foundations for Special Conditions: Introduction to special foundations – Foundation design in relation to ground movements – Foundations on recent refuse fills – Design of Foundation for seismic forces,IS Code recommendations – Introduction to theory of vibration - Design of Block foundation, IS Code recommendations

Textbooks

1. Donald P. Coduto, Foundation Design Principles and Practices - Prentice Hall, Inc., Englewood Cliffs, New Jersey, 1996
2. Bowles, J.E., Foundation Analysis and Design, McGraw Hill, New York, 1996
3. Tomlinson, M.J. Foundation Engineering, ELBS, Long man Group, UK Ltd., England, 1995
4. Muni Budhu, Soil Mechanics and Foundation, John Wiley and Sons Inc 2000
5. IS: 6403 - 1981

Reference Books

1. Peck, R.B., Hansen, W.E., and Thornburn, W.H., Foundation Engineering, John Wiley, 1974
2. Winterkorn, H.F. and Fang, Y.F., Foundation Engineering Handbook, Van Nostrand Reinhold, 1994
3. Robert Wade Brown, Practical Foundation Engineering Handbook, McGraw Hill, New York, 1996
4. Day, R.W., Geotechnical and Foundation Engineering, Design and Construction, McGraw Hill 1999

Code	Subject	L	T	P	IM	EM	CR
14511104	Ground Improvement Techniques	3	1	0	40	60	4

Unit – 1
Dewatering: Introduction – Scope and necessity of ground improvement in Geotechnical engineering– Basic concepts and philosophy– Drainage – Groundwater lowering by well points, deep wells, vacuum and electro-osmotic methods – Stabilization by thermal and freezing techniques

Unit – 2
Compaction and Sand Drains: In-situ compaction of granular and cohesive soils – Shallow and Deep compaction sand piles – Concept, design, factors influencing compaction – Blasting and dynamic consolidation – Preloading with sand drains, fabric drains, wick drains etc. – Theories of sand drain – Design and relative merits

Unit – 3
Stone Column, Lime Piles and Soil Nailing: Stone column, lime piles – Functions – Methods of installation – Design, estimation of load carrying capacity and settlement-slope stability-stability of trenches-lime-sand columns-Root piles, soil nailing – Applications.

Unit – 4
Earth Reinforcement: Earth reinforcement – Principles and basis mechanism of reinforced earth-reinforced soil retaining structures-simple design, Synthetic and natural fiber based Geo-textiles and their applications. Filtration, drainage, separation, erosion control – case studies

Unit – 5
Grouting: Grouting techniques – Types of grout – Suspension and solution grouts – Basic requirements of grout, Grouting equipment – principle of injection-injection methods – properties of treated ground-application of jet grouting-grout monitoring – Electro – chemical stabilization – Stabilization with cement, lime etc. – Stabilization of expansive clays.

Text Books:

1. Dr. P. Purushothama Raj., "Ground Improvement Techniques", Laxmi Publication Pvt. Ltd.
2. Jewell, R.A., Soil Reinforcement with Geo-textiles, CIRIA, London, 1996.
3. Das, B.M., Principles of Foundation Engineering, (Fourth Edition). PWS Publishing, 1999
4. Jones, J.E.P., Earth Reinforcement and Soil Structure, Butterworths, 1985.
5. Koerner, R.M. and Welsh, J.P., Construction and Geotechnical Engineering using Synthetic Fabrics, John Wiley, 1990.

Reference Books:

1. Moseley, M.D., Ground Treatment, Blackie Academic and Professional, 1998.
2. Hehn, R.W., Practical Guide to Grouting of Underground Structures, ASCE, 1996.
3. Shroff, A.V., Grouting Technology in Tunneling and Dam, Oxford &IBH Publishing Co. Pvt.Ltd., New Delhi, 1999.
4. Koerner, R.M., Designing with Geosynthetics (Third Edition), Prentice Hall, 1997.

Code	Subject (Elective)	L	T	P	IM	EM	CR
14511105	Project Planning and Management	3	1	0	40	60	4

Unit – 1
Introduction to Project management: Characteristics of projects, Definition and objectives of Project Management, Stages of Project Management, Project Planning Process, Establishing Project organization.

Unit – 2
Work definition: Defining work content, Time Estimation Method, Project Cost Estimation and budgeting, Project Risk Management, Project scheduling and Planning Tools: Work Breakdown structure, LRC, Gantt charts, CPM/PERT Networks.

Unit – 3
Developing Project Plan (Baseline), Project cash flow analysis, Project scheduling with resource constraints: Resource Levelling and Resource Allocation. Time Cost Trade off:
Crashing Heuristic

Unit – 4
Project Implementation: Project Monitoring and Control with PERT/Cost, Computers applications in Project Management, Contract Management, Project Procurement Management.

Unit – 5
Cost Analysis – Direct and Indirect project costs – Total costs – Cost Slopes – Crashing - Cost and Time Optimization.
Updating – Data required for updating – Process of updating – When to update.Resource allocation – Resources – Usage profiles – Histograms – Resource Smoothing – Resource levelling.

Text Books:

1. Shtub, Bard and Globerson, Project Management: Engineering, Technology, and Implementation, Prentice Hall, India
2. S. Choudhury, Project Scheduling and Monitoring in Practice.
3. BC Punmia and KKKhandelwal, PERT and CPM, Laxmi Publishers
4. LSSrinath, PERT and CPM,
5. P. K. Joy, Total Project Management: The Indian Context, Macmillan India Ltd.
6. John M Nicholas, Project Management for Business and Technology: Principles and Practice, Prentice Hall, India, 2002.
7. N. J. Smith (Ed), Project Management, Blackwell Publishing, 2002.

