ACADEMIC REGULATIONS (R22PG)

COURSE STRUCTURE AND DETAILED SYLLABUS

For

M.Tech.- Regular Two Year Post Graduate Degree Programe

(For the batches admitted from 2022-23)

MASTER OF TECHNOLOGY
IN
GEOTECHNICAL ENGINEERING

KANDULA SRINIVASA REDDY MEMORIAL COLLEGE OF ENGINEERING

(UGC-Autonomous)

Kadapa 516005, A.P

(Approved by AICTE, Affiliated to JNTUA, Ananthapuramu, Accredited by NAAC)

(An ISO 14001:2004 & 9001: 2015 Certified Institution)

E-mail: principal@ksrmce.ac.in **Website:** www.ksrmce.ac.in

ABOUT THE COLLEGE

The college owes its existence to the keen interest of Late Kandula Obul Reddy to develop technical education in Rayalaseema region of Andhra Pradesh. With a view to translating his noble ideal of imparting technical education into reality, a Technical Training Institute at Vempalli, Kadapa District was started in 1979 under the aegis of Sri Kandula Obul Reddy charities. It is in the year 1980 that K.S.R.M. College of Engineering was established to perpetuate the memory of Late Sri. Srinivasa Reddy, youngest son of Late Sri Obul Reddy. Sri Srinivasa Reddy, a brilliantstudent of III year Mechanical Engineering at Delhi College of Engineering, New Delhi, met with his untimely death in a scooter accident on 18th Oct, 1979. The college was formally inaugurated on 14 November 1980 by Sri T. Anjaiah, the Chief Minister of Andhra Pradesh and it started functioning from the academic year 1980-81.

The college had its modest beginnings in 1980 with an intake of 160 students with core branches "Civil, Electrical & Electronics, Electronics & Communications and Mechanical Engineering. Keeping in view the latest trends, priorities and relevance in Engineering and Technology, the Board of Management decided to start Computer Science and Engineering in 1990 commemorating the decennial year of the college. With the conserted efforts of the Management and the Successive Principals, the departments have been strengthened year after year and the intake has steadily been increased to 1080 by the year 2014. Furthering its sphere of activity, the college started post graduate programme in CAD/CAM (ME), Geo-technical Engineering (CE) in the year 2004, Power Systems (EEE) & Computer Science and Engineering (CSE) during 2010-11 and Digital Electronics and Communication Systems (ECE) in 2011-12 respectively. The branches have constantly been strengthened by increasing the intake from time to time. This reflects one aspect of the progress and development of the college.

The College campus is located 7 K.M. away from Kadapa town on Kadapa to Pulivendula Highway in a calm and salubrious area of 35 acres. The College is set in a serene environment with lush greenery and fresh air. Four multi-storeyed RCC structures measuring 26,700 sqm provide accommodation for the departments. The College has dedicated electric power feeder and 250 KVA substation. Other capital resources include transport vehicles and four hostels. Excellent Bus facilities exist from Kadapa to Hyderabad, Vijayawada, Nellore, Tirupati, Kurnool, Bangalore, Chittoor and Chennai.

VISION

To evolve as center of repute for providing quality academic programs amalgamated with creative learning and research excellence to produce graduates with leadership qualities, ethical and human values to serve the nation.

MISSION

M1: To provide high quality education with enriched curriculum blended with impactful teaching learning practices.

M2: To promote research, entrepreneurship and innovation through industry collaborations.

M3: To produce highly competent professional leaders for contributing to Socio-economic development of region and the nation.

ABOUT THE DEPARTMENT

Civil Engineering Department of KSRM College of Engineering is one of the five founding departments since the college was established in the year 1979. The motto of the department is EXCEED (Excellence in Civil Engineering Education). The department is offering B.Tech program with an intake of 180 students. The department is also offering M.Tech program in Geotechnical Engineering with an intake of 18 students. The department has well equipped laboratories needed for undergraduate and post graduate students. The department produced many skilled engineers, the bulk of whom made successful lives for themselves in India and abroad since inception. The department provides valuable consultancy services to various Government and Non-governmental Departments and individual firms in and around Rayalaseema region. The Civil Engineering Department is recognized as research center by JNTUA, Ananthapuramu. AICTE sponsored 13.55 Lakhs under MODROBS scheme to modernize and equip with latest digital equipment in Geotechnical Engineering Lab. The department undertakes all the infrastructure development and maintenance activities/works across the Kandula Group of Institutions-Kadapa.

VISION

To become a frontrunner in the field of Civil Engineering, and tackle national and global challenges that aligns with the needs of society.

MISSION

M1: To provide value added education and cope up with the changes through innovative and dynamic curriculum.

M2: To engage in research that creates state-of-the-art technologies and futuristic knowledge, with a strong emphasis on meeting the socio-economic requirements of society.

M3: To produce globally competent professionals with leadership skills, team work and ethical conduct.

PROGRAMME EDUCATIONAL OBJECTIVES

PEO1 - To excel in professional career in the industry or to be a successful entrepreneur to create a sustainable built environment.

PEO2 - To pursue higher education and involve in research with zeal for lifelong learning.

PEO3 - To demonstrate leadership qualities, ethical values and environmental awareness, to serve the society.

PROGRAMME OUTCOMES

1. **Engineering knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
2. **Problem analysis**: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
3. **Design/development of solutions**: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
4. **Conduct investigations of complex problems**: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
5. **Modern tool usage**: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
6. **The engineer and society**: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
7. **Environment and sustainability**: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
8. **Ethics**: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
9. **Individual and team work**: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
10. **Communication**: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
11. **Project management and finance**: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
12. **Life-long learning**: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

PROGRAMME SPECIFIC OUTCOMES

The graduates in Civil Engineering will be able to

PSO 1: Analyze, Design, Construct, Maintain and Operate infrastructural projects.
PSO 2: Assess the environmental impact of various projects and take required measures to curb environmental deterioration.
PSO 3: Use latest software pertaining to various streams of Civil Engineering.

K.S.R.M College of Engineering (Autonomous), KADAPA - 516005, AP
Regulations for PG Programs in Engineering (R22 PG)
(Effective from 2022-23)

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1.0 Nomenclature

1.1 *Academic Year*: Academic Term of, approximately, one-year duration that usually starts in June/July and ends in April/May next
1.2 *Semester*: Either of two Academic Terms that make up an Academic Year
1.3 *Major*: A specific field of study
1.4 *Minor*: An area outside of, or complementary to, a Major
1.5 *Subject*: An area of knowledge that is studied as part of a Course
1.6 *Core*: A subject that is mandatory for a Major course of study
1.7 *Elective*: A subject that is selected for study to suit one's individual needs
1.8 *Audit Subject*: A subject that is studied to meet certain requirements but has no credits assigned to it
1.9 *Humanities subjects*: Subjects that describe and interpret human achievements, problems and historical changes at individual and societal levels covering the disciplines of literature, history, and philosophy
1.10 *Social Sciences subjects*: Subjects that describe the mental and behavioural activities of individuals, groups, organizations, institutions, and nations covering the disciplines of anthropology, economics, linguistics, political science, and psychology
1.11 *Exam*: A test to measure one's progress, knowledge, or ability in a subject
1.12 *Credit*: A numerical weight given to a subject
1.13 *Grade*: A numerical or alphabetic designation measuring the level of achievement in an exam
1.14 *Attendance*: Physical presence of oneself in a classroom/laboratory for purpose of a scheduled academic instruction
1.15 *Course*: A series of subjects that constitute a Major field of study
1.16 *Branch*: Same as Course
1.17 *Program*: Same as Course
1.18 *Specialization*: Same as branch
1.19 *Degree*: An academic title conferred to honour distinguished achievement

2.0 Short Title and Application

2.1 These rules and regulations may be called as R22PG and come into force from Academic Year 2022-23 and exist until superseded by new regulations
2.2 These rules and regulations are applicable to all post graduate courses in engineering and technology leading to Master's Degree in Technology (M. Tech)
2.3 The Specializations offered, at present, are:
  2.3.1 Geotechnical Engineering, Code - 12
  2.3.2 Power Systems, Code - 07
  2.3.3 Renewable Energy, Code - 99
  2.3.4 Embedded Systems and VLSI, Code - 84
  2.3.5 Artificial Intelligence and Data Science, Code - 98
2.4 The Institute may offer new Specializations in future to which these rules and regulations will be applicable.

