

ACADEMIC REGULATIONS (R25)

COURSE STRUCTURE

AND

DETAILED SYLLABUS

For

M.Tech Two Year Programme

(Soil Mechanics and Foundation Engineering)

(Applicable for the batches admitted from the A.Y. 2025-26)



DEPARTMENT OF CIVIL ENGINEERING

UNIVERSITY COLLEGE OF ENGINEERING KAKINADA (A)

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY KAKINADA

KAKINADA – 533003, ANDHRA PRADESH, INDIA



R-25 Syllabus for M. Tech (SM&FE) UCEK w .e. f 2025-26

DEPARTMENT OF CIVIL ENGINEERING
UNIVERSITY COLLEGE OF ENGINEERING KAKINADA (A)
JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY KAKINADA
ACCREDITED BY NAAC A⁺

II – Semester

S.No.	Category	Course Name	L	T	P	C
1	Program Core 4	Advanced Foundation Engineering	3	1	0	4
2	Program Core 5	Earth Retaining Structures	3	1	0	4
3	Program Core 6	Soil Dynamics & Machine Foundations	3	1	0	4
4	Program Elective - 3	a) Pavement Analysis Design & Evaluation	3	0	0	3
5	Program Elective - 4	b) Construction Planning & Methods	3	0	0	3
		c) Geotechnical Earthquake Engineering				
		d) Geotechnics of Underground Structures				
		e) Earth Dams				
		f) Geo Environmental Engineering				
		g) Numerical Methods in Geotechnical Engineering				
		h) Reliability Analysis and Design				
6	Laboratory 3	Advanced Geotechnical Engineering Laboratory	0	1	2	2
7	Laboratory 4	Software Design Laboratory	0	1	2	2
8		Seminar II	0	0	2	1
	Total		15	5	6	23

1	Dr. K. Padma Kumari	<i>Padma Kumari</i>	6	Dr. A. Dali Naidu	
2	Dr. G. V.R. Prasada Raju	<i>Wal</i>	7	Dr. P.V.V. Satyanarayana	
3	Dr. K. Ramu	<i>K. Ramu</i>	8	Dr. L. S. Subrahmanyam	
4	Dr. D. Koteswara Rao	<i>K. Rao</i>	9	Dr. B.R. Phani Kumar	
5	Dr. S. Sireesh				



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R25 M. Tech (Soil Mechanics and Foundation Engineering) Course Structure

I – Semester

S. No	Category	Course Name	L	T	P	C
1	Program Core1	Advanced Soil Mechanics	3	1	0	4
2	Program Core2	Foundation Engineering	3	1	0	4
3	Program Core3	Ground Improvement Techniques	3	1	0	4
4	Program Elective I	a) Construction in Expansive Soils	3	0	0	3
5	Program Elective II	b) Soil-Foundation Interaction	3	0	0	3
		c) Critical State Soil Mechanics				
		d) Forensic Geotechnical Engineering				
		e) Design with Geo-synthetics				
		f) Rock Mechanics				
		g) Remote Sensing And GIS				
		h) Marine Geotechnical Engineering				
6	Laboratory 1	Geotechnical Engineering Laboratory-1	0	1	2	2
7	Laboratory 2	Geotechnical Engineering Laboratory - 2	0	1	2	2
8		Seminar-I	0	0	2	1
	Total		15	5	6	23

1	Dr. K. Padma Kumari	<i>Padma Kumari</i>	6	Dr. A. Dali Naidu	
2	Dr. G. V.R. Prasada Raju	<i>WV</i>	7	Dr. P.V.V. Satyanarayana	
3	Dr. K. Ramu	<i>K. Ramu</i>	8	Dr. L. S. Subrahmanyam	
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I Year - I Semester	Program Core 1	L	T	P	C
		3	1	0	4
Advanced Soil Mechanics					

Pre-Requisites: None

Course Outcomes: At the end of the course, the student will be able to

CO1	Acquire complete knowledge on stress components and distribution.
CO2	Acquire the complete knowledge on strain and stress strain relationships.
CO3	Tackle problems on seepage through soils
CO4	Understand consolidation phenomenon and apply it to various Geotechnical Engineering problems
CO5	Understand shear strength behavior of soils and its applications in Geotechnical Engineering

Mapping of Course Outcomes with Outcomes:

Course Out Comes	PO1	PO2	PO3	PO4	PO5
CO1	3	1	1	2	2
CO2	3	--	2	2	2
CO3	3	3	2	2	2
CO4	3	2	2	1	1
CO5	3	1	1	2	2



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III Semester

S.No.	Course No	Category	Course Name	PO's	L	T	P	C
1	MSEIII-1	RM-IPR	Research Methodology and IPR/Swayam 12 weeks Course --		3	0	0	3
2			Summer Internship / Industrial Training (8-10 weeks) *		0	0	0	3
3			Comprehensive Viva **		0	0	0	2
4			Dissertation Part-A***		0	0	20	10
			Total Credits / Marks		3	0	20	18

* Student to attend during Summer / Year Break and assessment will be done in 3rd Semester

** Comprehensive Viva can be conducted on courses conducted up to second semester

*** Internal Assessment

IV Semester

SL No.	Course No.	Category	Course Name	Po's	L	T	P	C
1	Dissertation	Core	Project / Dissertation Phase B (Continued from III Semester) ***		0	0	32	16
			Total Credits / Marks				32	16

1	Dr. K. Padma Kumari	<i>[Signature]</i>	6	Dr. A. Dali Naidu	
2	Dr. G. V.R. Prasada Raju	<i>[Signature]</i>	7	Dr. P.V.V. Satyanarayana	
3	Dr. K. Ramu	<i>[Signature]</i>	8	Dr. L. S. Subrahmanyam	
4	Dr. D. Koteswara Rao	<i>[Signature]</i>	9	Dr. B.R. Phani Kumar	
5	Dr. S. Sireesh				

UNIVERSITY COLLEGE OF ENGINEERING KAKINADA (A)
JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY KAKINADA

(Established by Andhra Pradesh Act No.30 of 2008)

Kakinada – 533 003, Andhra Pradesh (India)

ACADEMIC REGULATIONS R25 FOR M. Tech (REGULAR) PG DEGREE COURSE

Applicable for the students admitted to M. Tech (Regular) Course from the Academic Year 2025-26 and onwards. The M. Tech Degree of Jawaharlal Nehru Technological University Kakinada shall be conferred on candidates who are admitted to the program and who fulfil all the requirements for the award of the Degree.

1.0 ELIGIBILITY FOR ADMISSIONS

Admission to the above program shall be made subject to eligibility, qualification and specialization as prescribed by the University/affiliating bodies from time to time.

Admissions shall be made on the basis of merit/rank obtained by the candidates at the qualifying Entrance Test conducted by the State Govt./University or on the basis of any other order of merit as approved by the State Govt./University, subject to reservations as laid down by the Govt. from time to time.

2.0 AWARD OF M. Tech DEGREE

2.1 A student shall be declared eligible for the award of the M. Tech Degree, if he pursues a course of study in not less than two and not more than four academic years. Under any circumstances, permission shall not be given to complete the course work beyond four years. University is at discretion to accord permission to register for the backlog subjects beyond maximum duration.

2.2 The student shall register for all 80 credits and secure all the 80 credits.

2.3 The minimum instruction days in each semester are 90.

3.0 PROGRAMMES OF STUDY

The following specializations are offered at present for the M. Tech Programme of study.

S.No.	Department	Programme
1	Civil Engineering	1. M.Tech- Structural Engineering 2. M. Tech- Soil Mechanics and Foundation Engineering 3. M.Tech-Water Resource Engineering
2	Electrical and Electronics Engineering	1. M.Tech- High Voltage Engineering 2. M.Tech- Advanced Electrical Power System 3. M.Tech- Power Electronics and Drives
3	Mechanical Engineering	1. M.Tech- CAD/CAM 2. M.Tech- Machine Design

		3. M.Tech- Mechanical Engineering (Thermal Engineering)
4	Electronics and Communication Engineering	1. M.Tech- Computer and Communication 2. M.Tech- VLSI and Embedded Systems 3. M.Tech- Communication Engineering and Signal Processing
5	Computer Science and Engineering	1. M.Tech- Computer Science and Engineering 2. M.Tech- Computer Science and Engineering (Artificial Intelligence and Machine Learning) 3. M.Tech- Cyber Security
6	Food Engineering	1. M.Tech- Food Processing and Technology

4.0 ATTENDANCE

- 4.1 Attendance is calculated separately for each course. Attendance in all classes (Lectures/Laboratories) is compulsory. The minimum required attendance in each course is 75%. A student shall not be permitted to appear for the Semester End Examinations (SEE), if his/her attendance is less than 75%.
- 4.2 Condoning of shortage of attendance (between 65% and 75%) up to a maximum of 10% (*considering the days of attendance in sports, games, NSS activities and medical exigencies*) in each course (Theory/Lab/Seminar) is condoned on production of valid Certificates/documents in the stipulated time mentioned here with:
- 4.2.1 Students who are admitted as in patients for treatment are only eligible to claim condonation of attendance. Such students under medical exigencies need to Produce (a) Doctor Medical Prescription, (ii) Medical bills duly signed by Doctor/Hospital authorities, (c) Diagnosis reports, if any, (d) Discharge summary issued at the time of discharge and any other supporting documents within one/two week(s) from the date of discharge to the respective institution.
- 4.2.2 Students participation in Sports/Games and NSS activities shall also be permitted for condonation of attendance. In such cases, they need to produce (a) invitation letter from the organising institute/agency, (ii) participation certificate and any supporting documents within one/two week(s) from the date of participation to the respective institution
- 4.3 A prescribed fee per course shall be payable for condoning shortage of attendance after getting the approval of College Academic Committee for the same. The College Academic Committee shall maintain all the relevant documents along with the request from the students, whose attendance is condoned.
- 4.4 Shortage of Attendance below 65% in any course shall in no case be condoned.**
- 4.5 A Student, whose shortage of attendance is not condoned in any course(s) (Theory/Lab/Mini Project with Seminar) in any Semester, is considered as '**Detained in that course(s)**', and is not eligible to write Semester End Examination(s) of such Course(s), (in case of Mini Project with Seminar, his/her Mini Project with Seminar Report or Presentation are not eligible for evaluation) in that Semester; and he/she has to seek re-registration for those course(s) in subsequent Semesters, and attend the same as and when offered.

4.6 A student shall put in a minimum required attendance in at least FOUR courses in I semester for promotion to II Semester; and at least FOUR courses in II semester for promotion to III Semester.

Re-admission / Re-registration

4.7 A student shall not be permitted to appear for the Semester End Examination (SEE) in a course unless they meet the prescribed attendance requirements for that course. Such students may take readmission for the course in the subsequent semester when it is offered by paying the prescribed fee, *at least 30 days before the commencement of classwork*. The college must obtain permission from the University by submitting the list of students eligible/applied for readmission before the commencement of classwork

4.8 Students who fail due to **less internal marks (less than 50%)** may be extended re-registration and may be permitted during maximum permissible course duration.

4.9 In such a case, the candidate must re-register for the course(s) and secure the required minimum attendance. The candidate's attendance in the re-registered course(s) shall be calculated separately to decide upon eligibility for writing the end examination in those course(s).

4.10 In a semester, students are permitted to re-register maximum of FOUR courses.

4.11 Upon re-registration, the student's previous performance in the respective course(s) will be nullified. Re-registration must be completed by paying the prescribed fee (Rs.XXX/-) at least 30 days prior to the commencement of classwork. The college is required to obtain approval from the University by submitting a list of eligible and interested students before the start of commencement of classwork.

5.0 EVALUATION

The performance of the candidate in each semester shall be evaluated course-wise, with a maximum of 100 marks for theory and 100 marks for practical, on the basis of Internal Evaluation and End Semester Examination.

5.1 For the theory courses 60 marks shall be awarded based on the performance in the End Semester Examination and 40 marks shall be awarded based on the Internal Evaluation. The continuous / internal evaluation shall be made based on the **average** of the marks secured in the two CIE/Mid Term-Examinations conducted-one in the middle of the Semester and the other immediately after the completion of instruction. Each CIE/midterm examination shall be conducted for a total duration of 120 minutes with 4 questions (without choice) each question for 10 marks. End semester examination is conducted for 60 marks for all FIVE (5) questions (one question from one unit) to be answered (either or).