Reference Books:

1. Lock, Gower, Project Management Handbook.
2. Cleland and King, VNR Project Management Handbook.
3. Wiest and Levy, Management guide to PERT/CPM, Prentice Hall. India
4. HoraldKerzner, Project Management: A Systemic Approach to Planning, Scheduling and Controlling, CBS Publishers, 2002.
5. Robert K. Wysocki, Robert Back Jr. and David B. Crane, Effective Project Management, John Wiley, 2002.
6. Jack R Meredith and Samuel J Mantel, Project Management: A Managerial Approach, John Wiley, 2000.

Code	Subject (Elective)	L	T	P	IM	EM	CR
14511106	Soil Structure Interaction	3	1	0	40	60	4

Unit – 1
Soil-Foundation Interaction: Introduction to soil - Foundation interaction problems, Soil behavior, Foundation behavior, Interface, behavior, Scope of soil-foundation interaction analysis, soil response models, Winkler, Elastic continuum, two parameter elastic models, Elastic plastic behavior, Time dependent behavior.

Unit – 2
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.

Unit – 3
Plate on Elastic Medium: Infinite plate, Winkler, Two parameters, Isotropic elastic medium, Thin and thick plates, Analysis of finite plates, rectangular and circular plates, Numerical analysis of finite plates, simple solutions.

Unit – 4
Elastic Analysis of Pile: Elastic analysis of single pile, Theoretical solutions for settlement and load distribution, Analysis of pile group, Interaction analysis, Load distribution in groups with rigid cap.

Unit – 5
Laterally Loaded Pile: Load deflection prediction for laterally loaded piles, sub-grade reaction and elastic analysis, Interaction analysis, and pile raft system, solutions through influence charts.

Text Books:

1. Structure Soil Interaction - State of Art Report, Institution of structural Engineers, 1978.
2. McCarthy, D.F. Essentials of Soil Mechanics and Foundations, basic geo-techniques (6^{th} Edition), Prentice Hall, 2002.
3. Selvadurai, A.P.S., Elastic Analysis of Soil Foundation Interaction, Elsevier, 1979.
4. Hemsley, J.A, Elastic Analysis of Raft Foundations, Thomas Telford, 1998.

Reference Books:

1. Poulos, H.G., and Davis, E.H., Pile Foundation Analysis and Design, John Wiley, 1980.
2. Scott, R.F. Foundation Analysis, Prentice Hall, 1981.
3. ACI 336, Suggested Analysis and Design Procedures for Combined Footings and Mats, American Concrete Institute, Dehit, 1988.

Code	Subject (Elective)	L	T	P	IM	EM	CR
14511107	Environmental Geo-Technology	3	1	0	40	60	4

Unit – 1
Introduction: Industrialization and Urbanization, Pollution, Control and remediation.
Contamination: Surface contamination, Contamination transport, Soil-a Geotechnical trap, Effect of subsurface contamination, Detection of polluted zone, Monitoring and Effectiveness of designed facilities.

Unit – 2
Contaminants of Solid Waste in Landfills: Waste contaminants, landfills, types, shape and size of landfills. Liner and liner system, Cover and cover system, Stability of landfills. Landfill construction & operation, sustainable waste management.

Unit – 3
Contaminants of Slurry wastes: Slurry transported wastes, slurry ponds, operation, Embankment construction and raising, Design aspects, Environmental Impact and control.

Unit – 4
Vertical Barriers for Contaminant: Contaminated sites, Types of barriers, Soil-Bentonite slurry trench walls, Cement-Bentonite slurry trench walls, construction, material and design aspects.

Unit – 5
Geotechnical Reuse of Waste materials: Waste reduction, use in geotechnical construction, waste characteristics, transportation consideration, Engineering properties of Wastes, Waste material in Embankment and Fills.

Text Books:

1. Geo-environmental Engineering by Sharma H.D&Reddy K.R
2. Geo-environmental Engineering by ReddiL.N&Inyang.H.I
3. Geo Technical Practice for Waste Disposal by Daniel .D.EWentz, C.A., Hazardous Waste Management, McGraw Hill, Singapore, 1989.
4. Fried, J.J., Ground Water Pollution, Elsevier, 1975.
5. Westlake, K., (1995), Landfill Waste pollution and Control, Albion Publishing Ltd., England, 1995.
6. Lagrega, M.d., Buckingham, P.L., and Evans, J.C., Hazardous Waste Management, McGraw Hill, Inc. Singapore, 1994.

Reference Books:

1. Geotechnical Geo – Environmental Engineering hand Book – Kerry Row
2. Ground Water Contamination: Bedient, Refai& Newell.
3. Daniel, B.E., Geotechnical Practice for waste disposal, Chapman and Hall, London, 1993.
4. Proceedings of the International symposium of Environmental Geo-technology (Vol.I and II), Environmental Publishing Company, 1986 and 1989.
5. ASTM Special Technical Publication 874, Hydraulic Barrier in Soil and Rock, 1985.
6. Ott, W.R., Environmental Indices, Theory and Practice, Ann. Arbor, 1978.