3.0 Suspension and Amendment of Rules

3.1 Academic Council has the authority to suspend a rule temporarily.

3.2 Academic Council has the authority to amend a rule.

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

4.0 Requirements for Admission

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

4.2 A student is not allowed change of Specialization after admission.

4.3 A student must fulfil medical standards required for admission.

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

5.0 Structure of the M. Tech course

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

5.2 *Working Days*: Calendar for any semester shall be announced at least four weeks before its commencement. Minimum number of working days is 90 per semester.

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

5.4 *Credits*: All subjects that are assessed for marks have credits assigned to them. The credits assigned to subjects shall be given in curriculum. The total number of credits for entire course is 70 for all Specializations. The distribution of total credits semester-wise is given in Table 1.

Table 1 Semester-wise Total Credits:

Semester	Total Credits
First Semester	18
Second Semester	18
Third Semester	18
Fourth Semester	16
Total for entire course	**70**

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

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

their Faculty Advisors for selection of electives and for general advice on academic program.

5.7 All subjects/courses offered for the M.Tech. degree programme are broadly classified as follows:

S.No.	Broad Course Classification	Course Category	Description
1.	Core Courses	Foundational & Professional Core Courses (PC)	Includes subjects related to the parent discipline/department/branch of Engineering
2.	Elective Courses	Professional Elective Courses (PE)	Includes elective subjects related to the parent discipline/department/ branch of Engineering
		Open ElectiveCourses (OE)	Elective subjects which include inter - disciplinary subjects or subjects in an area outside the parent discipline which are of importance in the context of special skill development
3.	Research	Research Methodology & IPR	To understand importance and process of creation of patents through research
		Technical Seminar	Ensures preparedness of students to undertake major projects/Dissertation, based on core contents related to specialization
		Co-curricular Activities	Attending conferences, scientific presentations and other scholarly activities
		Dissertation	M.Tech. Project or Major Project
4.	Audit Courses	Mandatory noncredit courses	Covering subjects of developing desired attitude among the learners is on the line of initiatives such as Unnat Bharat Abhiyan, Yoga, Value educationetc.

6.0 Registration and Enrolment

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

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

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

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

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

7.0 Assessment Procedure – Internal Tests and End Examinations

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

7.2 Allocation of internal assessment and End examination marks.

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

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

7.2.3 For mini-project/mini-project with seminar total 100 marks are allocated for internal assessment. There shall be no end examination for this mini-project.

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

7.3 Internal Assessment Examinations

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

7.3.2 For theory subjects, including audit subjects, the internal assessment shall be done by midterm tests. For each subject, two midterm tests will be conducted for 40 marks each and the internal assessment mark is the better of two marks. If any student abstains for any midterm test, she or he will be awarded zero marks for that midterm test. There shall be no choice of questions in midterm tests.

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

7.3.4 There shall be a **Technical Seminar** during II semester for internal evaluation of 100 marks. 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, two other senior faculty members and faculty guide of the concerned student. The student has to secure a minimum of 50% of marks, to be declared successful. If he fails to obtain the minimum marks, he has to reappear for the same as and when supplementary examinations areconducted. The Technical seminar shall be conducted anytime during the semester as per the convenience of the Project Review Committee and students. There shall be no external examination for Technical Seminar.

7.3.5 There shall be Mandatory **Audit courses** in I & II semesters for zero credits. There is no external examination for audit courses. However,

attendance shall be considered while calculating aggregate attendance and student shall be declared to have passed the mandatory course/audit course only when he/she secures 50% or more in the internal examinations. In case, the student fails, a re- examination shall be conducted for failed candidates for 40 marks.

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

7.4 End examinations

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

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

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

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

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

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

7.4.7 There is no end examination for audit subjects.

8.0 Method of Assigning Letter Grades and Grade Points

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

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

8.3 Pass grade A+ to D+ is assigned to a subject based on total marks earned in that subject provided that a student earns at least i) 35% of marks in End examination marks and ii) 50% of marks in internal and End examination marks put together; otherwise fail grade F will be assigned to that subject.

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

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

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

Table 2: Letter Grades and Grade Points

Absolute Marks	Letter Grade	Grade Points	Remark
90-100	S (Out Standing)	10.0	Pass
80-89	A (Excellent)	9.0	Pass
70-79	B (Very Good)	8.0	Pass
60-69	C (Good)	7.0	Pass
50-59	D (Pass)	6.0	Pass
<50	F (Fail)	0.0	Fail
Absent	AB (Absent)	0.0	Fail
---	I	0.0	Result Withheld

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

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

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

8.10 CGPA to Percentage Conversion:

$$\text{Percentage} = (\text{CGPA} - 0.5) * 10$$

9.0 Credit Transfer Policy

As per University Grants Commission (Credit Framework for Online Learning Courses through SWAYAM) Regulation, 2016, the University shall allow up to a maximum of 40% of the total courses being offered in a particular Programme in a semester through the Online Learning courses through SWAYAM.

9.1 The University shall offer credit mobility for MOOCs and give the equivalent credit weightage to the students for the credits earned through online learning courses through SWAYAM platform.

9.2 The online learning courses available on the SWAYAM platform will be considered for credit transfer. SWAYAM course credits are as specified in theplatform.

9.3 Student registration for the MOOCs shall be only through the institution, it is mandatory for the student to share necessary information with the institution.

9.4 The institution shall select the courses to be permitted for credit transfer through SWAYAM. However, while selecting courses in the online platform institution would essentially avoid the courses offered through the curriculum in the offline mode.

9.5 The institution shall notify at the beginning of semester the list of the online learning courses eligible for credit transfer in the forthcoming Semester.

9.6 The institution shall also ensure that the student has to complete the course and produce the course completion certificate as per the academic schedule given for the regular courses in that semester

9.7 The institution shall designate a faculty member as a Mentor for each course to guide the students from registration till completion of the credit course.

9.8 The college shall ensure no overlap of SWAYAM MOOC exams with that of the college end examination schedule. In case of delay in SWAYAM results, the university will re-issue the marks sheet for such students.

9.9 Student pursuing courses under MOOCs shall acquire the required credits only after successful completion of the course and submitting a certificate issued by the competent authority along with the percentage of marks and grades.

Note: Students shall also be permitted to register for MOOCs offered through online platforms other than SWAYAM NPTEL.

10.0 Re-registration for Improvement of Internal Evaluation Marks

A candidate shall be given one chance to re-register for each subject provided the internal marks secured by a candidate are less than 50% and has failed in the end examination

10.1 The candidate should have completed the course work and obtained examinations results for **I, II and III** semesters.

10.2 The candidate shall be given one chance for each Theory subject and for a maximum of **three** Theory subjects for Improvement of Internal evaluation marks.

10.3 The candidate has to re-register for the chosen subjects and fulfil the academic requirements.

10.4 For reregistration the candidates have to apply to the college by paying the requisite fees, before the start of the semester in which re-registration is required

10.5 In the event of availing the Improvement of Internal evaluation marks, the internal evaluation marks as well as the End Examinations marks secured in the previous attempt(s) for the reregistered subjects stand cancelled.

11.0 Credits for Co-Curricular Activities

A Student shall earn 02 credits under the head of co-curricular activities, viz., attending Conference, Scientific Presentations and Other Scholarly Activities. Following are the guidelines for awarding Credits for Co-Curricular Activities:

Name of the Activity	Maximum Credits / Activity
Participation in National Level Seminar / Conference / Workshop / Training programs (related to the specialization of the student)	1
Participation in International Level Seminar / Conference / workshop/Training programs held outside India (related to the specialization of the student)	2
Academic Award/Research Award from State Level / National Agencies	1
Academic Award/Research Award from International Agencies	2
Research / Review Publication in National Journals (Indexed in Scopus/Web of Science)	1
Research / Review Publication in International Journals with Editorial board outside India (Indexed in Scopus / Web of Science)	2
Vocational Course / Certificate Course (Minimum 36 hours)	2

Note:

i) Credit shall be awarded only for the first author. Certificate of attendance and participation in a Conference/Seminar is to be submitted for awarding credit.

ii) Certificate of attendance and participation in workshops and training programs (Internal or External) is to be submitted for awarding credit. The total duration should be at least one week.

iii) Participation in any activity shall be permitted only once for acquiring required credits under co-curricular activities.