5.2 For practical courses, 60 marks shall be awarded based on the performance in the End Semester Examinations and 40 marks shall be awarded based on the day-to-day performance as Internal Marks. The internal evaluation based on the day to day work-10 marks, record- 10 marks and the remaining 20 marks to be awarded by

conducting an internal laboratory test. The end examination shall be conducted by the examiners, with breakup marks of Procedure-15, Experimentation- 25, Results-10, Viva-voce-10.

5.3 For Seminar, a student under the supervision of a faculty member, shall collect the literature on a topic and critically review the literature and submit it to the department in a report form and shall make an oral presentation before the Project Review Committee consisting of Head of the Department, supervisor/mentor and two other senior faculty members of the department. For Seminar, there will be only internal evaluation of 100 marks. A candidate has to secure a minimum of 50% of marks to be declared successful. Out of 100 marks, supervisor awards 60% marks and remaining 40% marks are awarded by the project review committee.

5.4 A candidate shall be deemed to have secured the minimum academic requirement in a course if he secures a minimum of 40% of marks in the End semester Examination and a minimum aggregate of 50% of the total marks in the End Semester Examination and Internal Evaluation taken together.

5.7 Laboratory examination for M. Tech. courses must be conducted with two Examiners, one of them being the Laboratory Class Teacher or teacher of the respective college and the ~~second examiner shall be appointed by the University from the panel of examiners submitted by the respective college.~~ second examiner shall be appointed by the Principal from the panel of examiners submitted by the respective HoD.

5.8 Students shall undergo mandatory summer internship / industrial training (2 credits) for a minimum of **eight weeks duration** at the end of second semester of the Programme/Summer Break. A student will be required to submit a summer internship/industrial training report to the concerned department and appear for an oral presentation before the committee. The Committee comprises of a HoD / Professor of the department and two faculty. The report and the oral presentation shall carry 40% and 60% weightages respectively. For summer internship / industrial training, there will be only internal evaluation of 100 marks. A candidate has to secure a minimum of 50% of marks to be declared successful.

5.9 The objective of comprehensive viva-voce is to assess the overall knowledge of the student in the relevant field of Engineering/Specialization in the PG program. Viva will be conducted in 3rd semester. The examination committee will be constituted by the HoD and consist of Professor of the department and two faculty. For comprehensive viva-voce, there will be only internal evaluation of 100 marks. A candidate has to secure a minimum of 50% of marks to be declared successful.

6.0 EVALUATION OF SEMINAR/INTERNSHIP/DISSERTATION WORK

All the students admitted under these regulations have to mandatorily comply the requirements of (i) Seminar-I. (ii) Seminar-II. (iii) Comprehensive Viva. (iv) Dissertation Part-A and (v) Dissertation Part-B. Out of these, (i) to (iv) are evaluated by internally by Project Review Committee (PRC) and (v) External Evaluation.

- 6.1 A Project Review Committee (PRC) shall be constituted with Head of the Department and Two other senior faculty members in the department.
- 6.2 Students are required to appear for Seminar-I and Seminar-II in First and Second respectively. They shall present before PRC on the topic of their choice/interest preferably on the courses listed in respective semesters. PRC shall advise the students in advance to select topics which strengthen their Dissertation Part-A and Dissertation Part-B.
- 6.3 Students shall undergo mandatory summer internship / industrial training (2 credits) for a minimum of eight weeks duration at the end of second semester of the Programme/Summer Break. A student will be required to submit a summer internship/industrial training report to the concerned department and appear for an oral presentation before PRC. The report and the oral presentation shall carry 40% and 60% weightages respectively. For summer internship / industrial training, there will be only internal evaluation of 100 marks. A candidate has to secure a minimum of 50% of marks to be declared successful.
- 6.4 The objective of comprehensive viva-voce is to assess the overall knowledge of the student in the relevant field of Engineering/Specialization in the PG program. Viva will be conducted in 3rd semester. For comprehensive viva-voce, there will be only internal evaluation of 100 marks. A candidate has to secure a minimum of 50% of marks to be declared successful.
- 6.5 Registration of Dissertation/Project Work: A candidate is permitted to register for the project work after satisfying the attendance requirement of all the courses, both theory and practical and duly approved by PRC.
- 6.6 After satisfying 6.5, student has to submit, in consultation with his project supervisor, the title, objective and plan of action of his project work for approval
- 6.7 If a candidate wishes to change his/her supervisor or topic of the project, he/she can do so with the approval of PRC. However, the PRC shall examine whether or not the change of topic/supervisor leads to a major change of his initial plans of project proposal. If yes, his date of registration for the project work starts from the date of change of Supervisor or topic as the case may be.
- 6.8 Continuous assessment of Dissertation-Part A and Dissertation-Part B during the Semester(s) will be monitored by PRC. *Dissertation-Part A* will be only internal evaluation by PRC for 100 marks. A candidate has to secure a minimum of 50% of marks to be declared successful.
- 6.9 The candidate shall submit a status report to the PRC in two stages, each accompanied by an oral presentation, with a minimum interval of three months between the two.
- 6.10 The work on the project shall be initiated at the beginning of the III Sem and the duration of the project is two semesters. A candidate is permitted to submit Project Thesis (*Dissertation – Part A & Part B*) only with the approval of PRC not earlier than 40 weeks from the date of registration of the project work. The candidate may be allowed to submit the project report if the project work is published or accepted in a reputable national or international journal or conference.

- 6.11 Three copies of the Project Thesis certified by the supervisor shall be submitted to the College/School/Institute along with plagiarism report (<40%).
- 6.10 The thesis shall be adjudicated by one examiner selected by the University. For this, the Principal of the College shall submit a panel of 5 examiners, eminent in that field, with the help of the guide concerned and head of the department.
- 6.11 If the report of the examiner is not favourable, the candidate shall revise and resubmit the Thesis, in the time frame as decided by the PRC. If the report of the examiner is not favourable again, the thesis shall be summarily rejected. The candidate has to reregister for the project and complete the project within the stipulated time after taking the approval from the University.
- 6.12 If the report of the examiner is favourable, Viva-Voce examination shall be conducted by a board consisting of the Supervisor, Head of the Department and the examiner who adjudicated the Thesis. The Head of the Department shall coordinate and make arrangements for the conduct of Viva-Voce examination. The Board shall jointly report the candidate's work for a maximum of 100 marks. Corresponding grade will be awarded by the University board.
- 6.13 If the report of the Viva-Voce is unsatisfactory (i.e., < 50 marks), the candidate shall retake the Viva-Voce examination only after three months. If he fails to get a satisfactory report at the second Viva-Voce examination, the candidate has to re-register for the project and complete the project within the stipulated time after taking the approval from the University.

7.0 Cumulative Grade Point Average (CGPA)

Marks Range Theory/ Laboratory (Max – 100)	Marks Range Mini Project/ Project Work for Dissertation (Max – 100)	Letter Grade	Level	Grade Point
≥ 90	≥ 90	S	Outstanding	10
≥80 to <90	≥80 to <90	A	Excellent	9
≥70 to <80	≥70 to <80	B	Very Good	8
≥60 to <70	≥60 to <70	C	Good	7
≥50 to <60	≥50 to <60	D	Fair	6
<50	<50	F	Fail	3
			Absent	0

Computation of SGPA

- The following procedure is to be adopted to compute the Semester Grade Point Average(SGPA) and Cumulative Grade Point Average(CGPA):
- The **SGPA** is the ratio of sum of the product of the number of credits with the grade points scored by a student in all the courses taken by a student and the sum of the number of credits of all the courses undergone by a student, i.e

$$SGPA (S_i) = \sum (C_i \times G_i) / \sum C_i$$

- Where C_i is the number of credits of the i th course and G_i is the grade point scored by the student in the i th course.

Computation of CGPA

- The **CGPA** is also calculated in the same manner taking into account all the courses undergone by a student over all the semester of a Programme, i.e.

$$CGPA = \sum (C_i \times S_i) / \sum C_i$$

- Where S_i is the SGPA of the i^{th} semester and C_i is the total number of credits in that semester.
- The SGPA and CGPA shall be rounded off to 2 decimal points and reported in the transcripts.
- Equivalent Percentage = $(CGPA - 0.5) \times 10$

8.0 AWARD OF DEGREE AND CLASS

After a student has satisfied the requirements prescribed for the completion of the program and is eligible for the award of M. Tech. Degree he shall be placed in one of the following four classes:

Class Awarded	CGPA to be secured	
First Division with Distinction	≥ 7.5 (without supplementary History)	From the CGPA secured from 80 credits
First Class	≥ 6.5	
Second Class	≥ 6.0 to < 6.5	

The secured grade, grade points, status and credits obtained will be shown separately in the memorandum of marks.

If a student wants to leave the program / exit after successful completion of first two semesters, he/she will be awarded Post Graduate Diploma in the specialization concerned.

9.0 WITHHOLDING OF RESULTS

If the student is involved in indiscipline/malpractices/court cases, the result of the student will be withheld.

10.0 GENERAL

10.1 Wherever the words “he”, “him”, “his”, occur in the regulations, they include “she”, “her”, “hers”.

10.2 The academic regulation should be read as a whole for the purpose of any interpretation.

10.3 In the case of any doubt or ambiguity in the interpretation of the above rules, the decision of the Vice-Chancellor is final.

10.4 The University may change or amend the academic regulations or syllabi at any time and the changes or amendments made shall be applicable to all the students with effect from the dates notified by the University.

MALPRACTICES RULES (FOLLOWING WILL BE UPDATED)

DISCIPLINARY ACTION FOR / IMPROPER CONDUCT IN EXAMINATIONS

	Nature of Malpractices/Improper conduct	Punishment
	<i>If the candidate:</i>	
1. (a)	Possesses or keeps accessible in examination hall, any paper, note book, programmable calculators, Cell phones, pager, palm computers or any other form of material concerned with or related to the subject of the examination (theory or practical) in which he is appearing but has not made use of (material shall include any marks on the body of the candidate which can be used as an aid in the subject of the examination)	Expulsion from the examination hall and cancellation of the performance in that subject only.
(b)	Gives assistance or guidance or receives it from any other candidate orally or by any other body language methods or communicates through cell phones with any candidate or persons in or outside the exam hall in respect of any matter.	Expulsion from the examination hall and cancellation of the performance in that subject only of all the candidates involved. In case of an outsider, he will be handed over to the police and a case is registered against him.
2.	Has copied in the examination hall from any paper, book, programmable calculators, palm computers or any other form of material relevant to the subject of the examination (theory or practical) in which the candidate is appearing.	Expulsion from the examination hall and cancellation of the performance in that subject and all other subjects the candidate has already appeared including practical examinations and project work and shall not be permitted to appear for the remaining examinations of the subjects of that Semester/year. The Hall Ticket of the candidate is to be cancelled and sent to the University.

3.	Impersonates any other candidate in connection with the examination.	The candidate who has impersonated shall be expelled from examination hall. The candidate is also debarred and forfeits the seat. The performance of the original candidate who has been impersonated, shall be cancelled in all the subjects of the examination (including practicals and project work) already appeared and shall not be allowed to appear for examinations of the remaining subjects of that semester/year. The candidate is also debarred for two consecutive semesters from class work and all University examinations. The continuation of the course by the candidate is subject to the academic regulations in connection with forfeiture of seat. If the imposter is an outsider, he will be handed over to the police and a case is registered against him.
4.	Smuggles in the Answer book or additional sheet or takes out or arranges to send out the question paper during the examination or answer book or additional sheet, during or after the examination.	Expulsion from the examination hall and cancellation of performance in that subject and all the other subjects the candidate has already appeared including practical examinations and project work and shall not be permitted for the remaining examinations of the subjects of that semester/year. The candidate is also debarred for two consecutive semesters from class work and all University examinations. The continuation of the course by the candidate is subject to the academic regulations in connection with forfeiture of seat.
5.	Uses objectionable, abusive or offensive language in the answer paper or in letters to the examiners or writes to the examiner requesting him to award pass marks.	Cancellation of the performance in that subject.