Code	Subject (Elective)	L	T	P	IM	EM	CR
14511108	Advanced Engineering Geology	3	1	0	40	60	4

Unit – 1
Geology of Soil Formations: Soil genesis, Geological classification of soils, Residual and transported soils, soil components, characteristics of soils derived from different types of rocks. Nature of alluvium and sand of the rivers of Deccan Trap region, Scarcity of sand in Deccan Trap area

Unit – 2
Stratigraphy and Indian Geology: Definition and scope, Geological Time scale, Physiographic divisions of India and their geological, geomorphologic and tectonic characteristics, General study of important geological formations of India namely Vindhyan, Gondwana, and Deccan traps with respect to 1. Introduction and general information. 2. Distribution. 3. Lithology. 4. Tectonics 5. Economic importance etc. Significance of these studies in Civil Engineering

Unit – 3
Engineering Geology of Deccan Traps: Types of basalts and associated volcanic rocks, Engineering characteristics of these rock types, Engineering significance of variation in size, number and infillings of gas cavities, Compact and amygdaloidal basalt as construction material, Effect of jointing, hydrothermal alteration and weathering on engineering behaviour of various verities of Deccan traps. Tail channel erosion problem in Deccan Trap region, suitability of basalts from tunneling point of view. Problems due to columnar basalt, dykes, red bole, tachylitic basalt, Volcanic breccia and fractures, Laterites-Origin, occurrence and engineering aspects. Ground water bearing capacity of the rocks of Deccan Trap region, Percolation tanks, Geological conditions suitable and unsuitable for construction of percolation tanks

Unit – 4
Seismic Activity of Deccan Trap Region: Continental Drift and plate Tectonics in brief, Seismic zones of world, Seismic activity of Deccan trap region. Various theories on the origin of the seismic activity of Deccan Trap region, Reservoir induced seismicity. Nature and characteristics of seismic activity of Deccan Trap region.Tectonics of Deccan Trap region.Tectonic Nature of seismic activity of Deccan Trap region.Prediction of earthquake.Earthquake proof constructions. Numerical problems based on seismic data

Unit – 5
Classification of Rocks: Rocks of peninsular India and the Himalayas - Index properties and classification of rock masses, competent and incompetent rock - value of RMR and ratings in field estimations.
Strength Criteria of Rocks: Behavior of rock under hydrostatic compression and deviatric loading - Models of rock failure - planes of weakness and joint characteristics - joint testing, Mohr - Coulomb failure criterion and tension cut-off. Hook and Brown Strength criteria for rocks with discontinuity sets

Text Books:

1. RBGupte, A Text Book of Engineering Geology, Pune VidyarthiGrihaPrakashan, Pune
2. Dr.D.V. Reddy, Engineering Geology for Civil Engineers
3. N ChennaKesavulu, Text book of Engineering Geology, Macmillan India Ltd.
4. Dutta AK, Introduction to Physical Geology, Kalyani Publishers, New Delhi.
5. Goodman, R.E., Introduction to Rock Mechanics, John Willey and Sons, 1989.

Reference Books:

1. S. Krishnamurthy, India's Mineral Resources, Oxford &IBH Co.
2. Hook, E and Bray, J., Rock slope Engineering, Institute of Mining and Metallurgy, U.K. 1981.
3. Hook, E and Brown, E.T., Underground Excavations in Rock, Institute of Mining and Metallurgy, U.K. 1981.
4. Obvert, L. and Duvall, W., Rock Mechanics and the Design of structures in Rock, John Wiley, 1967.
5. Indian stratigraphy by M S Krishnan

Code	Subject (Elective)	L	T	P	IM	EM	CR
14511109	Disaster Management	3	1	0	40	60	4

Unit – 1
Introduction - Concepts and definitions: disaster, hazard, vulnerability, risk, capacity, impact, prevention, mitigation).

Unit – 2
Disasters - Disasters classification; natural disasters (floods, draught, cyclones, volcanoes, earthquakes, tsunami, landslides, coastal erosion, soil erosion, forest fires etc.); manmade disasters (industrial pollution, artificial flooding in urban areas, nuclear radiation, chemical spills etc); hazard and vulnerability profile of India, mountain and coastal areas, ecological fragility.

Unit – 3
Disaster Impacts - Disaster impacts (environmental, physical, social, ecological, economical, political, etc.); health, psycho-social issues; demographic aspects (gender, age, special needs); hazard locations; global and national disaster trends; climate change and urban disasters.

Unit – 4
Disaster Risk Reduction (DRR) - Disaster management cycle – its phases; prevention, mitigation, preparedness, relief and recovery; structural and non-structural measures; risk analysis, vulnerability and capacity assessment; early warning systems, Post-disaster environmental response (water, sanitation, food safety, waste management, disease control); Roles and responsibilities of government, community, local institutions, NGOs and other stakeholders; Policies and legislation for disaster risk reduction, DRR programmes in India and the activities of National Disaster Management Authority.

Unit – 5
Disasters, Environment and Development - Factors affecting vulnerability such as impact of developmental projects and environmental modifications (including of dams, land-use changes, urbanization etc.) sustainable and environmental friendly recovery; reconstruction and development methods

Text Books:

1. PradeepSahni, 2004, Disaster Risk Reduction in South Asia, Prentice Hall.
2. Singh B.K., 2008, Handbook of Disaster Management: techniques & Guidelines, Rajat Publication.
3. GhoshG.K., 2006, Disaster Management, APH Publishing Corporation.

References:

1. http://ndma.gov.in/ (Home page of National Disaster Management Authority)
2. http://www.ndmindia.nic.in/ (National Disaster management in India, Ministry of Home Affairs)

Code	Subject (Electives)	L	T	P	IM	EM	CR
14511110	Geotechnical Instrumentation	3	1	0	40	60	4

Unit – 1
Review of Requirement of Field /Geotechnical Instrumentation in construction, soil and rock mechanics. Brief Review of Dam and Large structure design parameters, Objective and Purpose of Geotechnical instrumentation

Unit – 2
Geotechnical Parameters: Types of parameters, Study of Pore pressure, Total Pressure, Earth Pressure, Stress, Strain, Displacements, Load, Deformations, Tilt, Inclination, Slope, Depth, Bore Diameters, Temperature, Salinity, Conductivity, pH value