12.0 Requirements for Completing Subjects

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

12.2 *Credit-bearing subjects*: A student is considered to have completed a credit-bearing subject successfully and earned credits if she or he obtains a pass grade from A+ to D+ in that subject. If a student receives fail grade F or X in any subject, she or he must register for supplementary End examination for that subject as and when opportunity arises and improve grade to pass grade

12.3 *Audit subjects*: A student is considered to have successfully completed an audit subject if she or he earns at least 40% of marks in internal assessment marks.

Supplementary exam for audit subjects: If a student fails in audit subject, she or he shall register for supplementary examination in that subject as and when the opportunity arises and pass that subject. The supplementary exam will be

conducted for 40 marks covering the entire syllabus and student is deemed to have passed in the subject if she or he earns 16 marks (40% marks) in the supplementary exam, disregard of her or his performance in internal tests.

13.0 Requirements for taking End Examinations

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

13.2 A student shall be promoted from current semester to succeeding semester on satisfying the attendance requirement.

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

13.4 Attendance Requirement

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

13.4.2 Total class-periods conducted shall be reckoned from beginning to end of a semester as published in academic calendar.

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

13.4.5 A minimum aggregate attendance of 75% is required for promotion to succeeding semester.

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

13.4.7 A student earning less than 75% aggregate attendance will be denied promotion. A student who is not promoted on basis of attendance shall be removed from the rolls and shall register for the same semester when opportunity arises. The current semester record of the student is cancelled automatically.

14.0 Revaluation of End Examination Scripts

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

14.2 A Procedure for Revaluation: The script will be revaluated by an examiner appointed by the Principal. The maximum of revaluation and regular end examination marks will be awarded for that subject.

14.3 A student can apply for revaluation in a subject only once.

15.0 Supplementary End Examinations

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

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

15.3 A student will be allowed to improve grade in any theory subject provided she or he has completed coursework of all semesters but before award of provisional/final degree.

16.0 Requirements for Award of M. Tech degree

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

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

16.2.1 Registered and successfully completed all required credit-bearing and audit subjects with a total of 68 credits.

16.2.2 Secured a CGPA of 5.5 or more.

16.2.3 Cleared all dues to the Institute, library and hostel.

16.2.4 No disciplinary action is pending against her or him.

16.2.5 Satisfied any other stipulation of the affiliating University.

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

Table 3 Class of Degree

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

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

17.0 Transitory Regulations

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

Rules for Disciplinary Action for Malpractice / Improper Conduct inExaminations

S. No	Nature of Malpractice/Improper conduct	Punishment
1.	Possesses or keeps accessible, 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 examination hall in which he is appearing but has not made use of (material shall include any marks on the body of the student which can be used as an aid in the subject of the examination)	Expulsion from the examination hall and cancellation of the performance only in that subject.
2.	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.
3.	Copying detected on the basis of internal evidence, such as, during valuation or during special scrutiny.	Cancellation of the performance in that subject.
4.	Gives / receives assistance or guidance from any other student orally or by communicatingbody language.	Expulsion of both from the examination hall and cancellation of the performance only in that subject.
5.	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 student is appearing.	If copied material is related to the concerned subject and if that material is related to question paper then expulsion from the examination hall and cancellation of the performance in that subject and all other subjects including practical examinations and project workof that semester/year, otherwise expulsion from that subject only.
6.	Enters in a drunken state to the examination hall.	Expulsion from the examination hall and cancellation of performance in all subjects of the semester/year including practical examinations and projectwork.
7.	Smuggles in the Answer book or takes out or arranges to send out the question paper during the examination or answer book during or after the examination	Expulsion from the examination hall and cancellation of performance in all subjects of the semester / year including practical examinations and projectwork.
8.	Any outsider or impersonator found in and oroutside the examination hall.	Handing him over to the police and registering a case against him.

COURSE STRUCTURE

Annexure – 1 Curriculum
Geotechnical Engineering (Civil Engineering)

1st Semester

S. No.	Course Codes	Course Name	Category	L	T	P	IM	EM	Credits
1	2212101	Advanced Soil Mechanics	PCC	3	0	0	40	60	3
2	2212102	Advanced Foundation Engineering	PCC	3	0	0	40	60	3
3	**Program Elective Course – I**		PEC	3	0	0	40	60	3
	2212103	Soil Structure Interaction							
	2212104	Ground Improvement Techniques							
	2212105	Geoenvironmental Engineering							
4	**Program Elective Course – II**		PEC	3	0	0	40	60	3
	2212106	Critical Soil Mechanics							
	2212107	FEM in Geotechnical Engineering							
	2212108	Pavement Analysis and Design							
5	2212109	Soil Mechanics – 1 Lab	PCC	0	0	4	50	50	2
6	2212110	Soil Mechanics – 2 Lab	PCC	0	0	4	50	50	2
7	2212111	Research Methodology & IPR	-	2	0	0	40	60	2
8	**Audit Course – I**		Audit	2	0	0	40	0	0
	2270A01	English for Research Paper Writing							
	2270A02	Disaster Management							
	2270A03	Sanskrit for Technical Knowledge							
				16	**0**	**8**	**340**	**400**	**18**

2nd Semester

S. No.	Course Codes	Course Name	Category	L	T	P	IM	EM	Credits
1	2212201	Experimental Geomechanics	PCC	3	0	0	40	60	3
2	2212202	Earth Retaining Structures	PCC	3	0	0	40	60	3
3	**Program Elective Course – III**		PEC	3	0	0	40	60	3
	2212203	Dynamics of Soil and Foundations							
	2212204	Foundations on Expansive Soils							
	2212205	Offshore Geotechnical Engineering							
4	**Program Elective Course – IV**		PEC	3	0	0	40	60	3
	2212206	Design of Under Ground Excavations							
	2212207	Design with Geosynthetics							
	2212208	Geotechnical Earthquake Engineering							
5	2212209	Subsoil Exploration Lab	PCC	0	0	4	50	50	2
6	2212210	Geotechnical Engineering Modeling Lab	PCC	0	0	4	50	50	2
7	2212211	Technical Seminar	-	0	0	4	100	0	2
8	**Audit Course – II**		Audit	2	0	0	40	0	0
	2270A04	Value Education							
	2270A05	Constitution of India							
	2270A06	Pedagogy Studies							
				14	**0**	**12**	**400**	**340**	**18**

3rd Semester

S. No.	Course Codes	Course Name	Category	L	T	P	IM	EM	Credits
1	**Program Elective Course – V**		PEC	3	0	0	40	60	3
	2212301	Stability Analysis of Slopes							
	2212302	Foundations on Weak Rocks							
	2212303	Computational Geomechanics							
2	**Open Elective**		OEC	3	0	0	40	60	3
	2212304	Business Analytics							
	2212305	Operations Research							
	2212306	Waste to Energy							
3	2212307	Dissertation Phase – 1 (to be continued nest semester)	Project	0	0	20	100	0	10
4	2212308	Co-Curricular Activities		0	0	0	0	0	2
				6	**0**	**20**	**180**	**120**	**18**

4th Semester

S. No.	Course Codes	Course Name	Category	L	T	P	IM	EM	Credits
1	2212401	Dissertation Phase - 2	Project	0	0	32	50	50	16
				0	**0**	**32**	**50**	**50**	**16**

M.TECH.-
I- SEMESTER SYLLABUS

Course Title	ADVANCED SOIL MECHANICS					M. Tech. GTE I Sem		
Course Code	Category	Hours/Week			Credits	Maximum Marks		
2212101	PCC	L	T	P	C	Continuous Internal Assessment	End Exam	Total
		3	0	0	3	40	60	100
Mid Exam Duration: 02.00 Hrs.						End Exam Duration: 03.00 Hrs.		