6.	<p>Refuses to obey the orders of the Chief Superintendent/Assistant – Superintendent / any officer on duty or misbehaves or creates disturbance of any kind in and around the examination hall or organizes a walk out or instigates others to walk out, or threatens the officer-in charge or any person on duty in or outside the examination hall of any injury to his person or to any of his relations whether by words, either spoken or written or by signs or by visible representation, assaults the officer in-charge, or any person on duty in or outside the examination hall or any of his relations, or indulges in any other act of misconduct or mischief which result in damage to or destruction of property in the examination hall or any part of the College campus or engages in any other act which in the opinion of the officer on duty amounts to use of unfair means or misconduct or has the tendency to disrupt the orderly conduct of the examination.</p>	<p>In case of students of the college, they shall be expelled from examination halls and cancellation of their performance in that subject and all other subjects the candidate(s) has (have) already appeared and shall not be permitted to appear for the remaining examinations of the subjects of that semester/year. The candidates also are debarred and forfeit their seats. In case of outsiders, they will be handed over to the police and a police case is registered against them.</p>
7.	<p>Leaves the exam hall taking away answer script or intentionally tears of the script or any part thereof inside or outside the examination hall.</p>	<p>Expulsion from the examination hall and cancellation of performance in that subject and all the other subjects the candidate has already appeared including practical examinations and project work and shall not be permitted for the remaining examinations of the subjects of that semester/year. The candidate is also debarred for two consecutive semesters from class work and all University examinations. The continuation of the course by the candidate is subject to the academic regulations in connection with forfeiture of seat</p>

8.	Possess any lethal weapon or firearm in the examination hall.	Expulsion from the examination hall and cancellation of the performance in that subject and all other subjects the candidate has already appeared including practical examinations and project work and shall not be permitted for the remaining examinations of the subjects of that semester/year. The candidate is also debarred and forfeits the seat.
9.	If student of the college, who is not a candidate for the particular examination or any person not connected with the college indulges in any malpractice or improper conduct mentioned in clause 6 to 8.	<p>Student of the colleges expulsion from the examination hall and cancellation of the performance in that subject and all other subjects the candidate has already appeared including practical examinations and project work and shall not be permitted for the remaining examinations of the subjects of that semester/year. The candidate is also debarred and forfeits the seat.</p> <p>Person(s) who do not belong to the College will be handed over to police and, a police case will be registered against them.</p>
10.	Comes in a drunken condition to the examination hall.	Expulsion from the examination hall and cancellation of the performance in that subject and all other subjects the candidate has already appeared including practical examinations and project work and shall not be permitted for the remaining examinations of the subjects of that semester/year.
11.	Copying detected on the basis of internal evidence, such as, during valuation or during special scrutiny.	Cancellation of the performance in that subject and all other subjects the candidate has appeared including practical examinations and project work of that semester/year examinations.
12.	If any malpractice is detected which is not covered in the above clauses 1 to 11 shall be reported to the University for further action to award suitable punishment.	

Malpractices identified by squad or special invigilators:

1. Punishments to the candidates as per the above guidelines.
2. Punishment for institutions: (if the squad reports that the college is also involved in encouraging malpractices)
 - (i) A show cause notice shall be issued to the college.
 - (ii) Impose a suitable fine on the college.
 - (iii) Shifting the examination centre from the college to another college for a specific period of not less than one year.

Programme Structure
R25 MTech (XXXX) Structure

MTech (XXXX) I – Semester

S. No.	Course Code	Course Title	L	T	P	C
1		Program Core – 1	3	1	0	4
2		Program Core – 2	3	1	0	4
3		Program Core – 3	3	1	0	4
4		Program Elective – I	3	0	0	3
5		Program Elective – II	3	0	0	3
6		Laboratory – 1	0	1	2	2
7		Laboratory – 2	0	1	2	2
8		Seminar-I	0	0	2	1
		TOTAL	15	5	6	23

List of Professional Elective Courses in I Semester (Electives – I & II)

S.No.	Course Code	Course Title
1		
2		
3		
4		
5		
6		
7		
8		

@ Minimum 2/3 themes per elective

MTech (XXXX) II – Semester

Sl. No.	Course Code	Course Title	L	T	P	C
1		Program Core – 4	3	1	0	4
2		Program Core – 5	3	1	0	4
3		Program Core – 6	3	1	0	4
4		Program Elective – III	3	0	0	3
5		Program Elective - IV	3	0	0	3
6		Laboratory – 3	0	1	2	2
7		Laboratory – 4	0	1	2	2
8		Seminar – II	0	0	2	1
		TOTAL	15	5	6	23

List of Professional Elective Courses in II Semester (Electives III & IV)

S.No.	Course Code	Course Title
1		
2		
3		
4		
5		
6		
7		
8		

@ Minimum 2/3 themes per elective

MTech (XXXX) - III Semester

Sl. No.	Course Code	Course Title	L	T	P	C
1		Research Methodology and IPR / <i>Swayam 12 week MOOC course – RM&IPR</i>	3	0	0	3
2		Summer Internship/ Industrial Training (8-10 weeks)*	-	-	-	3
3		Comprehensive Viva [#]	-	-	-	2
4		Dissertation Part – A ^{\$}	-	-	20	10
		TOTAL	3	-	20	18

* Student attended during summer / year break and assessment will be done in 3rd Sem.

Comprehensive viva can be conducted courses completed upto second sem.

\$ Dissertation – Part A, internal assessment

MTech. (XXXX) – IV Semester

Sl. No.	Course Code	Course Title	L	T	P	C
1		Dissertation Part – B [%]	-	-	32	16
		TOTAL	-	-	32	16

% External Assessment

Revised Bloom's Taxonomy Action Verbs

Definitions	I. Remembering	II. Understanding	III. Applying	IV. Analyzing	V. Evaluating	VI. Creating
Bloom's Definition	Exhibit memory of previously learned material by recalling facts, terms, basic concepts, and answers.	Demonstrate understanding of facts and ideas by organizing, comparing, translating, interpreting, giving descriptions, and stating main ideas.	Solve problems to new situations by applying acquired knowledge, facts, techniques and rules in a different way.	Examine and break information into parts by identifying motives or causes. Make inferences and find evidence to support generalizations.	Present and defend opinions by making judgments about information, validity of ideas, or quality of work based on a set of criteria.	Compile information together in a different way by combining elements in a new pattern or proposing alternative solutions.
Verbs	<ul style="list-style-type: none"> Choose Define Find How Label List Match Name Omit Recall Relate Select Show Spell Tell What When Where Which Who Why 	<ul style="list-style-type: none"> Classify Compare Contrast Demonstrate Explain Extend Illustrate Infer Interpret Outline Relate Rephrase Show Summarize Translate 	<ul style="list-style-type: none"> Apply Build Choose Construct Develop Experiment with Identify Interview Make use of Model Organize Plan Select Solve Utilize 	<ul style="list-style-type: none"> Analyze Assume Categorize Classify Compare Conclusion Contrast Discover Dissect Distinguish Divide Examine Function Inference Inspect List Motive Relationships Simplify Survey Take part in Test for Theme 	<ul style="list-style-type: none"> Agree Appraise Assess Award Choose Compare Conclude Criteria Criticize Decide Deduct Defend Determine Disprove Estimate Evaluate Explain Importance Influence Interpret Judge Justify Mark Measure Opinion Perceive Prioritize Prove Rate Recommend Rule on Select Support Value 	<ul style="list-style-type: none"> Adapt Build Change Choose Combine Compile Compose Construct Create Delete Design Develop Discuss Elaborate Estimate Formulate Happen Imagine Improve Invent Make up Maximize Minimize Modify Original Originate Plan Predict Propose Solution Solve Suppose Test Theory



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Detailed Syllabus:

Unit	Contents	Contact Hours
Unit: 1	Analysis of Stress: Concept of Stress – Body force, Surface force and stress vector – The state of stress at a point – Normal and shear stress components – Rectangular stress components - Stress components on an arbitrary plane – Digression on Ideal fluid – Equality of Cross shears - Cauchy's formula – Equations of Equilibrium – Transformation of coordinates – Plane state of stress. Principal Stresses – Stress Invariants – Particular cases – Mohr's circle for the Three-dimensional state of stress – Mohr's stress plane – Plane of maximum shear – Octahedral stresses – Pure shear decomposition into Hydrostatic and pure shear states.	
Unit: 2	Analysis of Strain – Deformation – Deformation in the Neighborhood point – Change in length of a linear element – Change in length of a linear element – Linear component – Rectangular strain components – The state of strain at a point – Shear strain components – Change in direction of a linear element - Cubical Dilation – Change in the angle between Two line elements – Principal Axes of strain and principal strains – Plane state of strain – Compatibility condition – Strain deviator and its Invariants, Stress – Strain relations – Stress – Strain relations for isotropic materials – Modules of Rigidity – Bulk modules.	



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Unit: 3	Permeability and Seepage: Darcy's law – Validity of Darcy's Law, Coefficient of Permeability in the Field - Equation of Continuity – Use of Continuity Equation for Solution of Simple flow problems – Flow nets – hydraulic uplift force under structure – Flow nets in anisotropic material – Construction of flow nets for hydraulic structures on non-homogeneous sub soils – Directional variation of permeability in anisotropic medium – Seepage through earth dams – Entrance, discharge and transfer condition of line of seepage through earth dams. Flow net construction for earth dams – filter design.	
Unit: 4	Consolidation: Mechanism of consolidation – Primary consolidation – Stress history Pre-consolidation pressure – Terzaghi's one-dimensional consolidation theory and equation – Solution by Fourier series and finite difference methods – Determination of coefficient of consolidation – U versus T relationship for different forms of initial excess pore water pressure distribution – Degree of consolidation under time – dependent loading – secondary compression – Radial consolidation.	
Unit: 5	Shear strength: Principle of effective stress – Measurement of strength parameters - Strength tests based on drainage conditions – Skempton's pore pressure coefficients – Stress paths – Shear strength of cohesionless soils – Strength and deformation behaviors – Dilatancy – Critical void ratio – Liquefaction of soils – Shear strength of saturated cohesive soils – Triaxial testing. Normally and over consolidated clays.	

REFERENCES

1	"Advanced soil mechanics" by Braja M. Das., McGraw Hill Co.,
2	"Advanced Solid Mechanics" by L.S. Srinath
3	"Foundations of theoretical soil mechanics" by M.E. Harr., McGraw Hill Co.
4	"Introduction to Geotechnical engineering" by Holtz and Kovacs., Prentice Hall.
5	"Soil Mechanics" by R.F.Craig, Chapman and Hall.
6	"Elements of soil mechanics" by G.N. Smith., B.S.P. Professional Books Oxford,London



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I Year - I Semester	Program Core 2	L	T	P	C
		3	1	0	4
Foundation Engineering					

Pre-Requisites: None

Course Outcomes: At the end of the course, the student will be able to

CO1	Know the process of the soil exploration and sample collection, preservation and transportation of samples to the laboratory.
CO2	Interpret the results of field tests.
CO3	Determine the bearing capacity of soils for shallow foundations
CO4	Make the choice of foundation based on sub soil conditions.
CO5	Determine the settlement of foundations in different soils.