Unit – 3
Measurement Techniques: Hydraulic Methods, Pneumatic Methods, Resistance Devices using Carlson Techniques, Vibrating Wire Techniques, Piezo Resistance Techniques, Optical Fiber Based Sensing Techniques

Unit – 4
Applications: Measurement of geotechnical parameters for Earth and Rock fill Dams, Concrete Dam, Gravity Dam, Earthen Embankments, Large structures like Multi storied Buildings, Large structures Like Big Sports Stadiums, Canal, Tunnels for Road and Railways, Airport Tarmacs, Express Motorways

Unit - 5
Data Acquisition and Analysis: Digital and Analogue data acquisition techniques, Micro controller based Data Acquisition Systems and Data Presentation Systems, Computer Based Data analyzers

Text Books and Reference Books:

1. T H Hanna , 'Field Instrumentation', (Trans Tel (Germany) Publications)
2. Various Civil Engineering Conference reports including Conferences on Large Dams
3. BIS Standards and British Standards

Code	Subject	L	T	P	IM	EM	CR
14511111	Geo-Technical Engineering Lab	0	0	3	50	50	2

1. Specific Gravity
   - Pycnometer Method
   - Density Bottle Method
2. Grain Size Analysis
   - Dry sieve Analysis
   - Hydrometer Analysis
3. Consistency Limits
   - Liquid Limit
   - Plastic Limit
   - Shrinkage Limit
   - Indices
4. Swelling Index
   - Free Swell
   - Differential Swell
5. In-Situ Density
   - Core Cutter Method
   - Sand Replacement Method
6. Proctor Compaction
   - Standard Proctor Compaction
   - Modified Proctor Compaction
7. Soil Bearing Ratio/Pressure
   - California Bearing Ratio Test
   - North Dakota Cone Penetration Test
8. Shear Strength Parameters of Soil (different drainage conditions)
   - Direct Shear Test
   - Un-Confined Compression Test
   - Tri-axial Shear Test
   - Vane Shear Test
9. Seepage Analysis
   - Co-efficient of Permeability by Constant Head Method
   - Co-efficient of Permeability by Variable Head Method
10. Settlement Analysis
    - Consolidation Properties
11. Penetration Test
    - Standard Penetration Test
12. Chemical Analysis
    - Total Soluble Solids Content in Soils
    - Calcium Carbonate Content in Soils

Code	Subject	L	T	P	IM	EM	CR
14511201	Earth Retaining Structures	3	1	0	40	60	4

Unit - 1
Earth Pressure Theories: Introduction – State of stress in retained soil mass – Earth pressure theories – Analytical and graphical techniques – Active and passive cases – Earth pressure due to homogeneous and layered backfills, uniform surcharge ,uniformly sloping surcharge and randomly positioned surcharges, - Empirical methods – Wall movement and complex geometry

Unit – 2
Drainage and Stability Considerations: Lateral pressure due to compaction, strain softening, wall flexibility – influence of drainage – Earth pressure due to earthquake forces – Stability of retaining structures

Unit – 3
Sheet Pile Walls: Retaining structure – Selection of soil parameters – Analysis and design of cantilever and anchored sheet pile walls – Deadman and continuous anchors – Diaphragm and bored pile walls – Design requirements

Caissons: Types – Stability of caissons – principles of analysis and design – seismic influences - IRC Guidelines

Unit – 4
Supported Excavations: Lateral pressure on sheeting in braced excavation, stability against piping and bottom heaving - Earth pressure around tunnel lining, shaft and silos

Unit – 5
Design of Reinforced Earth Retaining Wall: Reinforced earth retaining wall – principles, Concepts and mechanism of reinforced Earth – Design consideration of reinforced earth – Materials used in reinforced earth - Geotextile – Geo-grids, Metal strips, facing elements.

Text Books:

1. Koerner, R.M., Design with Geosynthetics (Third Edition), Prentice Hall, 1997.
2. Das, B.M., Principles of Geotechnical Engineering (Fourth Edition). The PWS series in Civil Engineering, 1998
3. Mandal, J.N., Reinforced Soil and Geo-textiles, Oxford &IBH Publishing Co. Pvt. Ltd., New Delhi.
4. J E Bowles, Foundation Engineering→ to add this text book

Reference Books:

1. Winterkorn, H.F. and Fang, Y.F., Foundation Engineering Handbook, Van Nostrand Reinhold, 1994.
2. Day, R.W., Geotechnical and Foundation Engineering, Design and Construction, McGraw Hill 1999.
3. McCarthy, D.F., Essentials of Soil Mechanics and Foundations: Basic Geo-techniques (Sixth Edition), Prentice Hall, 2002.
4. Militisky, J. and Woods, R., Earth and Earth retaining structures, Routledge, 1992.
5. Clayton, C.R.I., Militisky, J. and Woods, R.I., Earth pressure and Earth-Retaining structures (Second Edition), Survey University Press, 1993.

Code	Subject	L	T	P	IM	EM	CR
14511202	Deep Foundations	3	1	0	40	60	4

Unit – 1
Pile Classifications: Function – classification of piles – Factors governing choice of pile foundation – Load transfer principles – piling equipments and methods – changes in soil condition during installation of piles – requirement of code of practice – responsibility of engineer and contractor.

Unit – 2
Axially Loaded Piles and Pile Groups: Allowable load evaluation of piles and pile groups – Static method – cohesive – cohesion less soil – time effects – Dynamic method – pile driving formulae –Wave equation application – modeling – theoretical analysis – Interpretation of field test results and pile load test results – Settlement of Piles and Pile groups.