Course Objectives: The course is designed to students,

- To explain about the consolidation theory, strength behaviour of soil under various conditions, analyze the stress paths for different practical situations, study the critical parameters in soils, study the elastic and plastic deformations in soils

Course Outcomes: On successful completion of this course, the student will be able to

CO 1	Determination of consolidation properties
CO 2	Determine the shear strength properties and interpretation of the triaxial test results
CO 3	Draw the stress paths for drained and undrained conditions of the soil mass
CO 4	Determine the critical state parameters of the soils
CO 5	Understand the elastic and plastic deformations

UNIT – I

Compressibility of Soils

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

UNIT – II

Strength Behavior of Soils

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

UNIT – III

Stress Path

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

UNIT – IV

Critical State Soil Mechanics

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

UNIT – V

Elastic and Plastic Deformations

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

Text books:

1. Das, B.M., Advanced Soil Mechanics, Taylor and Francis, 5th Edition, 2019.
2. Terzaghi, K., and Peck, R.B., Soil Mechanics in Engineering Practice, John Wiley & Sons, 1996.

Reference Books:

1. Atkinson, J.H. and Bransby, P.L, The Mechanics of Soils: An Introduction to Critical Soil Mechanics, McGraw Hill, 2013.
2. Wood, D.M., Soil Behavior and Critical State Soil Mechanics, Cambridge University Press, 1991.

Course Title	ADVANCED FOUNDATION ENGINEERING				M. Tech. GTE I Sem		
Course Code	Category	Hours/Week			Credits	Maximum Marks		
2212102	PCC	L	T	P	C	Continuous Internal Assessment	End Exam	Total
		3	0	0	3	40	60	100
Mid Exam Duration: 02.00 Hrs.						End Exam Duration: 03.00 Hrs.		

Course Objectives: The course is designed to students,

- To emphasize the importance of soil investigations including destructive and non-destructive methods
- To explain the concept of bearing capacity and how to estimate the safe bearing capacity for various foundation system including settlement consideration
- To explain the need and how do analysis the pile and pile group under various soil conditions
- To explain the concepts of Terzaghi and IRC Methods and individual components
- To analyze the foundations under uplifting loads

Course Outcomes: On successful completion of this course, the student will be able to

CO 1	Prepare the exploration report and bring the correlations between the soil properties
CO 2	Design the footing and estimating the bearing capacity for various theories
CO 3	Estimate the load capacity, group action and settlement by various methods
CO 4	Design the well foundation and its components
CO 5	Design the foundations for uplifting loads

UNIT – I

Planning of Soil Exploration

Planning of Soil Exploration for Different Projects, Methods of Subsurface Exploration, Methods of Borings Along with Various Penetration Tests.

UNIT – II

Shallow Foundations

Requirements for Satisfactory Performance of Foundations, Methods of Estimating Bearing Capacity, Settlements of Footings and Rafts, Proportioning of Foundations Using Field Test Data, IS Codes.

UNIT –III

Pile Foundations

Methods of Estimating Load Transfer of Piles, Settlements of Pile Foundations, Pile Group Capacity and Settlement, Negative Skin Friction of Piles, Laterally Loaded Piles, Pile Load Tests, Analytical Estimation of Load- Settlement Behavior of Piles, Proportioning of Pile Foundations, Lateral and Uplift Capacity of Piles.

UNIT – IV

Well Foundation

IS and IRC Codal Provisions, Elastic Theory and Ultimate Resistance Methods.

UNIT – V

Coffer Dams

Various Types, Analysis and Design Foundations under Uplifting Loads

Text books:

1. Bowles. J.E., Foundation Analysis and Design, Tata McGraw-Hill International Edition, 5th Edition, 1997.
2. Das B.M., Shallow Foundations: Bearing capacity and settlement, CRC Press, 2017.

Reference Books:

1. Tomlinson M.J., Pile design and construction Practice, Chapman and Hall Publication, 2008.
2. Poulos, H. G. and Davis, F. H., "Pile Foundation Analysis and Design", Wiley and Sons. 1980

Course Title	SOIL STRUCTURE INTERACTION (Program Elective Course – I)				M. Tech. GTE I Sem		
Course Code	Category	Hours/Week			Credits	Maximum Marks		
2212103	PEC	L	T	P	C	Continuous Internal Assessment	End Exam	Total
		3	0	0	3	40	60	100
Mid Exam Duration: 02.00 Hrs.						End Exam Duration: 03.00 Hrs.		

Course Objectives: The course is designed to students,

- To study the soil and foundation behaviour
- To analyze the beams on elastic foundations
- To analyze the plates on elastic medium
- To analyze the piles on elastic medium
- To analyze the load prediction on piles

Course Outcomes: On successful completion of this course, the student will be able to

CO 1	Apply different soil response models for specific problems based on the requirement
CO 2	Analyze the footings on elastic foundations
CO 3	Analyze the plates on elastic foundations
CO 4	Analyze the piles on elastic analysis and their settlement
CO 5	Compute pile response for various loading conditions for design purpose

UNIT – I

Soil-Foundation Interaction

Introduction to soil-foundation interaction problems, Soil behavior, Foundation behavior, Interface behavior, Scope of soil foundation interaction analysis, soil response models, Winkler, Elastic continuum, Two parameter elastic models, Elastic plastic behavior, Time dependent behavior.

UNIT – II

Beam on Elastic Foundation - Soil Models

Infinite beam, Two parameters, Isotropic elastic half space, Analysis of beams of finite length, Classification of finite beams in relation to their stiffness.

UNIT – III

Plate on Elastic Medium

Thin and thick plates, Analysis of finite plates, Numerical analysis of finite plates, simple solutions.

UNIT – IV

Elastic Analysis of Pile

Elastic analysis of single pile, Theoretical solutions for settlement and load distributions, Analysis of pile group, Interaction analysis, Load distribution in groups with rigid cap.

UNIT – V

Laterally Loaded Pile

Load deflection prediction for laterally loaded piles, Subgrade reaction and elastic analysis, Interaction analysis, Pile-raft system, Solutions through influence charts. An introduction to soil-foundation interaction under dynamic loads.

Text Books:

1. Selvadurai, A.P.S, Elastic Analysis of Soil-Foundation Interaction, Elsevier, 1979.
2. Poulos, H. G. and Davis, F. H., "Pile Foundation Analysis and Design", Wiley and Sons. 1980

Reference Books:

1. Structure Soil Interaction - State of Art Report, Institution of Structural Engineers, 1978.
2. Hemsley, J.A, Elastic Analysis of Raft Foundations, Thomas Telford, 1998.

Course Title	GROUND IMPROVEMENT TECHNIQUES (Program Elective Course – I)				M. Tech. GTE I Sem		
Course Code	Category	Hours/Week			Credits	Maximum Marks	
2212104	PEC	L	T	P	C	Continuous Internal Assessment	End Exam	Total
		3	0	0	3	40	60	100
Mid Exam Duration: 02.00 Hrs.						End Exam Duration: 03.00 Hrs.		

Course Objectives: The course is designed to students,

- To study the various modification methods, earth reinforcement techniques and their applications.

Course Outcomes: On successful completion of this course, the student will be able to

CO 1	Understand the mechanical modification and their importance
CO 2	Understand the chemical modification and their importance
CO 3	Understand the thermal modification and their importance
CO 4	Understand the mechanism of soil reinforcement and types of reinforcement
CO 5	Understand the applications of reinforcement, analysis and design

UNIT –I

Mechanical Modification

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

UNIT – II

Chemical Modification

Modification by admixtures, stabilization using industrial wastes, grouting

UNIT – III

Thermal Modification

Ground freezing and thawing.

UNIT –IV

Soil Reinforcement

Reinforced earth, basic mechanism, type of reinforcements, selection of stabilization / improvement of ground using Geotextiles, Goegrid, geomembranes, geocells, geonets, and soil nails.

UNIT – V

Application of Soil Reinforcement

Shallow foundations on reinforced earth, design of reinforced earth retaining walls, reinforced earth embankments structures, wall with reinforced backfill, analysis and design of shallow foundations on reinforced earth, road designs with geosynthetics.

Text Books:

1. Hausmann, M.R., Engineering Principles of Ground Modification, McGraw-Hill International Editions, 2013.
2. Moseley, M.P., Ground Improvement, Blackie Academic & Professional, 2004.

Reference Books:

1. Xanthakos, P.P., Abramson, L.W. and Bruce, D.A., Ground Control and Improvement, John Wiley & Sons, 1994.
2. Koerner, R. M., Designing with Geosynthetics, Prentice Hall Inc. 2012.