Mapping of Course Outcomes with Outcomes:

Course Out Comes	PO1	PO2	PO3	PO4	PO5
CO1	1	3	1	1	2
CO2	--	3	1	--	--
CO3	--	3	1	--	1
CO4	--	3	1	--	--



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Detailed Syllabus

Unit	Contents	Contact Hours
Unit: 1	Soil Exploration – Importance, Terminology, - Geophysical methods. Borings - Location, spacing and depth, Methods of Boring including Drilling, Stabilization of Boreholes, – Methods of sampling -Types of Samples and Samplers- Cleaning of Bore holes, Preservation, Labeling and Shipment of Samples - Design Considerations of Open Drive Samplers.	
Unit: 2	Field tests - The Standard Penetration Test – its limitations and Corrections – Cone Penetration Test – Field Vane Shear Test – Bore-Hole Shear Test – Dilatometer Test – Pressure Meter test – Planning of exploration -- Preparation of Soil Report – Bore log	
Unit: 3	Shallow Foundations –Bearing capacity – Terzaghi, Meyerhof's, Hansen's and Vesic's Bearing Capacity Theories – IS method of Bearing Capacity - Factors - - Bearing Capacity Based on Penetration Resistances - Safe Bearing Capacity and Allowable Bearing Pressure – Effect of Soil Compressibility on Bearing Capacity – Eccentrically loaded Foundations -- Bearing Capacity of Stratified Soils	
Unit: 4	Types of foundations and the choice of the type of foundations. Design Considerations including Location and Depth - Proportioning of Shallow Foundations- Isolated and Combined Footings and Mats - Design Procedure for Mats. Floating Foundation	
Unit: 5	Settlement Analysis – Elastic settlement of Soils – Meyerhof's, De Beer and Marten's and Schemertmann's equations-Elastic settlements of surface and subsurface footing in clays - Skempton and Bjerrum's pseudo three-dimensional approach to consolidation settlement, settlement from in-situ tests. Tolerable settlements	



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REFERENCES	
1	Principles of Foundation Engineering by Braja M. Das.
2	Soil Mechanics in Engineering Practice by Terzaghi and Peck
3	Foundation Design by Wayne C. Teng, John Wiley & Co.,
4	Foundation Analysis and Design by J.E. Bowles McGraw Hill Publishing Co.,
5	Analysis and Design of sub structures by Swami Saran
6	Design Aids in Soil Mechanics and Foundation Engineering by Shanbaga R. Kaniraj, Tata McGraw Hill.
7	Foundation Design and Construction by MJ Tomlinson – Longman Scientific
8	A short course in Foundation Engineering by Simmons and Menzes - ELBS



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I Year - I Semester	Program core 3	L	T	P	C
		3	0	0	3
Ground Improvement Techniques					

Pre-Requisites: Soil Mechanics

Course Outcomes: At the end of the course, the student will be able to

CO1	Understand the principles of various ground improvement techniques
CO2	Prefer suitable ground improvement techniques based on the Soil conditions and local available Materials
CO3	Understand the principles and suitability of various stabilization techniques
CO4	Select suitable stabilization techniques based on the Soil conditions and local available materials
CO5	Understand the Principles of dewatering techniques and to apply suitable dewatering technique in the field depending on the requirement
CO6	Understand the grouting technology and its applications by selecting the suitable grout based on the field conditions

Mapping of Course Outcomes with Outcomes:

Course Out Comes	PO1	PO2	PO3	PO4	PO5
CO1	1	--	3	1	--
CO2	1	--	3	1	2
CO3	--	1	3	1	2
CO4	1	--	3	1	2
CO5	--	--	3	1	1
CO6	--	--	3	1	--

Detailed Syllabus:

Unit	Contents	Contact Hours
Unit: 1	Introduction – Need for Engineering Ground – Classifications of Ground Modification Techniques – Suitability, Feasibility and Desirability. Densification of cohesionless soils – Deep Compaction – Vibrofloation – Vibro Composer method - Blasting – Densification at Ground. -Vibrocompaction- Heavy Tamping	



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Unit: 2	Improvement of Cohesive soils – Preloading - Soil Replacement – Radial Consolidation – Vertical and Radial Consolidation - Vertical Drains – Sand Drains – Effect of Smear – Sandwicks – Band drains – Dynamic Compaction.	
Unit: 3	Stabilization- Mechanical Stabilization, Lime Stabilization, Cement Stabilization, Bitumen Stabilization, Thermal Stabilization, Chemical Stabilization and Stabilization with Different Admixtures	
Unit: 4	Dewatering :- Dewatering methods – open sumps and ditches – gravity flow wells – Vacuum dewatering – Electro – kinetic dewatering – Electroosmosis Grouting: Overview of grouting - Suspension grouts – Solution grouts – Emulsion grouts-Categories of grouting – Grouting Techniques – ascending stage, descending stage and stage grouting – Grouting Plant - Grout control - Grouting applications – Dams, Tunnels, Shafts and drifts, excavations.	
Unit: 5	Stone Columns – Methods of installation of Stone Columns – Load shared by stone columns and the stabilized ground – uses of stone columns Lime columns and granular trenches – Installation – In situ ground reinforcement – ground anchors – types – Components and applications – uplift capability- Stability of foundation trenches and surrounding structures through soil Nailing, tie backs.	



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REFERENCE:

1	Construction and Geotechnical Methods in Foundation Engineering By R.M. Koerner, McGraw – Hill Book Co.
2	Current Practices in Geotechnical Engineering Vol.1, Alam Singh and Joshi, International Book Traders, Delhi, & Geo-Environ Academia.
3	Foundation Analysis and Design (1V Ed.) By J.E. Bowles, McGraw – Hill Book Co.,
4	Ground Improvement Techniques by P. Purushotham Raj, Laxmi Publications (P) Ltd., New Delhi.
5	Ground Improvement – Edited by M.P. Moseley, Blackie Academic & Professional.
6	Soil Mechanics for Road Engineers, H.M.S.O, London.
7	Ground Improvement Techniques by Bergado et al.
8	Engineering Principles of Ground Modification by Manfred R Hausmann.



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I Year - I Semester	Elective 1	L	T	P	C
		3	0	0	3
a) Construction in Expansive Soils					

Pre-Requisites: None

Course Outcomes: At the end of the course, the student will be able to

CO1	Understand the behaviour of expansive soils
CO2	Assess the foundation practices on expansive soils
CO3	Perform the methods of stabilization expansive soils
CO4	Select additives and the methodology for stabilization
CO5	Apply the gained knowledge for suitable performance

Mapping of Course Outcomes with Program Outcomes:

Course Out Comes	PO1	PO 2	PO3	PO4	PO5
CO1	2	--	1	1	--
CO2	--	2	2	--	--
CO3	--	--	3	--	--
CO4	--	--	3	1	--
CO5	--	1	1	--	3

Detailed Syllabus:

Unit	Contents	Contact Hours
Unit: 1	Clay mineralogy-Nature of soils-clay mineral structures-cation exchange-soil water-soil structure-soil water interaction.	



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Unit: 2	Swelling characteristics: swelling-factors effecting swelling-swell potential-swell pressure- methods of determination – factors affecting swelling potential and swell pressure – Heave ---factors affecting heave- methods of determination of heave.	
Unit: 3	Foundation Practices in Expansive Clays – Sand cushion – Belled Piers – CNS layer technique – Under – reamed pile foundations – Construction techniques – design specifications – Load - carrying capacity in compression and uplift of single and multi – under reamed piles in clays and sands – granular pile Anchors.	
Unit: 4	Lime soil columns and Lime slurry pressure injection – Stabilization with admixtures – Preponding – Vertical and Horizontal Moisture Barriers .	
Unit: 5	Shear strength of expansive soils-Kattis concept of bilinea strength envelope-Stress state variables in partly saturated soils fredlunds strength parameters-determination of matrix suction by axis translation technique-field suction measurement	

REFERENCES:

1	F.H.Chen, Foundations on Expansive Soils, Eleveir Scientific Publishing Company, Newyork.
2	J.D.Nelson and D.I. Miller, Expansive soils- Problems and Practice in Foundation and Pavement Engineering by, John Wiley & Sons, Inc.
3	D.G. Fredlund and H.Rahardjo, Soil Mechanics for Unsaturated Soils, WILEY Inter science Publication, John Wiley & Sons, Inc
4	D.R. Katti, AR Katti, Behaviour of Saturated Expansive Soils and Control methods, Taylor and Francis Gopal Ranjan and AS Rao, Basic and Applied Soil Mechanics, New Age International Publishers,
5	NewDelhi. Hand Book on Under reamed and Bored Compaction Pile Foundations – CBRI, Roorkee. IS: 2720(Part XLI) – 1977 Measurement of Swelling Pressure of Soils.



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I Year - I Semester	Elective 1	L	T	P	C
		3	0	0	3
b) – Soil Foundation Interactions					

Pre-Requisites: Soil Mechanics, Mathematics

Course Outcomes: At the end of the course, the student will be able to

CO1	Use a stress strain behaviour of Soil in modelling to determine the soil response with the applied loads.
CO2	Apply concepts to analyze and to compute the response of the infinite and finite beams, plates on the soil medium

Mapping of Course Outcomes with Outcomes:

Course Out Comes	PO1	PO2	PO 3	PO4	PO5
CO1	3	--	--	1	1
CO2	1	3	--	1	1

Detailed Syllabus:

Unit	Contents	Contact Hours
Unit: 1	Introduction to Soil – Foundation Interaction Problems – Contact Pressure Distribution – Idealized Soil Behaviors, Foundation Behaviour, Interface Behaviour, Analytical techniques.	
Unit: 2	Idealized Soil Response Models for the Analysis of Soil – Foundation Interaction – Elastic Models for Soil Behaviour, Cointler model, Elastic Continuous Model, Two –Parametric Elastic Models – Elastic – Plastic and Time Dependent Behaviour of Soil Masses.	



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Unit: 3	Plane Strain Analysis of an Infinite plate and an Infinitely Long. Beam; Bernoulli – Euler Beam Theory and its Modifications – Effect of Shear Deformations.	
Unit: 4	Finite Beams on a Winkler Medium – Method of Initial Parameters – Method of Super Position – Strain Energy Method.	
Unit: 5	Analysis of finite plates – Axi Symmetric Loading of a Circular Plate – Circular Plate Resting on a Winkler Medium – Circular Plate Resting on a Two – parameter elastic	

REFERENCE:

- | | |
|----|---|
| 1. | Analytical and computer methods in foundation engineering, JE Bowles, McGraw Hill publications. |
| 2. | Foundation analysis and design, JE Bowles, McGraw Hill Publications. |
| 3. | Foundation analysis by RF Scott, Printice Hall |
| 4. | Hytenyi, Beams on Elastic Foundations – university of Michigan Press. |
| 5. | Elastic Analysis of soil – Foundation Interaction. APS Selvadurai – Elsevier |



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I Year - I Semester	Elective 1	L	T	P	C
		3	0	0	3
c) - Critical State Soil Mechanics					

Pre-Requisites: Soil Mechanics

Course Outcomes: At the end of the course, the student will be able to

CO1	Use a critical state framework to determine soil response
CO2	Use a constitutive model to determine soil response
CO3	Analyze the behaviour of soil under different boundary conditions

Mapping of Course Outcomes with Program Outcomes:

Course Out Comes	PO1	PO2	PO3	PO4	PO5
CO1	3	1	1	1	2
CO2	2	1	--	2	2
CO3	1	1	--	3	1

Detailed Syllabus:

Unit	Contents	Contact Hours
Unit: 1	Stress and strain – Stress and Strain Paths and Invariants – Critical State line – families of Undrained and Drained tests – Undrained and Drained planes – The Roscoe surface – Rosco surface as a state boundary surface.	
Unit: 2	Behaviour of Over Consolidated Samples – Hvorslev Surface – Critical State Line – Complete State Boundary surface – Volume Changes and Pore Pressure changes – Behaviour of Sands – Effect of Dilation.	
Unit: 3	Soil behaviour Before failure – Plasticity of Soils – Cam clay - Power in Cam – Clay – Critical States and Yielding of Cam – clay, Compression of Cam – Clay.	



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Unit: 4	Routine Soil Tests and the Critical State Model – Mohr – Coulomb Failure Criterion – One – dimensional compression – Undrained Shear Strength – General states of stress – Pore pressure Parameters – Interpretation of Index Test Data.	
Unit: 5	Test paths in consolidation and shear testing -- Soil Parameters for Design – Choice of Analysis – Methods – Choice of Strength Parameters.	

REFERENCES:

1.	The Mechanics of Soils by J.H. Atkinson and P.L. Bransby & ELBS McGraw – Hill Book Co.,
2.	Critical State Soil Mechanics – A. Sehofield and P. Wroth McGraw Hill Book Co.
3.	Guide to soil Mechanics – Bolton seed, Mac millan Press Ltd., London.