Unit – 3
Lateral and Uplift Load Evaluation: Piles subjected to Lateral loads - laterally loaded piles in sands and cohesive soils– Broms method, elastic –p-y curve analyses – Batter piles – response to moment – pile subjected to uplift loads – load –deformation behavior – Lateral and uplift load test data interpretation. Foundation on week compressible – collapsible soil – case studies

Unit – 4
Structural Design of Pile and Pile Groups: Pile foundation – structural design – pile cap analysis, pile – raft system basic interactive analysis – pile and pile groups subjected to vibrations – fundamental solutions.

Unit – 5
Well Foundations: Types – Different shapes of wells – Components of wells – Depth of well foundation and bearing capacity – Forces acting on a well foundation – Terzaghi's analysis of well foundation – Heavy wells – Lateral stability of well foundation - Well curb, cutting edge, steining and bottom plug – Well sinking – IRC Method.

Text Books:

1. Tomlinson, M.J., Pile design and construction practice, Cement and concrete association, 1977.
2. Das, B.M., Principles of Foundation Engineering, Design and Construction, PWS., Publishing, 1999 (Fourth Edition)
3. Tomlinson, M.J. Foundation engineering, ELBS, Longman Group, U.K. Ltd., England 1995.
4. Bowles, J.E., Foundation Analysis and Design, McGraw Hill book Company, 1996.
5. IS: 2911

Reference Books:

1. Cernica, J.N. Geotechnical Engineering Foundation Design, John Wiley and Sons, Inc. 1995.
2. Poulos, H.G., Davis, E.H., Pile foundation analysis and design, John Wiley and Sons, New York, 1980.
3. Grigorian, Pile Foundation for Buildings and Structures in collapsible Soil, Oxford &IBH Publishing Co, Pvt. Ltd., New Delhi, 1999.
4. Donald, P., Cudoto, Foundation Design Principles and Practices, Prentice Hall, Inc. Englewood Cliffs, New Jersey, 1996.

Code	Subject	L	T	P	IM	EM	CR
14511203	Construction Practices in Expansive Soils	3	1	0	40	60	4

Unit – 1
Introduction: Purpose – Organization – General Considerations
Site Characterization: Organization of investigation – factors influencing swelling and shrinkage of soils – site exploration
Identification and classification of expansive soils: Identification tests – engineering classification – mineralogical methods – cation exchange capacity – free swell – potential volume change – expansion index test – California bearing ratio – coefficient of linear extensibility – classification schemes – soil classification methods – classification using engineering index properties

Unit – 2
Heave Prediction: Constitutive relationships for expansive soils – soil suction – measurement of soil suction – heave prediction based on oedometer tests – heave prediction based on soil suction tests – empirical procedures – discussion on heave prediction

Unit – 3
Design Alternatives: Structural foundation alternatives – drilled pier and beam foundations – stiffened slabs-on-grade – shallow footing foundations – moisture control methods for foundations – soil stabilization – general principles of pavement design – design factors and treatment methods for expansive pavement sub-grades – highway pavements – airfield procedures

Unit – 4
Treatment of expansive soils: General considerations and guidelines – site preparation – removal and replacement – remolding and compaction – surcharge loading – pre-wetting – chemical admixtures – lime – cement – salt treatment – fly ash – organic compounds – moisture control by horizontal and vertical barriers – electro chemical treatment – heat treatment

Unit – 5
Remedial measures: Remedial measures for buildings – investigation of structures and foundation soil – remedial procedure alternatives – mud jacking and injection – epoxy treatment of cracks – moisture stabilization – moistures barriers – remedial measures for pavements – remedial maintenance – moisture barriers – removal , replacement and compaction control – drainage

Text Books:

1. John D Nelson and Debora J Miller., “Expansive Soils – Problems and Practice in Foundation and Pavement Engineering”, John Wiley & Sons, INC.
2. RamachandraPhanikumar and Sana Suri., “Expansive Soils – Problems and Remedies”, LAP Lambert Academic Publishing.
3. D.R. Katti, AR Katti, Behavior of Saturated Expansive Soils and Control methods, Taylor and Francis
4. GopalRanjan and AS Rao, Basic and Applied Soil Mechanics, New Age International Publishers, New Delhi.

Reference Books:

1. Foundation in Expansive Soils, Technical Manual, US Army Corps of Engineers, Washington DC.
2. Marc Pansu and Jacques Gautheyrou., “Hand Book of Soil Analysis”, Springer Publishers.
3. D.R. Snethen., “A Review of Engineering Experiences with Expansive Soils in Highway Sub-grades”, Federal Highway Administration, Washington DC.
4. F.H.Chen, Foundations on Expansive Soils, Elsevier Scientific Publishing Company, New York.
5. Hand Book on under reamed and Bored Compaction Pile Foundations – CBRI, Roorkee. IS: 2720(Part XLI) – 1977 Measurement of Swelling Pressure of soils.

Code	Subject	L	T	P	IM	EM	CR
14511204	Soil Dynamics and Machine Foundations	3	1	0	40	60	4

Unit – 1
Fundamentals of Vibration: Definitions, Simple harmonic motion, Response of SDOF systems of Free and Forced vibrations with and without viscous damping, Frequency dependent excitation, Systems under transient loads, Rayleigh's method of fundamental frequency, Logarithmic decrement, Determination of viscous damping, Transmissibility, Systems with Two and Multiple degrees of freedom, Vibration measuring instruments - Types of damping - Equivalent stiffness of springs in series and parallel - Principles of vibration measuring devices

Unit – 2
Wave Propagation and Dynamic Soil Properties: Propagation of seismic waves in soil deposits - Attenuation of stress waves, Stress-strain behaviour of cyclically loaded soils, Strength of cyclically loaded soils, Dynamic soil properties - Laboratory and field testing techniques, Elastic constants of soils, Correlations for shear modulus and damping ratio in sand, gravels, clays and lightly cemented sand. Liquefaction of soils: An introduction and evaluation using simple methods.