Course Title	GEOENVIRONMENTAL ENGINEERING (Program Elective Course – I)				M. Tech. GTE I Sem		
Course Code	Category	Hours/Week			Credits	Maximum Marks	
2212105	PEC	L	T	P	C	Continuous Internal Assessment	End Exam	Total
		3	0	0	3	40	60	100
Mid Exam Duration: 02.00 Hrs.						End Exam Duration: 03.00 Hrs.		

Course Objectives: The course is designed to students,

- To learn concepts of geo-environmental engineering, and planning and design of waste in landfills, ash ponds and tailing ponds.
- Explain the effects of pollutants in soil properties
- Awareness about the adverse effects of soil and ground water contaminants
- Analyze and apply the various techniques for remediation of the contaminants

Course Outcomes: On successful completion of this course, the student will be able to

CO 1	Understand the soil-environment interaction and contaminants
CO 2	Design the landfill and its stability
CO 3	Identify the slurry waste, design the slurry ponds and its operations
CO 4	Identify the contaminated sites and design the barriers
CO 5	Identify the properties of the waste and reuse the material

UNIT –I

Introduction and Contamination

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

UNIT – II

Contaminants of Solid Waste in Landfills

Waste contaminants, landfills, types, shape and size of landfills. Liner and liner system, Cover and cover system, Stability of landfills. Landfill construction & operation, sustainable waste management.

UNIT – III

Contaminants of Slurry Wastes

Slurry transported wastes, slurry ponds, operation, Embankment construction and raising, Design aspects, Environmental Impact and control.

UNIT – IV

Vertical Barriers for Contaminant

Contaminated sites, Types of barriers, Soil-Bentonite slurry trench walls, Cement-Bentonite slurry trench walls, construction, material and design aspects.

UNIT – V

Geotechnical Reuse of Waste Materials

Waste reduction, use in geotechnical construction, waste characteristics, transportation consideration, Engineering properties of Wastes, Waste material in Embankment and Fills.

Text Books:

1. Geo-environmental Engineering by Sharma H.D & Reddy K.R, John Wiley & Sons, Inc, 2004.
2. Geo-environmental Engineering by Reddi L.N & Inyang. H.I, CRC Press, 2000.

Reference Books:

1. Geotechnical Geo – Environmental Engineering hand Book – Kerry Row, Springer Science, New York, 2001.
2. Ground Water Contamination: Bedient, Refai & Newell, Prentice Hall Publishers, 1999.

Course Title	CRITICAL SOIL MECHANICS (Program Elective Course – II)				M. Tech. GTE I Sem		
Course Code	Category	Hours/Week			Credits	Maximum Marks		
2212106	PEC	L	T	P	C	Continuous Internal Assessment	End Exam	Total
		3	0	0	3	40	60	100
Mid Exam Duration: 02.00 Hrs.						End Exam Duration: 03.00 Hrs.		

Course Objectives: The course is designed to students,

- To demonstrate basic mechanisms behind index properties and tests on soil, relate behaviour of soils subjected to various loading and drainage conditions within unified framework of Critical state soil mechanics.
- To analyze theory of elasticity and plasticity to characterize the stress – strain behaviour of soils and to formulate basic elasto-plastic model based on Critical State Soil Mechanics (CSSM) like Cam-clay

Course Outcomes: On successful completion of this course, the student will be able to

CO 1	Understand the behaviour soil under various stress strain conditions
CO 2	Determine the critical state line for various drained conditions
CO 3	Understand the behaviour of over consolidated soils
CO 4	Understand the behaviour of sands in critical state
CO 5	Understand the behaviour of sails before failure by constructing elasto-plastic model

UNIT –I

Soil Behavior

State of Stress and Strain in Soils, Stress and Strain Paths and Invariants, Behavior of Soils under Different Laboratory Experiments

UNIT – II

The Critical State Line and the Roscoe Surface

Families of Undrained Tests, Families of Drained Tests, The Critical State Line, Drained and Undrained Surfaces, The Roscoe Surface

UNIT – III

Behavior of Over Consolidated Samples

The Hvorslev Surface: Behaviour of Over Consolidated Samples, Drained and Undrained Tests, The Hvorslev Surface, Complete State Boundary Surface, Volume Changes and Pore Water Pressure Changes

UNIT – IV

Behaviour of Sands

The Critical State Line for Sands, Normalized Plots, The Effect of Dilation, Consequences of Taylor's Model

UNIT – V

Behaviour of Soils before Failure

Elastic and Plastic Deformations, Plasticity Theory, Development of Elastic-Plastic Model Based on Critical State Soil Mechanics, The Cam-Clay Model, The Modified Cam-Clay Model

Text Books:

1. J. H. Atkinson and P. L. Bransby, "The Mechanics of Soils: An Introduction to Critical State Soil Mechanics", Mcgraw Hill, 1978
2. Wood, D.M., Soil Behavior and Critical State Soil Mechanics, Cambridge University Press, 1991

Reference Books:

1. B. M. Das, "Fundamental of Geotechnical Engineering", Cengage Learning, 2013
2. Das, B.M., Advanced Soil Mechanics, Taylor and Francis, 5th Edition, 2019.

Course Title	FEM IN GEOTECHNICAL ENGINEERING (Program Elective Course – II)				M. Tech. GTE I Sem		
Course Code	Category	Hours/Week			Credits	Maximum Marks	
2212107	PEC	L	T	P	C	Continuous Internal Assessment	End Exam	Total
		3	0	0	3	40	60	100
Mid Exam Duration: 02.00 Hrs.						End Exam Duration: 03.00 Hrs.		

Course Objectives: The course is designed to students,

- To explain the basic concepts of FEM
- To explain the principles and formulation of variational methods
- To analyze the displacements and explain the problems in soils and rocks
- To explain the applications of FEM in geotechnical engineering

Course Outcomes: On successful completion of this course, the student will be able to

CO 1	Understand the basic concepts of the FEM
CO 2	Understand the various principles an boundary condition in FEM
CO 3	Analyzing the one and two dimensional problems
CO 4	Understand the FEM and FDM for non-linear, soil and rock masses
CO 5	Understand the FEM applications in geotechnical engineering

UNIT – I

Basic Concepts

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

UNIT – II

Variational Principles

Variational principles, variational formulation of boundary value problems, Variational methods approximation such as Ritz and weighted residual (Galerkin) methods, Applications.

UNIT – III

Displacements Based Elements

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

UNIT – IV

Iso-Parametric Formulation

Application of FEM to Problems in soils and rocks, Introduction to non-linearity, Finite difference method, Description and application to consolidation, seepage, Winkler foundation etc.,

UNIT – V

Applications in Geotechnical Engineering

Application of FEM to Problems in soils, Introduction to non-linearity, Finite difference method, Description and application to consolidation, seepage, Winkler foundations.

Text Books:

1. Cook, R.D., Malkus, D.S., and Plesha, M.E., Concepts and Applications of Finite Element Analysis, John Wiley, 2007.
2. Smith, I.M., Programming the Finite Element Method with Application to Geomechanics, John Wiley and sons, New Delhi, 2000.

Reference Books:

1. Reddy, J.N., An Introduction to the Finite Element Method, McGraw Hill, 2005.
2. Potts, D.M. and Zdramcovic, L., Finite Element analysis in Geotechnical Engineering - Application, Thomas Telford, 2001.

Course Title	PAVEMENT ANALYSIS AND DESIGN (Program Elective Course – II)				M. Tech. GTE I Sem		
Course Code	Category	Hours/Week			Credits	Maximum Marks	
2212108	PEC	L	T	P	C	Continuous Internal Assessment	End Exam	Total
		3	0	0	3	40	60	100
Mid Exam Duration: 02.00 Hrs.						End Exam Duration: 03.00 Hrs.		

Course Objectives: The course is designed to students,

- To understand the different types of pavements, conduct analysis of flexible pavements for stresses, strains, and deflections in one-, two-, and three-layered systems, design flexible pavements using the AASHTO design procedure, conduct analysis of rigid pavements for stresses, strains, and deflections, To design rigid pavements using the AASHTO design procedure.