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III Semester	Elective 1	L	T	P	C
		3	0	0	3
d) - Forensic Geotechnical Engineering					

Pre-Requisites: None

Course Outcomes: At the end of the course, the student will be able to

CO1	Understand the forensic geotechnical investigation need, scope and methodology
CO2	Acquire reverse engineering and back-analysis skills for failure root cause identification
CO3	Develop ability to document findings and suggestion rectification measures

Detailed Syllabus:

Unit	Contents	Contact Hours
Unit: 1	Introduction to Forensic Geotechnical Engineering Historical failures: slopes (finite/infinite), dams, tunnels, foundations, retaining structures-Characterization of geotechnical failures and inadequacy of traditional design approaches-Principles of mobilizable strength design and introduction to forensic methodology-Objectives, ethical responsibilities, and legal context for geotechnical forensic engineers.	
Unit: 2	Forensic Investigation Methodology Planning investigations and scoping work-Data collection: design documents, site inspection, distress characterization (visual, photographic)-Development of failure hypotheses and root cause analysis-Diagnostic tests: field tests (SPT, CPT, geophysical methods), lab tests for forensic analysis-Back-analysis, technical shortcomings in design/construction-Instruments for monitoring and post-failure assessment	
Unit: 3	Performance Evaluation and Advanced Analysis Reverse engineering, numerical modeling, and simulation for failure backtracking-Reliability-based evaluation, probabilistic failure modeling-Advanced techniques: geotechnical instrumentation, monitoring, remote sensing for forensic purposes	



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Unit: 4	Case Histories and Applications Settlement issues: tilting, excessive settlement in structures- Failures due to soil type: collapsible, expansive, soluble, organic soils-Slope and embankment failures: landslides, creep, debris flow-Retaining wall and foundation failures, trench collapses, dam/embankment collapses-Earthquake-induced geotechnical failures, liquefaction-Legal case studies and lessons learned from post-failure investigations	
Unit: 5	Reporting, Remediation, and Legal Practice Preparation of forensic reports and documentation techniques- Communication of findings to stakeholders, suggesting repairs/rehabilitation measures-Acting as expert witness: report review, ethics, court appearances-Relevant codes, standards, and protocols for forensic geotechnical practice	

REFERENCES:

1.	Foundation and Forensic Geotechnical Engineering, P.K. Basudhar,.Krishna B.
2.	Forensic Geotechnical and Foundation Engineering, Robert M. Day McGraw Hill, 2nd Edition
3.	Analytical and Computer Methods in Foundation, J.E. Bowels, McGraw Hill
4.	Forensic Geotechnical, Engineering V.V.S. Rao & G. L. Sivakumar Babu, Springer India, 2010
5.	Guidelines for Forensic Engineering Practice, ASCE TCFE, ASCE 2013



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I Year - I Semester	Elective 2	L	T	P	C
		3	0	0	3
a) – Designing with Geosynthetics					

Pre-Requisites: None

Course Outcomes: At the end of the course, the student will be able to

CO1	Use geosynthetic materials in the field of geotechnical construction works.
CO2	Assess the properties of different materials of Geosynthetics
CO3	Distinguish and describe various manufacturing methods of geotextiles, geogrids, geomembranes and geo-composites
CO4	Understand concepts and design the geosynthetics for the functions of separation, reinforcement, stabilization, filtration, drainage and moisture barriers
CO5	Design reinforced earth retaining walls, gabions, pond liners, covers for reservoirs, canal liners, landfill liners, caps and closures, dams and embankments etc
CO6	Distinguish survivability requirements of geo-composites and design geo-webs, geo-cells, sheet drains, strip drains and moisture barriers etc

Detailed Syllabus:

Unit	Contents	Contact Hours
UNIT-I	Types, Applications and Functions of Geosynthetics: Introduction Function: Reinforcement, separation, drainage, filtration and barrier – Uses and Applications.	
UNIT-II	Manufacture, Properties and Testing Methods of Geosynthetics: Raw materials – manufacturing process of various types of geosynthetics.	
UNIT-III	Design of reinforced earth retaining Walls: -Types of soil reinforced structures like wrap-around walls -full-height panel walls -discrete-facing panel walls -modular block walls, Construction aspects -Usage of BS 8006 -FHWA design codes -Internal and External stability analyses -Seismic loads.	
UNIT-IV	Design of reinforced earth slopes: Basal reinforcement for	



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	construction on soft clay soils, construction of steep slopes with reinforcement layers on stable foundation soil, different slope stability analysis, erosion control on slopes using geosynthetics.	
Unit-V	Design of Filters, Drains, Prefabricated vertical drains and Erosion Control Measures using Geosynthetics: Different filtration requirements- Criteria for selection of geotextiles for filtration- Erosion control techniques for slopes and coastal regions, Designing of PVD for stabilizing soft and marine soils	

REFERENCE

1	"Designing with Geosynthetics" by Robert M. Koerner Prantice Hall, Eaglewood Cliffs, NJ 07632.
2	"Construction and Geotechnical Engineering using Synthetic Fabrics" by Robert M. Koerner and Joseph P. Welsh. John Wiley and Sons, New York.
3	"Engineering with Geosynthetics", by G. Venkatappa Rao and GVS Suryanarayana Raju – Tata McGraw Hill Publishing Company Limited, New Delhi.
4	"Foundation Analysis and Design" by J.E. Bowles McGraw Hill Publications.
5	FHWA code
6	BS 8006 code



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I Year - I Semester	Eleective 2	L	T	P	C
		3	0	0	3
b) - Rock Mechanics					

Pre-Requisites: None

Course Outcomes: At the end of the course, the student will be able to

CO1	Classify rock mass based on field investigation data
CO2	Select the rock strength parameters for design
CO3	Suggest suitable tests on rocks for intended purpose
CO4	Design suitable rock important techniques

Mapping of Course Outcomes with Program Outcomes:

Course Out Comes	PO1	PO2	PO3	PO4	PO5
CO1	--	1	--	1	1
CO2	--	2	--	1	--
CO3	--	--	--	2	--
CO4	--	--	2	--	1

1.Slightly 2. Moderately 3.Substantially

Detailed Syllabus:

Unit	Contents	Content Hours
Unit: 1	Introduction and Classification of Rocks: Development of Rock Mechanics: Applications of Rock Mechanics – Rock Vs. Soil: Engineering Classification of intact rock and fissured rocks: Classification based on Structural features – Rock quality Designation Number and Velocity Ratio Methods.	
Unit: 2	Strength and Deformation Behaviour of Rocks and Failure Theories: Typical Stress – Strain Curves – Static and Creep Test; Strength of rock – Unconfined Shear Strength and Triaxial Shear Strength of Rocks; Creep behaviour of Rocks; rock fracture and friction; Coulomb – Navier; Mohr's and Griffith Theory and its Modification (General discussion only – derivation of equation not included.)	



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Unit: 3	Laboratory Testing of Rock Samples – Factors affecting test results sampling procedure and preparation of specimens; Tensile Tests – Direct, Indirect and Flexural tests; Uniaxial compression test; Unconfined and Triaxial shear tests; Determination of Elastic constants – Pulse generation and Resonant Frequency of a vibrating bar methods.	
Unit: 4	In-Situ Testing of Rock masses Plate –bearing test, Pressure Tunnel test; Flat Jack Test; Permeability of Rock and rock masses; Pore water pressure in rocks.	
Unit:5	Methods of Improving the Properties of Rock Masses – Pressure Grouting and Rock bolting. -- Design of simple – Openings in competent rocks; laminated rocks and rocks containing planes of weakness. (Distribution of stresses around simple openings suction only without derivation)	

REFERENCE:

- | | |
|----|--|
| 1. | Jaegar, J.C., and Cook, N.G.W. – Fundamentals of Rock Mechanics |
| 2. | Stagg, K.C. and Zienkiewicz., O.C – Rock Mechanics in Engineering Practice. |
| 3. | Obert, L & Duvall, W.L. – Rock Mechanics and the Design of Structures in Rock. |



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I Year - I Semester	Elective 2	L	T	P	C
		3	0	0	3
c) - Remote Sensing and Geographical Information System (ELECTIVE-II)					

Pre-Requisites: None

Course Outcomes: At the end of the course, the student will be able to

CO1	Familiar with ground, air and satellite based sensor platforms.
CO2	Select and apply appropriate data manipulation and visualization methods for a number of Earth science applications, including Geographical Information Systems (GIS)
CO3	Operate PC- based visualization software effectively
CO4	To plot, map and interpret, Geo-spatial data and present the results in an organised

Mapping of Course Outcomes with Outcomes:

Course Out Comes	PO1	PO 2	PO 3	PO4	PO5
CO1	--	--	--	--	2
CO2	--	--	--	--	2
CO3	--	--	--	1	2
CO4	--	--	--	--	2

Detailed Syllabus:

Unit	Contents	Contact Hours
Unit: 1	Remote Sensing : Definition, Elements involved in Remote Sensing, Ideal Vs Real Remote Sensing, Characteristics of Real Remote Sensing System, Nature of Electromagnetic Radiation. The Electromagnetic Spectrum, Remote Sensing Terminology and Units, Energy Interaction with Earth Features, Vegetation, Soils and Water bodies, Energy interaction in the atmosphere. Spatial Resolution, Spectral Resolution and Radiometric Resolution, Characteristics of Various sensors and satellites: LANDSAT, SPOT, IRS, ERS.	



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Unit: 2	<p>Introduction to GIS: What is GIS , Components of GIS, Overview of GIS, Examples of GIS application for civil engineering, Using a GIS for Decision making under uncertainty, Geo-referenced datamap projection, co-ordinate system.</p> <p>Data Input/Output: Keyboard entry, Manual Digitizing, Scanning, remotely sensed data, Existing Digital data – Cartographic database, Natural resources data sets, Digital elevation data and census related data sets, Data output devices.</p>	
Unit: 3	<p>Data Quality: Components of data Quality, Sources of error. Data management: Data Base approach, Three classic data models (Hierarchical network Relational data models), Query languages, Nature of Geographic data.</p> <p>Spatial data models: Raster and Vector data models. Data bases for GIS managing Spatial and attribute data together – Organizing Geographic Information within a DBMS, Limitations and Practical Approaches.</p>	
Unit: 4	<p>GIS Analysis functions : Organizing data for analysis, Classification of GIS Analysis function,</p> <p>Maintenance and Analysis of Spatial data – Transformations, Edge matching and editing,</p> <p>Maintenance and analysis of non-spatial attribute data – Editing and query functions.</p>	
Unit: 5	<p>GIS analysis functions for Integrated analysis of spatial and attribute data: Retrieval and Classification functions, Overlay operations, Neighborhood operations, Connectivity function, Output, Formatting – Map annotation, Text pattern and line styles, Graphic symbols, Cartographic modeling by GIS, analysis procedure with an example.</p>	



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TEXT BOOKS:

- | | |
|----|--|
| 1. | Principles of Geographic Information Systems by Peter A. Burrough and Rachael A.McDonnell – Oxford University Press. |
| 2. | Principles of Remote Sensing by Paul J Curran Geographic Information Systems, - A Management Perspective by STAN ARONOFF, Published by WDL Publications, Ottawa, Canada. |
| 3. | Michael Hord. Remote Sensing Methods and Applications, John Wiley. |
| 4. | Remote Sensing and Geographical Information Systems – 2 nd Edition by M. Anji Reddy. |

REFERENCE BOOKS:

- | | |
|----|---|
| 1. | Remote sensing and Image Interpretation by LILESAND and KIEFER, Published by john Wiley and sons. |
| 2. | Fundamental of GIS by MICHAEL N DEMERS Published by John Wiley & Sons Inc. |



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I Year - I Semester	Elective 2	L	T	P	C
		3	0	0	3
d) MARINE GEOTECHNICAL ENGINEERING					

Pre-Requisites: None

Course Outcomes: At the end of the course, the student will be able to

CO1	Classify marine sediments and understand the basic properties of marine soils and soil investigation and boring methods
CO2	Understand the laboratory and field testing of marine soils and the advanced testing methods of soft marine clays.
CO3	Analyse soil stabilisation and treatment methods and ground improvement techniques such as stone columns.
CO4	Appreciate bearing capacity and various modes of stability such as sliding stability, time-bound settlements and to design suction anchors, gravity foundations and earth retaining structures.
CO5	Possess a comprehensive knowledge of driven piles, RC bored cast in situ piles, pile groups and negative skin friction and also laterally loaded piles.