Unit – 3
Vibration Analyses: Types, General Requirements, Permissible amplitude, Allowable soil pressure, Modes of vibration of a rigid foundation block, Methods of analysis, Lumped Mass models, elastic half space method, elasto-dynamics, effect of footing shape on vibratory response, dynamic response of embedded block foundation, Vibration isolation.

Unit – 4
Design of Machine Foundations: Analysis and design of block foundations for reciprocating engines, Dynamic analysis and design procedure for a hammer foundation, IS code of practice design procedure for foundations of reciprocating and impact type machines. Vibration isolation and absorption techniques.

Unit – 5
Machine Foundations on Piles: Introduction, Analysis of piles under vertical vibrations, Analysis of piles under translation and rocking, Analysis of piles under torsion, Design procedure for a pile supported machine foundation.

Text Books:

1. Swami Saran - Soil Dynamics and Machine Foundation, Galgotia Publications Pvt. Ltd. (2010)
2. Prakash, S. - Soil Dynamics, McGraw Hill Book Company (1981)

Reference Books:

1. I.Chowdhary and S P Dasgupta - Dynamics of Structures and Foundation, 2009.
2. Arya, S. D, O'Neil, M. and Pincus, G.- Design of Structures and Foundations for Vibrating Machines, Gulf Publishing Co., 1979.
3. Prakash, S. and Puri, V. K. - Foundation for Machines: Analysis and Design, John Wiley & Sons, 1998.
4. KameswaraRao, N. S. V. - Vibration Analysis and Foundation Dynamics, Wheeler Publication Ltd., 1998.
5. Richart, F. E. Hall J. R and Woods R. D. - Vibrations of Soils and Foundations, Prentice Hall Inc., 1970.
6. Das, B. M. - Principles of Soil Dynamics, PWS KENT publishing Company, Boston.2002
7. Bharat Bhushan Prasad – Advanced Soil Dynamics and Earthquake Engineering, PHI Learning Pvt. Limited, New Delhi, 2011.

Code	Subject (Elective)	L	T	P	IM	EM	CR
14511205	Finite Element Method	3	1	0	40	60	4

Unit – 1
Basic Concepts: Basic concepts - Discretization of continuum, typical elements, the element characteristic matrix, Element assembly and solution for unknowns - Applications.

Unit – 2
VariationalPrinciples :Variational principles, variational formulation of boundary value problems, Variational methods approximation such as Ritz and weighted residual (Galerkin) methods, Applications

Unit – 3
Displacements Based Elements: Displacements based elements, finite elements for axial symmetry. One-dimensional problems of stress, deformation and flow, Assembly, Convergence requirements, Finite elements analysis of two-dimensional problems. The linear and quadratic triangle, Natural coordinates.

Unit – 4
Iso-parametric Formulation: Application of FEM to Problems in soils and rocks, Introduction to non-linearity, Finite difference method, Description and application to consolidation, seepage, Winkler foundation etc.,

Unit – 5
Applications in Geotechnical Engineering
Application of FEM to Problems in soils, Introduction to non-linearity, Finite difference method, Description and application to consolidation, seepage, Winkler foundations

Text Books:

1. Reddy, J.N., An Introduction to the Finite Element Method, McGraw Hill, 1984.
2. Tirupathi R. Chandrupatla and Ashok D. Belegundu., Introduction to Finite Elements in Engineering, Prentice- Hall, 1991.
3. Rajasekaran, S., Finite Element Analysis in Engineering Design, Wheller Publishing, Allahabad, 1993.
4. Smith, I.M., Programming the Finite Element Method with Application to Geomechanics, John Wiley and sons, New Delhi, 2000.

Reference Books:

1. Cook, R.D., Malkus, D.S., and Plesha, M.E., Concepts and Applications of Finite Element Analysis, John Wiley, 1989.
2. Gupta, O.P. Finite and Boundary Element Methods in Engineering, Oxford &IBH Publishing Co., Pvt. Ltd., New Delhi, 2000.
3. Potts, D.M. and Zdramcovic, L., Finite Element analysis in Geotechnical Engineering - Application, Thomas Telford, 2001.
4. Shen, J. and Kushwaha. R.L., Soil-Machine Interaction - A finite element perspective Moral Dikker, Inc. 1998.

Code	Subject (Elective)	L	T	P	IM	EM	CR
14511206	Design with Geo-Synthetics	3	1	0	40	60	4

Unit – 1
Geosynthetics and Properties and Testing Methods: Introduction to Geosynthetics – Basic description – History – Manufacturing methods – Uses and Applications. Properties and Testing methods of Geotextiles – Geogrids – Geomembranes – Geocomposites.

Unit – 2
Geotextiles: Designing for Separation – Reinforcement – Stabilization – Filtration – Drainage and Moisture barriers.

Unit – 3
Geogrids: Designing for Reinforcement – Stabilization – Designing Gabions – Construction methods – Design of retaining walls.

Unit – 4
Geomembranes: Survivability Requirements – Pond Liners – Covers for Reservoirs – Canal Liners – Landfill Liners – Caps and closures – Dams and Embankments.

Unit – 5
Geocomposites: Geocomposites – An added advantage – Geocomposites in Separation – Reinforcement – Filtration – Geocomposites as Geowebs and Geocells – Sheet drains – Strip drains and Moisture barriers.

Text Books:

1. "Designing with Geosynthetics by Robert M. KoernerPrantice Hall, Eaglewood cliffs, NJ 07632.
2. "Engineering with Geosynthetics", by G. Venkatappa Rao and GVSSuryanarayana Raju – Tata McGraw Hill Publishing Company Limited – New Delhi.
3. "Foundation Analysis and Design" by J.E. Bowles McGraw Hill Publications.