Course Outcomes: On successful completion of this course, the student will be able to

CO 1	Identify the various types and components of pavements and design factors
CO 2	Understand the stress strain behaviour in flexible pavement
CO 3	Design the flexible pavement for highways and airports
CO 4	Understand the stress components in rigid pavements
CO 5	Design the rigid pavement and their components

UNIT – I

Introduction

Types and component parts of pavements, Factors affecting design and performance of pavements. Highway and airport pavements

UNIT – II

Stresses and Strains in Flexible Pavements

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

UNIT – III

Flexible Pavement Design Methods for Highways and Airports

Empirical, semi-empirical and theoretical approaches; Development, principle, design steps of the different pavement design methods including AASHTO, Asphalt Institute, Shell Methods. IRC method of pavement design

UNIT – IV

Stresses in Rigid Pavements

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

UNIT – V

Rigid Pavement Design

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

Text Books:

1. Yoder R.J and Witchakm. W., Principles of Pavement Design, John Wiley, 2000.
2. Yang H Huang - Pavement Analysis and Design, 2nd Edition, Pearson Education, 2010.

Reference Books:

1. Guidelines for the Design of Flexible Pavements, IRC: 37 - 2001, the Indian Roads Congress, New Delhi.
2. Guideline for the Design of Rigid Pavements for Highways, IRC: 58-1998, the Indian Roads Congress, New Delhi.

Course Title	SOIL MECHANICS – 1 LAB					M. Tech. GTE I Sem		
Course Code	Category	Hours/Week			Credits	Maximum Marks		
2212109	PCC	L	T	P	C	Continuous Internal Assessment	End Exam	Total
		0	0	4	2	50	50	100
						End Exam Duration: 03.00 Hrs.		

Course Objectives: The course is designed to students,

- Classify the soil by physical observation
- Carryout interpolation among the estimated soil design parameters

Course Outcomes: On successful completion of this course, the student will be able to

CO 1	Estimate index and engineering properties of soils (coarse and fine)
CO 2	Identify the soil classification

List of Experiments:

1. Determination of Moisture Content and Specific Gravity
2. Grain Size Analysis
3. Determination of Atterberg's Limits
4. Visual Classification Test for Soils
5. Determination of In-Situ Densities
    a) Core Cutter Method
    b) Sand Replacement Method
6. Proctor Compaction
    a) Standard Proctor Compaction
    b) Modified Proctor Compaction
7. Determination of Coefficient of Permeability
    a) Constant Head Method
    b) Variable Head Method
8. Consolidation Test

Text Books:

1. S. Mittal and JP Shukla, Soil Testing for Engineers, Khanna Publishers, New Delhi, 2008.
2. KVS Apparao and VCS Rao, Soil Testing – Laboratory Manual & Question Bank, University Science Press, New Delhi, 2013.

Reference Books:

1. Compendium of Indian Standards on Soil Engineering: Part – 1 & 2, Laboratory and Field Testing of Soils for Civil Engineering Purposes.
2. Braja M. Das, Soil Mechanics Laboratory Manual, Oxford University Press, New York, 2016.

Course Title	SOIL MECHANICS – 2 LAB					M. Tech. GTE I Sem		
Course Code	Category	Hours/Week			Credits	Maximum Marks		
2212110	PCC	L	T	P	C	Continuous Internal Assessment	End Exam	Total
		0	0	4	2	50	50	100
						End Exam Duration: 03.00 Hrs.		

Course Objectives: The course is designed to students,

- Conduct the various tests to determine shear strength parameters of the soils
- Study the bearing and swell pressure, chemical components in soils

Course Outcomes: On successful completion of this course, the student will be able to

CO 1	Estimate shear strength and bearing pressure of the soils
CO 2	Estimate the swell pressure, amount of solids and amount $CaCO_3$ in soils

List of Experiments:

1. Direct Shear Test
2. Unconfined Compression Test
3. Triaxial Shear Test – UU, CU, CD Tests
4. California Bearing Ratio
5. Laboratory Vane Shear Test
6. Swell Pressure Test
7. Total Soluble Solids Content in Soils
8. Calcium Carbonate Content in Soils

Text Books:

1. S. Mittal and JP Shukla, Soil Testing for Engineers, Khanna Publishers, New Delhi, 2008.
2. KVS Apparao and VCS Rao, Soil Testing – Laboratory Manual & Question Bank, University Science Press, New Delhi, 2013.

Reference Books:

1. Compendium of Indian Standards on Soil Engineering: Part – 1 & 2, Laboratory and Field Testing of Soils for Civil Engineering Purposes.
2. Braja M. Das, Soil Mechanics Laboratory Manual, Oxford University Press, New York, 2016.

Course Title	RESEARCH METHODOLOGY & IPR				M. Tech. GTE I Sem		
Course Code	Category	Hours/Week			Credits	Maximum Marks	
2212111	MC	L	T	P	C	Continuous Internal Assessment	End Exam	Total
		2	0	0	2	40	60	100
Mid Exam Duration: 02.00 Hrs.						End Exam Duration: 03.00 Hrs.		

Course Objectives: The course is designed to students,

- About the basics of how research problems are defined, research methods are adopted and/or developed, research is undertaken, and how research results are communicated to the peers.

Course Outcomes: On successful completion of this course, the student will be able to

CO 1	Understand research problem formulation.
CO 2	Analyze research related information, follow research ethics
CO 3	Understand that today's world is controlled by Computer, Information Technology, but tomorrow world will be ruled by ideas, concept, and creativity.
CO 4	Understanding that when IPR would take such important place in growth of individuals & nation, it is needless to emphasis the need of information about Intellectual Property Right to be promoted among students in general & engineering in particular.
CO 5	Understand that IPR protection provides an incentive to inventors for further research work and investment in R & D, which leads to creation of new and better products, and in turn brings about, economic growth and social benefits.

UNIT – I

Introduction

Meaning of research problem, Sources of research problem, Criteria Characteristics of a good research problem, Errors in selecting a research problem, Scope and objectives of research problem. Approaches of investigation of solutions for research problem, data collection, analysis, interpretation, Necessary instrumentations

UNIT –II

Literature

Effective literature studies approaches, analysis Plagiarism, Research ethics

UNIT – III

Technical Writing

Effective technical writing, how to write report, Paper Developing a Research Proposal, Format of research proposal, a presentation and assessment by a review committee

UNIT –IV

Nature of Intellectual Property

Patents, Designs, Trade and Copyright. Process of Patenting and Development: technological research, innovation, patenting, development. International Scenario: International cooperation on Intellectual Property. Procedure for grants of patents, Patenting under PCT.

UNIT –V

Patent Rights and New Developments in IPR

Scope of Patent Rights. Licensing and transfer of technology. Patent information and databases. Geographical Indications. Administration of Patent System. New developments in IPR; IPR of Biological Systems, Computer Software etc. Traditional knowledge Case Studies, IPR and IITs.

Text Books:

1. Stuart Melville and Wayne Goddard, "Research methodology: An Introduction for Science & Engineering Students", Juta Education, 1996.
2. Ranjit Kumar, 2nd Edition, "Research Methodology: A Step by Step Guide for beginners", Sage Publications, 2011.

Reference Books:

1. Robert P. Merges, Peter S. Menell, Mark A. Lemley, "Intellectual Property in New Technological Age", Clause 8 Publishing, 2021.
2. T. Ramappa, "Intellectual Property Rights Under WTO", S. Chand, 2008

Course Title	ENGLISH FOR RESEARCH PAPER WRITING				M. Tech. GTE I Sem		
Course Code	Category	Hours/Week			Credits	Maximum Marks	
2270A01	Audit	L	T	P	C	Continuous Internal Assessment	End Exam	Total
		2	0	0	0	40	00	40
Mid Exam Duration: 02.00 Hrs.							

Course Objectives: The course is designed to students,

- On how to improve your writing skills and level of readability.
- About what to write in each section (Abstract, Introduction, Methodology etc.) and what tenses to use. Of course, not all disciplines use the same section headings, but most papers nevertheless tend to cover similar areas.