Detailed Syllabus:

Unit	Contents	Contact Hours
UNIT1	Classification of marine sediments and soils; basic soil properties, correlation between engineering parameters, geotechnical investigation, bore techniques.	
UNIT 2	Soil testing methods in laboratory and fields; very soft and recent deposits in river mouth; characteristics of thixotropic soils; Advanced testing methods for soft marine clays; sensitivity of soils; time-dependent behaviour of marine sediments. Upper and lower bound soil characteristics.	



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UNIT 3	Soil stabilization; fills and reclamations; soil treatments and ground improvement methods; stone columns and band drains; coastal protections and reclamation dykes.	
UNIT 4	Bearing capacity, sliding stability, over-turning stability, short-term and long-term settlements, factor of safety; Bucket foundation; Suction anchors; Gravity foundation; Earth retaining structures; Diaphragm walls; stability of breakwater on soft soils.	
UNIT 5	RC bored piles; Driven piles, drilled and grouted steel piles; Axial and lateral capacity, point bearing and skin friction, factor of safety, lateral load on piles, p-y, t-z and q-z curves, linear spring methods; bearing capacity in soils, weathered rock, and intact rock. Pile group effect, scour around piles, seabed subsidence and design of piles against seabed movement, negative skin friction, cyclic degradation. Pile driving and monitoring; pile testing and correlations; Pile remedial measures.	

REFERENCE

1.	Chakrabarti, SK. 2005. Handbook of Offshore Engineering, Elsevier, ISBN: 978-008-05-2381-1
2.	Tomlinson, MJ. 1994. Pile Design and Construction practice, 4th Ed., E&FN Spon, London, UK, ISBN: 0-203-47457-0.
3.	Joseph E. Bowles. 1988. Foundation analysis and design, 5th Ed., McGraw-Hill, Singapore, ISBN: 0-07-118844-4
4.	Ben C. Gerwick Jr. 2007. Construction of Marine and Offshore Structures, CRC Press, USA, ISBN: 978-042-91-2502-7



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I Year - I Semester	Laboratory 1	L	T	P	C
		0	1	2	2
Geotechnical Engineering Laboratory -1					

Pre-Requisites: None

Course Outcomes: At the end of the course, the student will be able to

CO1	conduct various laboratory tests on soils, analyze and the interpretation of results
-----	--

Mapping of Course Outcomes with Program Outcomes:

Course Out Comes	PO1	PO2	PO3	PO4	PO5
CO1	2	--	--	3	--

Syllabus:

S.No	List of Experiments	Contact Hours
1	Determination of moisture content and specific gravity of soil	
2.	Grain size distribution analysis and hydrometer analysis	
3.	Atterberg limits (liquid limit, plastic limit, shrinkage limit)	
4.	Field identification tests	
5.	Vibration test for relative density of sand	
6.	Standard and modified proctor compaction tests	
7.	Falling head permeability test and constant head permeability test	
8.	CBR	



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I Year - I Semester	Laboratory- 2	L	T	P	C
		0	1	2	2
Geotechnical Engineering Laboratory Lab-2					

Pre-Requisites: None

Course Outcomes: At the end of the course, the student will be able to

CO1	conduct various laboratory tests on soils, analyze and the interpretation of results
-----	--

Mapping of Course Outcomes with Outcomes:

Course Out Comes	PO1	PO2	PO3	PO4	PO5
CO1	2	--	--	3	--

Syllabus:

S.No	List of Experiments	Contact Hours
1	Unconfined compression test	
2	Direct shear test	
3	Tri-axial compression test-UU,CU,CD tests.	
4	Laboratory vane shear test	
5	Free swell index test	
6	Swell pressure test	
7	Consolidation test	
8	Field density test (core cutter and sand replacement methods)	
9	PH, electrical conductivity, chloride and sulphate in soils	



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I Year - II Semester	Program core 4	L	T	P	C
		3	1	0	4
Advanced Foundation Engineering					

Pre-Requisites: Geotechnical Engineering – I & II

Course Outcomes: At the end of the course, the student will be able to

CO1	Understand classification of piles and determine the load carrying capacity of piles by various methods
CO2	Determine the load carrying capacity of pile groups
CO3	Evaluate the pull-out capacity of piles and down drag forces on piles due to negative skin friction
CO4	Determine the load carrying capacity of laterally loaded piles
CO5	Determine the load carrying capacity of piers and caissons

Detailed Syllabus:

Unit	Contents	Contact Hours
Unit: 1	Shallow Foundations – Beams on Elastic foundations, solution by Finite Difference and – Finite Element Method (Direct Approach) Limit analysis, Lower Bound and Upper-bound theories Method of Finite difference solution of Raft foundations.	
Unit: 2	Single Pile: Pile Foundations-Classification of Piles-Factors influencing - Choice- Load Carrying Capacity of Single Piles in Clays and Sands Using Static Pile Formulae- α - β - and λ - Methods – Bearing Capacity of Piles by Meyerhof, Vesic and Coyle and Castello's Methods – Bearing Capacity of Piles with the penetration Test Data -- Dynamic Pile Formulae-Limitations-Monotonic and Cyclic Pile Load Tests.- Pull-out resistance of piles -Meyerhof's, Vesic's equations and Coyle and Castello correlations for piles in sands (Elastic settlement of piles)- Pull out Resistance of piles - Negative skin friction in piles – Typical field situations – Estimation of downdrag - Neutral point – Methods of minimizing downdrag.	



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Unit: 3	Pile groups -Efficiency of Pile Groups- Different Formulae- Load Carrying Capacity of Pile Groups in Clays and Sands – Settlement of Pile Groups in Clays and Sands – Computation of Load on each Pile in a Group.	
Unit: 4	Laterally loaded vertical piles - Modulus of subgrade reaction – Piles in granular soils and cohesive soils subjected to lateral loading - Matlock & Reese analysis for piles in sands - Davisson & Gill analysis for piles in clays, Broms' Analysis for piles in sands and clays.	
Unit: 5	Drilled pier – Types of Drilled piers – Load Transfer Mechanism -- Load carrying capacity of piers in clays and sands- Settlement of Drilled Shafts – Lateral Carrying Capacity of Drilled Shafts. Caisson Foundations: Caissons – Types – Pneumatic Caisson – Construction Aspects - Well Foundations – Design of components – Design of wells – Lateral stability of well foundations – Terzaghi's analysis – IRC method.	

REFERENCE

1.	Principles of Foundation Engineering -Braja M. Das
2.	Foundation Analysis and Design – J.E. bowles, McGraw – Hill Publishing Co.,
3.	Analysis and design of foundations and Earth Retaining Structures. –S. Prakash, Gopal Rajan and Swami Saran – SaritaPrakasan, Merut.
4.	Foundation Design and Construction – M.J. Tomlinson, Pitman
5.	Soil Mechanics and Foundation Engineering, Vol. II, Foundation Engg., - VNS Murthy
6.	Pile Foundation Analysis & Design by Poulos and Davis.



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I Year - II Semester	Program core 5	L	T	P	C
		3	1	0	4
Earth Retaining structures					

Pre-Requisites: Soil Mechanics

Course Outcomes: At the end of the course, the student will be able to

CO1	Quantify the lateral earth pressures associated with different earth systems
CO2	Evaluate the mechanical properties of geosynthetics used for soil reinforcement
CO3	Identify the merits and demerits of different earth retaining systems.
CO4	Select the most technically appropriate type of retaining wall for the application from a thorough knowledge of available systems
CO5	Design of retaining structures using appropriate design methods, factors of safety, earth pressure diagrams and field verification methods
CO6	Aware of current guidelines regarding the design of earth retaining structures.
CO7	Design retaining structures considering both external and internal stability aspects

Mapping of Course Outcomes with Outcomes:

Course Out Comes	PO1	PO 2	PO 3	PO4	PO5
CO1	1	--	2	3	1
CO2	1	--	2	1	1
CO3	3	--	1	1	--
CO4	1	1	2	2	3
CO5	--	2	3	1	--
CO6	--	2	--	--	--
CO7	1	2	1	2	1

Detailed Syllabus:

Unit	Contents	Contact Hours
Unit: 1	Earth pressures – Different types and their coefficients- Classical Theories of Earth pressure – Rankine's and Coulomb's Theories for Active and Passive earth pressure- Computation of Lateral Earth Pressure in Homogeneous and Layered soils- Graphical solutions for Coulomb's Theory in active and passive conditions.	



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Unit: 2	Retaining walls – different types - Type of Failures of Retaining Walls – Stability requirements – Drainage behind Retaining walls – Provision of Joints – Relief Shells.	
Unit: 3	Sheet Pile Structures – Types of Sheet piles – Cantilever sheet piles in sands and clays – Anchored sheet piles – Free earth and Fixed earth support methods – Rowe’s moment reduction method – Location of anchors and Design of Anchorage system.	
Unit: 4	Braced cuts and Cofferdams: Lateral Pressure in Braced cuts – Design of Various Components of a Braced cut – Stability of Braced cuts – Bottom Heave in cuts. – types of cofferdam, suitability, merits and demerits – Design of single – wall cofferdams and their stability aspects – TVA method and Cummins’ methods	
Unit: 5	Pseudo static analysis of Earth Retaining Structures using Mononobe & Okabe Solution .	

REFERENCES

1.	Principles of Foundation Engineering by Braja M. Das.
2.	Foundation analysis and design – Bowles, JE – McGraw Hill
3.	Soil Mechanics in Engineering Practice – Terzaghi, K and Rolf, B. peck 2 nd Edn. – John Wiley & Co.,
4.	Analysis and Design of Foundations and Retaining Structures, Prakash, S – SarithaPrakashan, Mearut.



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I-II Semester	Program core 6	L	T	P	C
		3	1	0	4
Soil Dynamics & Machine Foundations					

Pre-Requisites: None

Course Outcomes: At the end of the course, the student will be able to

CO1	Understand the fundamental behaviour of geotechnical structures under dynamic loading
CO2	Understand the theories of vibration analysis
CO3	Conduct various laboratory and filed tests to determine the dynamic soil prosperities and its interpretation
CO4	Design the machine foundations
CO5	Design vibration isolators under any vibratory machines and analysis of geotechnical structures under dynamic loads

Mapping of Course Outcomes with Program Outcomes:

Course Out Comes	PO1	PO2	PO 3	PO4	PO5
CO1	3	2	--	2	2
CO2	1	3	1	2	2
CO3	2	1	1	--	1
CO4	--	1	--	3	--
CO5	1	1	1	1	2

Detailed Syllabus:

Unit	Contents	Contact Hours
Unit: 1	Introduction: Types of motion- SHM- Fundamental definitions- SDOF systems- Free and forced vibration with and without damping- Types of damping-Equivalent stiffness of springs in series and parallel- Principles of vibration measuring devices- Introduction to two and multi degree freedom systems.	



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Unit: 2	Theories of Vibration Analysis- EHS Theory and lumped parameter model- Different modes of vibration- Natural frequency of foundation soil system – Barkan and IS methods – Pressure bulb concept – Reisner Theory – Limitations of Reisner theory – Sung's solutions --Pauw's Analogy – Heigh's Theory.	
Unit: 3	Dynamic properties of soils, Determination of E, G and Poisons ratio from field and laboratory tests, recommendations of Indian codes- Stress waves in bounded elastic medium- Use of wave theory in the determination of elastic properties, Elastic coefficients of soils and their determination- damping factor from free and forced vibration tests.	
Unit: 4	Machine Foundations: Classification based on the type of dynamic force and structural form, design data, design criteria, foundations for reciprocating, impact and high speed machined like turbo generators- IS code provisions for the design of the same.	
Unit: 5	Vibration Isolation and Special Topics: Transmissibility, Principles of isolation- Methods of isolation- Vibration isolators- Types and their characterizes - Liquefaction of soils, Dynamic bearing capacity, Earth retaining structures under dynamic loads-Pile foundations with dynamic loads.	