Reference Books:

1. Jewell, R.A., Soil Reinforcement with Geotextile, CIRIA, London, 1996.
2. John, N.W.M., Geotextiles, John Blackie and Sons Ltd., London, 1987.
3. Jones, C.J.F.P., Earth Reinforcement and Soil Structures, Earthworks, London, 1982.
4. Koerner, R.M., Designing with Geosynthetics, (Third Edition), Prentice Hell, 1997.
5. Proc. Conference on polymer and Reinforcement, Thomas Telford Co., London, 1984.
6. "Construction and Geotechnical Engineering using Synthetic Fabrics" by Robert M. Koerner and Josoph P. Welsh. John Willey and Sons, New York.

Code	Subject (Elective)	L	T	P	IM	EM	CR
14511207	Pavement Design	3	1	0	40	60	4

Unit – 1
Introduction: Types and component parts of pavements, Factors affecting design and performance of pavements. Highway and airport pavements

Unit – 2
Stresses and strains in flexible pavements: Stresses and strains in an infinite elastic half space use of Boussinesq's equations - Burmister's two layer and three layer theories; Wheel load stresses, various factors in traffic wheel loads; Equivalent single wheel load of multiple wheels. Repeated loads and EWL factors

Unit – 3
Flexible pavement design methods for highways and airports: Empirical, semi-empirical and theoretical approaches; Development, principle, design steps of the different pavement design methods including AASHTO, Asphalt Institute, Shell Methods. IRC method of pavement design

Unit – 4
Stresses in rigid pavements: Types of stresses and causes; Introduction to Westergaard's equations for calculation of stresses in rigid pavement due to the influence of traffic and temperature; Considerations in rigid pavement analysis, EWL; wheel load stresses, warping stresses, frictional stresses, combined stresses.

Unit – 5
Rigid pavement design: Design of cement concrete pavement for highways and runways; Design of joints, reinforcements, tie bars, dowel bars. IRC method of design; Design of continuously reinforced concrete pavements

Text Books:

1. Yang H Huang - Pavement Analysis and Design, 2nd Edition, Pearson Education
2. KhannaS.K& Justo C.E.G – Highway Engineering, Khanna Publishers.
3. Srinivasa Kumar R – Pavement design, University press (India) Pvt. Ltd 2013

Reference Books:

1. Wright, P.H., Highway Engineers, John Wiley & Sons, Inc., New York, 1996
2. Croney, D., Design and Performance of Road Pavements, HMO Stationary Office, 1979.
3. Design and Specification of Rural Roads (Manual), Ministry of Rural Roads, Government of India, New Delhi, 2001
4. Yoder R.J And Witchakm.W., Principles of Pavement Design, John Wiley, 2000.
5. Guidelines for the Design of Flexible Pavements, IRC: 37 - 2001, the Indian Roads Congress, New Delhi.
6. Guideline for the Design of Rigid Pavements for Highways, IRC: 58-1998, the Indian Roads Congress, New Delhi.

Code	Subject (Elective)	L	T	P	IM	EM	CR
14511208	Remote Sensing and Applications	3	1	0	40	60	4

Unit – 1
Introduction: Electromagnetic spectrum, energy sources and Radiation principle, Energy interactions in the atmosphere, energy interactions with earth surface features – Vegetation, Soil and water.

Unit – 2
Data Acquisition: Platforms – sensors used for the remote sensing data acquisition. Data processing – Radiometric, Geometric corrections

Unit – 3
Digital Image Processing: Image enhancement – linear, non-linear spatial filtering; edge enhancement. Classification – supervised, unsupervised classification.

Unit – 4
Geographical Information System (GIS): Definition data input and output; Topology, Digital elevation data; Data management – relational data model. Spatial data models – Raster and Vector data Models. GIS analysis – Classification, overlay operation

Unit – 5
Land use/Land cover Analysis: Classification principles and systems; Applications of soil, water resources, environmental, earthquakes, landslides. Software scenario – watershed modelling, watershed management, environmental modelling

Text Books:

1. Remote Sensing and image interpretation by Lille sand T.M. and Kiefer R.W. John Wiley and Sons. New York.
2. Introduction to remote sensing by J.B. Campbell, Taylor & Francis, London.
3. Anji Reddy, M. – Remote Sensing and GIS – BS Publications, 2004

Reference Books:

1. F.F. Sabins Jr., - Remote Sensing Principles and Interpretations – W.H. Freeman & Co., 1987
2. Paul J. Gibson & Clare H. Power – Introductory Remote Sensing – British Library, London. 1st Published, 2000.
3. Stan Arnoff – Geographic Information Systems – A management perspective, Canada, 1995.
4. Introductory digital image processing by J.R. Jensen, Prentice Hall International Ltd., London.
5. Remote Sensing in Civil Engineering, by Kennie, T.J.M. and Matthews M.C. Surrey University Press, Glasgow.

Code	Subject (Elective)	L	T	P	IM	EM	CR
14511209	Geotechnical Earthquake Engineering	3	1	0	40	60	4

Unit – 1
Elements of Earthquake Seismology and Dynamics: Theory of vibration - Basic Definition - Governing equation for single degree freedom system - Forced vibrations - Rotating mass type excitation - Base excitation - Isolation vibration measuring instruments. Mechanism of Earthquakes - Causes of earthquake - Earthquake Fault sources - Elastic Rebound theory - Seismic wave in Earthquake shaking - Definition of earthquake terms - Locating an earthquake - Quantification of earthquakes.