Course Outcomes: On successful completion of this course, the student will be able to

CO 1	Understand that how to improve writing skills and level of readability
CO 2	Learn about what to write in literature
CO 3	Understand the skills needed for writing the title
CO 4	Understand the skills needed for writing the results and conclusions
CO 5	Understand the skills needed for writing a title ensure the good quality of paper at very first time submission

UNIT –I

Planning and Preparation

Planning and Preparation, Word Order, breaking up long sentences, Structuring Paragraphs and Sentences, Being Concise and Removing Redundancy, Avoiding Ambiguity and Vagueness, Clarifying Who Did What, Highlighting Your Findings, Hedging and Criticizing, Paraphrasing and Plagiarism, Sections of a Paper, Abstracts. Introduction

UNIT – II

Review of Literature

Review of the Literature, Methods, Results, Discussion, Conclusions, The Final Check

UNIT –III

Key Skills

Key skills are needed when writing a Title, key skills are needed when writing an Abstract, key skills are needed when writing an Introduction, skills needed when writing a Review of the Literature

UNIT – IV

Skills needed to Write Results and Conclusions

Skills are needed when writing the Methods, skills needed when writing the Results, skills are needed when writing the Discussion, skills are needed when writing the Conclusions

UNIT – V

Paper Submission

Useful phrases, how to ensure paper is as good as it could possibly be the first- time submission.

Text Books:

1. Adrian Wallwork, English for Writing Research Papers, Springer New York Dordrecht Heidelberg London, 2011.
2. Day R, How to Write and Publish a Scientific Paper, Cambridge University Press, 2006.

Reference Books:

1. Goldbort R (2006) Writing for Science, Yale University Press (available on Google Books)
2. Highman N (1998), Handbook of Writing for the Mathematical Sciences, SIAM. Highman's Book.

Course Title	DISASTER MANAGEMENT					M. Tech. GTE I Sem		
Course Code	Category	Hours/Week			Credits	Maximum Marks		
2270A02	Audit	L	T	P	C	Continuous Internal Assessment	End Exam	Total
		2	0	0	0	40	00	40
Mid Exam Duration: 02.00 Hrs.								

Course Objectives: The course is designed to students,

- To provide a general concept in the dimensions of disasters caused by nature beyond the human control as well as the disasters and environmental hazards induced by human activities with emphasis on disaster preparedness, response and recovery

Course Outcomes: On successful completion of this course, the student will be able to

CO 1	Learn to demonstrate a critical understanding of key concepts in disaster risk reduction and humanitarian response
CO 2	Critically evaluate disaster risk reduction and humanitarian response policy and practice from multiple perspectives.
CO 3	Develop an understanding of standards of humanitarian response and practical relevance in specific types of disasters and conflict situations.
CO 4	Critically understand the strengths and weaknesses of disaster management approaches, planning and programming in different countries, particularly their home country or the countries they work in
CO 5	Understand the risk assessment and applying the reduction techniques, implementing the disaster mitigation programs to bring awareness

UNIT –I

Introduction

Disaster: Definition, Factors and Significance; Difference Between Hazard and Disaster; Natural and Manmade Disasters: Difference, Nature, Types and Magnitude.

UNIT –II

Repercussions of Disasters and Hazards

Economic Damage, Loss of Human and Animal Life, Destruction of Ecosystem. Natural Disasters: Earthquakes, Volcanisms, Cyclones, Tsunamis, Floods, Droughts and Famines, Landslides and Avalanches, Manmade disaster: Nuclear Reactor Meltdown, Industrial Accidents, Oil Slicks and Spills, Outbreaks of Disease and Epidemics, War and Conflicts.

UNIT –III

Disaster Prone Areas in India

Study of Seismic Zones; Areas Prone to Floods and Droughts, Landslides and Avalanches; Areas Prone to Cyclonic and Coastal Hazards with Special Reference to Tsunami; Post-Disaster Diseases and Epidemics

UNIT –IV

Disaster Preparedness and Management

Preparedness: Monitoring of Phenomena Triggering a Disaster or Hazard; Evaluation of Risk: Application of Remote Sensing, Data. From Meteorological and Other Agencies, Media Reports: Governmental and Community Preparedness.

UNIT –V

Risk Assessment and Mitigation

Disaster Risk: Concept and Elements, Disaster Risk Reduction, Global and National Disaster Risk Situation. Techniques of Risk Assessment, Global Co-Operation in Risk Assessment and Warning, People's Participation in Risk Assessment. Strategies for Survival. Meaning, Concept and Strategies of Disaster Mitigation, Emerging Trends in Mitigation. Structural Mitigation and Non-Structural Mitigation, Programs of Disaster Mitigation in India.

Text Books:

1. R. Nishith, Singh AK, "Disaster Management in India: Perspectives, Issues and Strategies", New Royal Book Company, 2007.
2. Sahni, Pardeep Et. Al. (Eds.)," Disaster Mitigation Experiences and Reflections", Prentice Hall of India, New Delhi, 2004.

Reference Books:

1. Goel S. L., Disaster Administration and Management Text and Case Studies", Deep & Deep Publication Pvt. Ltd., New Delhi, 2007.

Course Title	SANSKRIT FOR TECHNICAL KNOWLEDGE					M. Tech. GTE I Sem		
Course Code	Category	Hours/Week			Credits	Maximum Marks		
2270A03	Audit	L	T	P	C	Continuous Internal Assessment	End Exam	Total
		2	0	0	0	40	00	40
Mid Exam Duration: 02.00 Hrs.								

Course Objectives: The course is designed to students,

- To get a working knowledge in illustrious Sanskrit, the scientific language in the world
- Learning of Sanskrit to improve brain functioning
- Learning of Sanskrit to develop the logic in mathematics, science & other subjects enhancing the memory power
- The engineering scholars equipped with Sanskrit will be able to explore the huge knowledge from ancient literature

Course Outcomes: On successful completion of this course, the student will be able to

CO 1	Understand the basic Sanskrit language
CO 2	Ancient Sanskrit literature about science & technology can be understood

UNIT –I: Alphabets in Sanskrit

UNIT –II: Past/Present/Future Tense, Simple Sentences

UNIT –III: Order, Introduction of roots

UNIT –IV: Technical information about Sanskrit Literature

UNIT-V: Technical concepts of Engineering-Electrical, Mechanical, Architecture, Mathematics.

Text Books:

1. "Teach Yourself Sanskrit" Prathama Deeksha - Vempati Kutumba Shastri, Rashtriya Sanskrit Sansthanam, New Delhi Publication, 2012.
2. "Abhyas pustakam" – Dr. HR Vishwas, Samskrita-Bharti Publication, New Delhi, 2020.

Reference Books:

1. "India's Glorious Scientific Tradition" Suresh Soni, Ocean books (P) Ltd., New Delhi, 2006.

M.TECH.-
II- SEMESTER SYLLABUS

Course Title	EXPERIMENTAL GEOMECHANICS				M. Tech. GTE II Sem		
Course Code	Category	Hours/Week			Credits	Maximum Marks	
2212201	PCC	L	T	P	C	Continuous Internal Assessment	End Exam	Total
		3	0	0	3	40	60	100
Mid Exam Duration: 02.00 Hrs.						End Exam Duration: 03.00 Hrs.		

Course Objectives: The course is designed to students,

- To identify the soil type of soil from a job site or in a professional setting, determine that soil's properties based on type and evaluate design decisions from your understanding of that soil's properties.
- To explore the scientific principles used to describe the major engineering properties of soil, and the engineering testing methods used to quantify these properties.

Course Outcomes: On successful completion of this course, the student will be able to

CO 1	Plan subsurface investigation based on the requirement of civil engineering project and site condition. Can finalize depth and number of boreholes.
CO 2	Execute different subsurface exploration tests
CO 3	Collect disturbed/undisturbed samples for laboratory tests and can suggest design parameters.
CO 4	Expose different methods for estimation of dynamic soil properties required for design purpose.
CO 5	Develop instrumentation scheme for monitoring of critical sites.

UNIT –I

Introduction

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

UNIT –II

Open Excavation and Borings of Exploration

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

UNIT –III

Soil Samples and Samplers

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

UNIT –IV

In-Situ Testing

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

UNIT –V

Geophysical Methods and Wave Measurements

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

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

Text Books:

1. S.P. Brahma, Foundation Engineering, Tata McGraw-Hill Publishers, New Delhi, 1993.
2. V.N.S. Murthy, Soil Mechanics & Foundation Engineering, CBS Publishers & Distributors Pvt. Ltd., India, 2017.