REFERENCES:

1.	Vibrations of Soils and Foundations – Richart Hall and Woods
2.	Vibration Analysis and Foundation Dynamics, NSV Kameswara Rao, Wheeler Publishing, New Delhi.
3.	Foundations of Machines- Analysis and Design- Prakash and Puri
4.	Analysis and design of Foundations for Vibrations- P J Moore
5.	Fundamentals of Soil Dynamics- B M Das
6.	Dynamics of bases and Foundations- D DBarkar



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I Year - II Semester	Elective 3	L	T	P	C
		3	0	0	3
a)- Pavement Analysis, Design & Evaluation					

Pre-Requisites: None

Course Outcomes: At the end of the course, the student will be able to

CO1	Understand the design parameters of pavement design
CO2	Design flexible and rigid pavements for different field conditions
CO3	Compute the stress distribution in different pavement layers
CO4	Evaluate the pavements and design overlay systems

Mapping of Course Outcomes with Program Outcomes:

Course Out Comes	PO1	PO2	PO3	PO4	PO5
CO1	1	-	-	1	-
CO2	1	1	-	-	-
CO3	1	3	1	-	1

Detailed Syllabus:

Unit	Contents	Contact Hours
Unit: 1	Pavement Types, Wheel Loads and Design Factors: Definition of Pavement Types, Comparison of Highway pavements, Wheel Loads, Tyre pressure, Contact pressure, Design Factors: Traffic and Loading, Environment, Materials, Failure criteria, Reliability.	
Unit: 2	Stresses in Pavements: Layered System Concepts: One Layer System: Boussinesq's Theory. Two Layer Theory: Burmister's Theory. Three Layer System. Stresses in Rigid Pavements. Relative Stiffness of Slabs, Modulus of Subgrade Reaction, Stresses due to Warping, Stresses due to Friction, Stresses due to Load, IRC Recommendations.	
Unit: 3	Pavement Design: IRC Method of Flexible Pavement Design, AASHTO Method of Flexible Pavement Design, IITPAVE method of pavement design of Flexible Pavements, IRC Method for Rigid Pavements, use of Geosynthetics in pavements.	



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Unit: 4	Pavement Inventories: Serviceability Concepts, Visual Rating, Pavement Serviceability Index, Roughness Measurements, Measurement of Distress Modes Cracking, Rutting, Rebound Deflection using Benkleman Beam Deflection Method, Load Man Concept, Skid Resistance Measurement.	
Unit: 5	<p>Pavement Evaluation: Functional Pavement Performance Evaluation: AASHTO Method, Psycho Physical and Psycho Metric Scaling Techniques, Deduct Value Method.</p> <p>Structural Conditional Evaluation Technique: Benkelman Beam Deflection Method, Pavement Distress Rating Technique. Design of Overlays by Benkelmen Beam Deflection Methods as per IRC – 81 - 1997 – pavements on problematic soils.</p>	

REFERENCES:

1.	Yoder and Witzorack, "Principles of Pavement Design", John Willey and Sons.
2.	Yang, H. Huang, "Pavement Analysis and Design", Prentice Hall Publication, Englewood Cliffs, New Jersey.
3.	Sargious, M.A. Pavements and Surfacing for Highways and Airports – Applied science Publishers limited
4.	Ralps Hass and Hudson, W.R. " Pavement Management System" Mc-Graw Hill Book Company.
5.	IRC codes of practice.



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I Year - II Semester	Elective 3	L	T	P	C
		3	0	0	3
b)-- Construction Planning & Methods					

Pre-Requisites: None

Course Outcomes: At the end of the course, the student will be able to

CO1	understand the construction planning
CO2	utilize the various earth moving equipment
CO3	to prepare the Project Budget

Mapping of Course Outcomes with Outcomes:

Course Out Comes	PO1	PO 2	PO 3	PO4	PO5
CO1	1	1	--	--	--
CO2	--	--	2	--	1
CO3	--	--	2	--	--

Detailed Syllabus:

Unit	Contents	Contact Hours
Unit: 1	Project Management: Planning – Scheduling – Control – Bar chart – Milestone charts – Development of CPM and Pert networks – Time Estimates – Evaluation of Project duration – Cost Analysis – Updating – Crashing and Resource Allocation.	
Unit: 2	Equipment: Equipment Economics – Cost of Owning and operating – Earth moving equipment – Dozers – Scrapers – graders – shovels – hoes – loaders – clamshell buckets – Draglines– Cranes.	
Unit: 3	Trucks and Handling Equipment: Rear dump trucks – Capacities of trucks and handling equipment – calculation of truck production – compaction equipment – types of compaction rollers – quality control – soil stabilization.	



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Unit: 4	Aggregate production: Crushers – Jaw Crushers – Gyratory crushers – impact crushers – selection of crushing equipment – screening of aggregate – concrete mixers – mixing and placing concrete – consolidating and finishing.	
Unit: 5	Project Budgeting: Introduction – Project costs – types of costs – Accuracy and timing of cost estimates – methods of crushing costs – cost control – cost inflation – escalation and contingencies.	

REFERENCES:

1	Peurifoy and Schexnayder, “ Construction Planning, Equipement and Methods”, Tata McGraw Hill Edition, New Delhi.
2	Kraig Knutson, Clifford, J.S, Christine Flori and Rishard E. Mayo, “Construction Management Fundamentals”. Tata McGraw Hill Edition, New Delhi.
3	Chitkara, “Construction Project Management”, Tata McGraw Hill Edition, New Delhi.
4	Timothy.J. Kopprnborg, “Contemporary Project Management”, CenageLerraning.



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I Year - II Semester	Elective 3	L	T	P	C
		3	0	0	3
c) - Geotechnical Earthquake Engineering					

Pre-Requisites: None

Course Outcomes: At the end of the course, the student will be able to.

CO1	Learn the fundamental definitions of earth quake engineering
CO2	Understand earth quake ground motions
CO3	Gain knowledge on dynamic properties of the soil and its estimation
CO4	Understand liquefaction and lateral spreading of soil.
CO5	Do the seismic design of foundations, slopes and retaining structures

Mapping of Course Outcomes with Outcomes:

Course Out Comes	PO1	PO 2	PO 3	PO4	PO5
CO1	1	--	--	1	--
CO2	2	1	--	--	1
CO3	--	--	--	3	1
CO4	2	1	2	--	2
CO5	1	3	1	--	2

Detailed Syllabus:

Unit	Contents	Contact Hours
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Unit: 1	Earthquake Seismology: Introduction -- Seismic waves - Causes of earth quake - Continual drift and Plate tectonics – Earthquake fault sources – Faults, fault geometry, fault movement - Elastic Rebound Theory – Location of Earth Quakes - Quantification of Earthquakes – Intensity and magnitude – Earthquake Energy.	
Unit: 2	Earthquake ground motion: Seismograph - Characteristics of Ground motion: - Ground motion parameters – Amplitude Parameters – peak acceleration, peak velocity, peak displacement other amplitude parameters – Frequency content parameters – ground response spectra, Fourier spectra, Power spectra, response spectra – spectral parameters – duration. Local site Specification and Code based design.	
Unit: 3	Dynamic Soil Properties: Representation of Stress conditions by the Mohr Circle – Measurement of Dynamic properties – field, laboratory, interpretation of observed ground response - - One dimensional response analysis - linear approach, E quivalent linear approach.	
Unit: 4	Liquefaction and Lateral Spreading – Liquefaction Related phenomena - Liquefaction susceptibility – Initiation of Liquefaction – Effects of Liquefaction – Remedies on Seismic hazards – Densification – Reinforcement – Grouting and mixing Techniques – Drainage Techniques.	



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Unit: 5	Seismic Design of Foundation, Slopes and Retaining Structures: Seismic Design requirements for Foundation – Seismic Bearing capacity - Seismic Settlement -- Internal stability and weakened instability of slopes - Seismic design of retaining walls: Dynamic Response of Retaining walls - Seismic Displacement of Retaining walls - Seismic Design Considerations.	
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REFERENCES:

1	“Geotechnical Earth Quake Engineering” by SL Kramer, Pearson Education.
2	“Earth Quake” W.H. Freeman, New York.



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I Year - II Semester	Elective 3	L	T	P	C
		3	0	0	3
d) GEOTECHNICS OF UNDERGROUND STRUCTURES					

Pre-Requisites: None

Course Outcomes: At the end of the course, the student will be able to.

CO1	Understand the prerequisites and features of arching in soils, theory of arching and application of arching to different types of soils.
CO2	The student will be able to appreciate types of conduits, bedding conditions for conduits and soil pressure in conduits and pressures in silos.
CO3	Upon completing this course, the student will be able to analyse stresses in the vertical shafts and tunnels and understand the construction of earth tunnels.
CO4	Analyse lateral earth pressure on sheeting and design braced cuts and tie-backs.
CO5	Understand soil nailing and components of nailing system and design nailing systems. Further, he will be able to analyse anchorage systems and design anchorages.

Detailed Syllabus:

Unit	Contents	Contact Hours
UNIT 1	Arching in soils, prerequisites and features of arching, Theory of arching in soils, Application of arching in cohesive frictional and cohesive-frictional soils.	
UNIT 2	Soil pressures on conduits- Loads on ditch, negative and positive projecting conduits, Bedding conditions for conduits and types of conduits, Pressures in silos, Janssen's theory for pressures in silos.	
UNIT 3	Stresses in Vicinity of Vertical Shafts, Tunnels, Construction of Earth Tunnels Retaining Systems for Underground Excavations.	
UNIT 4	Braced Cuts: Lateral Earth pressure on Sheet piling, Types of Sheet piling and Bracing Systems, Design of Braced Cuts Tie Backs: Components, advantages over Braced Cuts, Design concepts.	



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UNIT 5	Soil Nailing: Components of nailing system, Driven and Grouted Nails, Design of nailing system, anchored Spider Netting Types of Anchorage Systems for anchored Sheet pile walls, Design of anchorages, considerations in positioning of anchorages.	
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REFERENCE	
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|----|---|
| 1. | Leonards, G.A (1962) "Foundation Engineering", Mc Graw Hill Co. |
| 2. | Design of Foundation Systems by Nainan P Kurian, Narosa Publishing House. Retaining Structures", Sarita prakasha. |
| 3. | Shamsher Prakash, Gopal Ranjan and Swami Saran (1987) "Analysis and Design of Foundations |



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I Year - II Semester	Elective 4	L	T	P	C
		3	0	0	3
a) - Earth Dams					

Pre-Requisites: None

Course Outcomes: At the end of the course, the student will be able to

CO1	Understand the basic concepts of earth-fill dams and rock-fill dams and identify the site topography and foundations conditions
CO2	Identify basic design requirements and causes of failures of dams, distinguish foundation types and the different fill materials
CO3	Estimate seepage through dam sections, foundations and select core and shell materials
CO4	Understand and design the methods to control seepage through different units of dams
CO5	Able to undertake slope stability analysis of dams distinguish different types of instruments like piezometers, settlement gauges and CO6 inclinometers to install for performance studies of dams

Mapping of Course Outcomes with Outcomes:

Course Out Comes	PO1	PO 2	PO 3	PO4	PO5
CO1	1	1	1	1	1
CO2	1	--	2	2	3
CO3	1	2	2	2	2
CO4	--	1	--	3	3
CO5	2	1	1	2	2
CO6	--	1	--	2	3



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Detailed Syllabus:

Unit	Contents	Contact Hours
Unit: 1	BASIC CONCEPTS AND MISCELLANEOUS TOPICS.: Evolution – Types of Dams – Earthfill Dams – Rockfill Dams – Selection of Type of Dam – Site Topography – Foundation Conditions – Basic Design Requirements – Causes of Failure and Deterioration of Dams – Design Investigations – Fill Material – Foundations – Design Studies .	
Unit: 2	SEEPAGE THROUGH DAM SECTION AND ITS CONTROL: Estimation of Seepage through Dam Section and foundation – Considerations in selection and design of core and determination of shell material Drains: – Pervious Downstream Shell – Chimney Drains – Rock Toe and Drains – Use of Geo-textiles as Filter Material.	
Unit: 3	CONTROL OF SEEPAGE THROUGH FOUNDATIONS: General Considerations – different types of cutoff walls – Provision of d/s aprons – relief wells SLOPE PROTECTION – Necessity with respect to u/s and d/s slopes – u/s slope protection by Dumped Riprap- Hand-placed Riprap – Soil -Cement Slope Protection – Downstream Slope Protection by providing berms - grass turfing.	
Unit: 4	STABILITY ANALYSIS OF SLOPES OF EARTH DAMS: Slope stability analysis techniques –Methods of Slices, Fellenius Method, Simplified Bishop method, Taylor's method, Simplified Janbu's Method; Stability of earth dam slopes – u/s slope during sudden drawdown, d/s slope during steady seepage, stability of u/s and d/s slopes during and after construction.	