Unit – 2
Ground Motion Characteristics: Strong Motion Records -characteristics of ground motion - Factors influencing ground motion - Estimation of frequency content parameters - (Seismic site investigations - Evaluation of Dynamic soil properties

Unit – 3
Ground Response Analysis - Local Site Effects and Design Ground Motion: Wave propagation Analysis - Site Amplification Need for Ground Response Analysis - Method of analysis - One Dimensional Analysis - Equipment linear Analysis site effects - Design Ground Motion - Developing Design Ground Motion

Unit – 4
Seismic Stability Analysis: Earthquake - Resistant Design of foundation of buildings - Design considerations - Geotechnical - Architectural - Structures - Capacity Design - Seismic analysis. Earthquake Response of slopes - Evaluation of slope stability - Pseudostatic Analysis - Newmark's Study of Block Analysis - Dynamic Analysis - Earth pressure due to ground shaking Evaluation, Liquefaction-Susceptibility-Evaluation Cyclic stress approach - Liquefaction Resistance - Laboratory and Field Tests with interpretation - Lateral Deformation - Case Study

Unit - 5
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 - Ground Improvement Techniques.

Text Books:

1. KameswaraRao, N.S.V., Dynamics soil tests and applications, Wheeler Publishing - New Delhi, 2000.
2. KrammerS.L., Geotechnical Earthquake Engineering, prentice hall, international series, Pearson Education (Singapore) Pvt. Ltd., 2004.
3. KameswaraRao, Vibration Analysis and Foundation Dynamics, wheeler Publishing, New Delhi, 1998.

Reference Books:

1. ShamsherPrakash and Vijay Kumar Puri., Foundations for Machines, John Wiley and Sons, New Delhi, 1988
2. “Earth Quake” W.H. Freeman, New York.

Code	Subject (Elective)	L	T	P	IM	EM	CR
14511210	Project Safety Management	3	1	0	40	60	4

Unit – 1
Construction Accidents: Accidents and their Causes – Human Factors in Construction Safety – Costs of Construction Injuries – Occupational and Safety Hazard Assessment – Legal Implications.

Unit – 2
Safety Programmes: Problem Areas in Construction Safety – Elements of an Effective Safety Programme – Job-Site Safety Assessment – Safety Meetings – Safety Incentives.

Unit – 3
Contractual Obligations: Safety in Construction Contracts – Substance Abuse – Safety Record Keeping.

Unit – 4
Designing for Safety: Safety Culture – Safe Workers – Safety and First Line Supervisors – Safety and Middle Managers – Top Management Practices, Company Activities and Safety – Safety Personnel – Sub contractual Obligation – Project Coordination and Safety Procedures – Workers Compensation

Unit – 5
Owners' and Designers' Outlook: Owner's responsibility for safely – Owner preparedness – Role of designer in ensuring safety – Safety clause in design document.

Text Books and Reference Books:

1. Jimmy W. Hinze, Construction Safety, Prentice Hall Inc., 1997.
2. Richard J. Coble, Jimmie Hinze and Theo C. Haupt, Construction Safety and Health Management, Prentice Hall Inc., 2001.

Code	Subject	L	T	P	IM	EM	CR
14511211	Computer Geo-Technical Applications Lab	0	0	3	50	50	2

The following problems may be solved using C/C++/Java or any other programming language. The solution may be verified using commercially available or open software

1. Evaluation of allowable bearing pressure for different conditions
2. Slope stability analysis by different methods
3. Seepage analysis thorough homogenous earth dams
4. Analysis and design of single pile and pile group
5. Analysis and Design of retaining walls

Code	Subject	L	T	P	IM	EM	CR
14512101	Seminar	-	-	-	100	-	2

Objective: To understand the concept and importance of independent learning and research

Task: Each student shall prepare and submit a technical report under the guidance of a faculty member. The topic of the report shall be relevant to geotechnical engineering and shall apply or extend the principles already learnt in classroom. The work may theoretical, and/or laboratory oriented.The seminar work must be executed by students individually

Monitoring and Evaluation:. The progress of work shall be monitored periodically throughtwo reviews by a Seminar Review Committee (SRC) consisting of two senior faculty members and the concerned guide of the student. The students shall submit a report before final presentation. The allocation of marks is: 60 marks for evaluation by concerned guide and 40 marks for evaluation by SRC. The guide will award

marks based on day-to-day work done by student. SRC will award marks based on seminar report and presentation. The evaluation must be completed by the end of the third semester. The reviewsare for guidance only and no marks are allocated. The topic of seminar shall not be same as project work

Code	Subject	L	T	P	IM	EM	CR
14512201	Project Work	-	-	-	50	50	16

Objectives:

- To understand the concepts of Research Methodology
- To identify problems related to the geotechnical engineering and related fields
- To appreciate the importance of inter-disciplinary research
- To understand the concept and importance of independent learning and research

Process

1. Students shall be allocated guides during the first week of third semester
2. Students shall pursue project work along with seminar work during third semester
3. During third semester students shall complete the tasks of problem identification and literature review. The project proposal shall be approved by Project Review Committee (PRC) consisting of HOD, two senior faculty members and the guide of concerned student
4. In fourth semester, students shall execute and complete the project work
5. At the completion of project, the students shall submit a project report

Monitoring and Evaluation

1. The progress of project work will be reviewed by PRC. Three reviews shall be conducted: one in third semester and two in fourth semester
2. Internal evaluation: Out of total 50 internal marks, 30 marks will be evaluated by guide and PRC will evaluate for 20 marks. Guide will award marks based on day-to-day work. PRC will award marks based on project report and presentation
3. End examination: End examination will be based on project report and viva voce by duly appointed examiners. Maximum marks for end examination is 50.