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Unit: 5	INSTRUMENTATION: – Purpose - Types of Instruments and Brief Description – Installation – piezometers --Casagrande and Vibration wire -- Settlement gauges – Inclinometers.	
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REFERENCE:

1.	Earth Dams by HD Sharma
2.	Earth and Rockfill Dams HD Sharma & Bharat Singh



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I-II Semester	Elective 4	L	T	P	C
		3	0	0	3
b) Geo-Environmental Engineering					

Pre-Requisites: None

Course Outcomes: At the end of the course, the student will be able to

CO1	Understand various ground contaminations, pollution transport phenomena.
CO2	Collect pollutant data
CO3	Apply principles to get the information about the transport through the unsaturated soil
CO4	Develop various models for contamination transport.

Mapping of Course Outcomes with Program Outcomes:

Course Out Comes	PO1	PO 2	PO3	PO4	PO5
CO1	2	--	1	--	1
CO2	1	--	3	1	1
CO3	1	1	2	1	2
CO4	--	2	2	1	2

Detailed Syllabus:

Unit	Contents	Contact Hours
Unit: 1	Introduction- Ground water contamination, pollutant transport and ground water remediation. Sources and Types of ground water contamination – underground storage tanks, Land fills, surface impoundments, waste disposal injection wells, Septic system, Agricultural wastes, Land application, radioactive contamination, other sources of contamination.	



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Unit: 2	Clay Mineralogy, -Clay-water interaction, Electric Charges on Surfaces, Electric Double Layer, Diffuse Double-Layer (DDL) Models, Stern and Grahame Models, Interaction Energies, DLVO Model and Interaction Energies, Swelling Clays, Soil-Water Characteristics, Soil-Water Potentials, Measurement of Soil-Water Potentials, Soil water Characteristics Curves, Evaluation of Measured Soil-Water Potentials, Potentials and Swelling Soils, -Cation exchange capacity, Specific surface area measurements.	
Unit: 3	Contaminant Transport Mechanisms: Introduction – Advection process – Diffusion – Dispersion process – Diffusion – Mass transport Equations : Derivation of advection dispersion equation for solute transport; One Dimensional Models – Continuous source in one dimension – Instantaneous source in one dimension – Adsorption effects – Transport in one dimensional with first order decay – Sorption: The concept of sorption. Factors influencing sorption – Contaminant characteristics, Soil characteristics, Fluid media characteristics. Sorption Isotherm: Linear sorption Isotherm – Freundlich Sorption isotherm – Langmuir Sorption Isotherm, Sorption effects on fate and transport of pollutants.	
Unit: 4	Soil-pollutant interactions, Soil-Water Characteristics, Soil-Water Potentials, Measurement of Soil-Water Potentials, Soil-water Characteristics Curves, Unsaturated Hydraulic conductivity, Governing equation for unsaturated flow, Evaluation of Measured Soil-Water Potentials, Potentials and Swelling Soils, -Cation exchange capacity, Specific surface area measurements.	



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Unit: 5	Remediation and Pollution Mitigation, Pollutants and Site Contamination, Pollution Mitigation, Elimination, and Management, In situ and ex situ Remedial Treatment, Physico-chemical Techniques, Contaminated Soil Removal and Treatment, Vacuum Extraction: Water and Vapour, Electrokinetic Application, Solidification and Stabilization, - Inorganic Pollutants, Permeable reactive barriers, Organic Chemical Pollutants, Biological Techniques.	
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TEXT BOOKS:

1.	Ground water Contamination (Transport and Remediation) By Philip. B. Bedient, Hanadi, S. Rifai& Charles. J. Newell, Prentice Hall PTR, Upper Saddle River, NJ07458.
2.	Geoenvironmental Engineering by Raymond N. Yong, CRC Press.
3.	Barrier Systems for Waste Disposal Facilities by Rowe, R. K., Quigley, R. M., Brachman, R. W. I. and Booker, J. R. (2004), Taylor & Francis, London, UK.
4.	Geotechnical and Geoenvironmental Engineering Hand Book by R. K. Rowe, Springer.

REFERENCES

1.	Geoenvironmental Engineering by R. Krishna Reddy - John Wiley & Sons, Inc.
2.	Geoenvironmental engineering by Reddy, L.N and Inyang, I.H. – Marcel Drekker, 2000.
3.	Environmental geotechniques by Sarsby, R. – Thompson Telford, 2000. Geotechnical Practices for Waste Disposal by Daniel, D.E., 1993.



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I Year - II Semester	Elective 4	L	T	P	C
		3	0	0	3
c) Numerical Methods in Geotechnical Engineering					

Pre-Requisites: None

Course Outcomes: At the end of the course, the student will be able to

CO1	Apply various models to the soil mass to find out the behavior of the soil
CO2	Apply FD solution to homogeneous and layered soils, one, two and three dimensional Consolidation problems
CO3	Apply the FD and FEM solutions for shallow foundations and Deep foundations

Mapping of Course Outcomes with Program Outcomes:

Course Out Comes	PO1	PO2	PO 3	PO4	PO5
CO1	2	1	--	--	1
CO2	1	3	--	--	1
CO3	1	3	--	--	1

Detailed Syllabus:

Unit	Contents	Contact Hours
Unit: 1	Introduction: Categories of Problems in Geo-technical Engineering, Finite Difference Method, Boundary Corrections for Grids. Accuracy, Convergence and Stability. Idealization of soil behaviour; Linear, Bilinear and multi-linear, Hyperbolic, Spline function, Ramberg – Osgood's Model, Polynomials, Higher order elastic models, perfect plasticity, frictional. Elastic models of soil behaviour – The winkler – Filenenko-boroditch – Pasternak – Ressiener models.	
Unit: 2	Seepage: Finite Difference Solution to Laplace equation for Homogeneous and Layered Soils.	



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<u>Unit: 3</u>	Consolidation: Finite Difference Solution for One Dimensional, Two and three dimensional consolidations. Multi layered systems. Consolidation of Ground for Construction Load and Static Load.	
<u>Unit: 4</u>	Shallow Foundations: Beams on Elastic foundations, solution by Finite Difference and – Finite Element Method (Direct Approach) Limit analysis, Lower Bound and Upper bound theories Method of Finite difference solution of Raft foundations.	
<u>Unit: 5</u>	Pile Foundation: Pile Stresses – Static loading – Finite Element Method Solution (Direct approach) of the pile static pile capacity- wave equation -- Lateral piles by Finite Element Method (Direct Approach) and Finite Difference method.	

REFERENCE:

1.	Numerical methods in Geotechnical Engineering by C.S. Desai and J.T. Christian McGraw Hill publications.
2.	Analytical and computer methods in foundation engineering, JE Bowles, McGraw Hill publications.
3.	Foundation analysis and design, JE Bowles, McGraw Hill publications
4.	Foundation analysis by RF Scott, Printice Hall
5.	Hytenyi, Beams on Elastic Foundations – university of Michigan Press.
6.	Elastic Analysis of Soil – Foundation Interaction, APS Selvadurai – Elsevier
7.	Pile Foundation Analalysis& Design by Poulos and Davis.



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I Year - II Semester	Elective 4	L	T	P	C
		3	0	0	3
d) RELIABILITY ANALYSIS AND DESIGN					

Pre-Requisites: None

Course Outcomes: At the end of the course, the student will be able to

CO1	Understand the concepts of structural safety and design methods and basic statistics. He will also be able to appreciate probability theory, random events and random variables.
CO2	Analyse the statistics of properties of concrete and steel and understand the statistics of properties of bricks and mortar and appreciate the analysis of gravity loads and wind loads.
CO3	Upon completing this course, the student will be able to analyse structural reliability and understand its applications.
CO4	Understand the basic variables and failure surface and first order second moment methods.
CO5	At the end of this course, the student will be able to determine partial safety factors, safety checking formats and optimal safety factors. He will also be able to perform RCC design and appreciate the reliability of structural systems.

Detailed Syllabus:

Unit	Contents	Contact Hours
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UNIT 1	Concepts of Structural Safety: General, Design methods. Basic Statistics: Introduction, Data reduction, Histograms, Sample correlation. Probability Theory: Introduction, Random events, Random variables, Functions of random variables, Moments and expectation, Common probability distribution, Extremal distribution.	
UNIT 2	Resistance Distributions and Parameters: Introduction, Statistics of properties of concrete, Statistics of properties of steel, Statistics of strength of bricks and mortar, Dimensional variations, Characterization of variables, Allowable stresses based on specified reliability. Probabilistic Analysis of Loads: Gravity loads, Wind load.	
UNIT 3	Basic Structural Reliability: Introduction, Computation of structural reliability. Monte Carlo Study of Structural Safety: General, Monte Carlo method, Applications.	
UNIT 4	Level 2 Reliability Methods: Introduction, Basic variables and failure surface, First-order second-moment methods (FOSM).	
UNIT 5	Reliability Based Design: Introduction, Determination of partial safety factors, Safety checking formats, Development of reliability based design criteria, Optimal safety factors, Summary of results of study for Indian standard – RCC design. Reliability of Structural Systems: Preliminary concepts as applied to simple structures.	

REFERENCE

1. Structural Reliability by R.EMelchers, John Wiley and Sons Ltd.
2. Structural Reliability Analysis and Design by R.Ranganatham, Jaico Publishing House.



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I Year - II Semester	Laboratory III	L	T	P	C
		0	1	2	2
Advanced Geotechnical Engineering Laboratory					

Pre-Requisites: None

Course Outcomes: At the end of the course, the student will be able to

CO1	conduct various filed tests on soils, analyze and the interpretation of results
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Mapping of Course Outcomes with Program Outcomes:

Course Out Comes	PO1	PO2	PO3	PO4	PO5
CO1	2	–	–	3	–

Detailed Syllabus:

List of Experiments:

S.No	List of Experiments	Contact Hours
1.	Auger boring	
2.	Standard penetration test	
3.	Plate load test	
4.	Field CBR test	
5.	Geotextile Testing : Grab Testing	
6.	Geotextile Testing : Creep Testing	
7.	Electrical resistivity of soil	



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I Year - II Semester	Laboratory IV	L	T	P	C
		0	1	2	2
Software Design Laboratory					

Pre-Requisites: None

Course Outcomes: At the end of the course, the student will be able to

CO1	Develop Computer s for solution of various geotechnical Problems
CO2	Use different Geotechnical software to solve various geotechnical s

Mapping of Course Outcomes with Program Outcomes:

Course Out Comes	PO1	PO2	PO3	PO4	PO5
CO1	1	2	--	1	1
CO2	1	2	--	1	1

Detailed Syllabus:

S.No	List of Experiments	Contact Hours
1.	Ultimate, Net and Safe Bearing Capacity Using Terzaghi and IS Code Methods.	
2.	Net Settlement Pressure	
3.	Hyperbolic Curve Fitting of Tri-axial Compression Data	
4.	Terzaghi One dimensional consolidation solution by FDM (perform analysis of substructures by packages)	
5.	Beam on Elastic Foundation by FDM	
6.	FDM Solution for Raft Foundation	
7.	Axial Loaded Piles by Direct FEM	
8.	Laterally Loaded Piles by FDM & FEM	
9.	Stability Analysis by Bishop theory	
10.	Stability Analysis by Method of Slices.	

The Student Can able to write atleast any Eight Programs listed above