Reference Books:

1. Hvorslev, MJ, Sub Surface Exploration and Sampling of Soils for Civil Engineering Purpose, Water-ways Station, Vicksburg, Mississippi, 1949.
2. Ara Arman and Naresh Samtani, Sub Surface Investigations, Federal Highway Administration, Arlington, Virginia, 2002.

Course Title	EARTH RETAINING STRUCTURES				M. Tech. GTE II Sem		
Course Code	Category	Hours/Week		Credits	Maximum Marks		
2212202	PCC	L	T	P	C	Continuous Internal Assessment	End Exam	Total
		3	0	0	3	40	60	100
Mid Exam Duration: 02.00 Hrs.						End Exam Duration: 03.00 Hrs.		

Course Objectives: The course is designed to students,

- To calculate earth pressure on various earth retaining structures such as gravity retaining walls, sheet pile, bulkheads, bracing/struts and coffer dams, design a relevant earth retaining structure for given soil condition, design of sheet pile with and without anchors, and to design the reinforced wall by using different materials.

Course Outcomes: On successful completion of this course, the student will be able to

CO 1	Determine the earth pressure and point of application for various types of soils and surcharge.
CO 2	Analyzing the stability of a retaining structure and drainage conditions.
CO 3	Design of sheet pile wall and fixing the embedment length, design and analyze the caissons according to IRC guidelines.
CO 4	Designing of lateral supporting system and their stability.
CO 5	Design of reinforced earth wall.

UNIT –I

Earth Pressure

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

UNIT –II

Retaining Walls

Proportioning of retaining walls, stability of retaining walls, mechanically stabilized retaining walls/reinforced earth retaining walls.

UNIT –III

Sheet Pile Wall

Free Earth System, Fixed Earth System.

UNIT –IV

Bulkheads

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

UNIT –V

Braced Excavations

Earth pressure against bracings in cuts, Heave of the bottom of cut in soft clays.

Text Books:

1. Das, B.M., Principles of Geotechnical Engineering, Cengage Learning India Private Limited, UP, 2018.
2. Mandal, J.N., Reinforced Soil and Geo-textiles, Oxford & IBH Publishing Co. Pvt. Ltd., New Delhi.

Reference Books:

1. McCarthy, D.F., Essentials of Soil Mechanics and Foundations: Basic Geo-techniques (Sixth Edition), Prentice Hall, 2002.
2. Militisky, J. and Woods, R., Earth and Earth Retaining Structures, Routledge, 1992.

Course Title	DYNAMICS OF SOIL AND FOUNDATIONS (Program Elective Course-III)					M. Tech. GTE II Sem		
Course Code	Category	Hours/Week			Credits	Maximum Marks		
2212203	PEC	L	T	P	C	Continuous Internal Assessment	End Exam	Total
		3	0	0	3	40	60	100
Mid Exam Duration: 02.00 Hrs.						End Exam Duration: 03.00 Hrs.		

Course Objectives: The course is designed to students,

- Study vibration concepts in soils, effect of liquefaction, dynamic elastic constants, cyclic plate load test, machine foundation design and bearing capacity of foundations.

Course Outcomes: On successful completion of this course, the student will be able to

CO 1	Understands theory of vibration and resonance phenomenon, dynamic amplification
CO 2	Understand propagation of body waves and surface waves through soil.
CO 3	Exposed to different methods for estimation of dynamic soil properties required for design purpose
CO 4	Predict dynamic bearing capacity and assess liquefaction potential of any site
CO 5	Apply theory of vibrations to design machine foundation based on dynamic soil properties and bearing capacity

UNIT –I

Fundamentals of Vibrations and Wave Propagation

Single, two and multiple degree of freedom systems, vibration isolation, vibration absorbers, vibration measuring instruments. Wave propagation**:** elastic continuum medium, semi-infinite elastic continuum medium, soil behaviour under dynamic loading.

UNIT –II

Liquefaction of Soils

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

UNIT –III

Dynamic elastic constants of soil

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

UNIT –IV

Machine Foundations

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

UNIT –V

Bearing Capacity of Foundations

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

Text Books:

1. Das, B.M., "Fundamentals of Soil Dynamics", Elsevier,1983.
2. Prakash, S., Soil Dynamics, McGraw Hill, 1981.

Reference Books:

1. Kameswara Rao, N.S.V., Vibration Analysis and Foundation Dynamics, Wheeler Publication Ltd., 1998.
2. Prakash, S. and Puri, V.K., Foundation for Machines: Analysis and Design, John Wiley & Sons, 1998.

Course Title	FOUNDATIONS ON EXPANSIVE SOILS (Program Elective Course-III)				M. Tech. GTE II Sem		
Course Code	Category	Hours/Week			Credits	Maximum Marks	
2212204	PEC	L	T	P	C	Continuous Internal Assessment	End Exam	Total
		3	0	0	3	40	60	100
Mid Exam Duration: 02.00 Hrs.						End Exam Duration: 03.00 Hrs.		

Course Objectives: The course is designed to students,

- To study the behaviour, treatment and moisture control of the expansive soils and design steps for shallow and deep foundations and estimation of lateral pressure.

Course Outcomes: On successful completion of this course, the student will be able to

CO 1	Understand the behaviour of expansive soils
CO 2	Understand the treatment methods and moisture control techniques
CO 3	Design the shallow foundations on the expansive soils
CO 4	Design the deep foundations on the expansive soils
CO 5	Determine the lateral pressure and designing the support systems

UNIT-I

Nature of Expansive Soils

Microscale Aspects of Expansive Soil Behavior, Macroscale Aspects of Expansive Soil Behavior, Identification of Expansive Soils, Characteristics of Expansive Soil Profiles

UNIT –II

Soil Treatment and Moisture Control

Over excavation and Replacement, Pre-wetting Method, Chemical Admixtures, Moisture Control Alternatives

UNIT –III

Design Methods for Shallow Foundations

Spread Footing Foundations, Stiffened Slab Foundations, Remedial Measures for Shallow Foundations

UNIT –IV

Design Methods for Deep Foundations

Pier and Grade Beam Foundation, Patented Piers, Deep Foundation Design Examples, Remedial Measures for Deep Foundations

UNIT –V

Lateral Pressure on Earth Retaining Structures

Computation of Lateral Pressure from Expansive Soils, Testing for Measuring Lateral Swelling Pressure, Reduction of Lateral Swelling Pressure, Design for Lateral Earth Pressure.

Text Books:

1. John D Nelson and Debora J Miller., "Expansive Soils – Problems and Practice in Foundation and Pavement Engineering", John Wiley & Sons, INC., 1997.
2. Ramachandra Phani Kumar and Sana Suri., "Expansive Soils – Problems and Remedies", LAP Lambert Academic Publishing, 2013.

Reference Books:

1. D.R. Snethen., "A Review of Engineering Experiences with Expansive Soils in Highway Sub-grades", Federal Highway Administration, Washington DC., 1976.
2. F.H. Chen, Foundations on Expansive Soils, Elsevier Scientific Publishing Company, New York, 1988.

Course Title	OFFSHORE GEOTECHNICAL ENGINEERING (Program Elective Course-III)				M. Tech. GTE II Sem		
Course Code	Category	Hours/Week			Credits	Maximum Marks	
2212205	PEC	L	T	P	C	Continuous Internal Assessment	End Exam	Total
		3	0	0	3	40	60	100
Mid Exam Duration: 02.00 Hrs.						End Exam Duration: 03.00 Hrs.		

Course Objectives: The course is designed to students,

- Execute investigation program for marine soil deposits and select necessary design parameters. Design suitable marine foundation as per project requirement. Can develop numerical model for response of marine foundation for offshore conditions.

Course Outcomes: On successful completion of this course, the student will be able to

CO 1	Understand the marine soil deposits and their properties
CO 2	Understand the behaviour of soils subjected to repeated loading
CO 3	Perform site investigation in marine environment
CO 4	Differentiate the offshore and nearshore foundation structures,
CO 5	Design the marine foundations by using FEM based analysis

UNIT –I

Marine Soil Deposits

Offshore environment, Offshore structures and foundations, Specific problems related to marine soil deposits, Physical and engineering properties of marine soils

UNIT –II

Behavior of Soils Subjected to Repeated Loading

Effect of wave loading on offshore foundations, Behavior of sands and clays under cyclic loading, Laboratory experiments including repeated loading, Cyclic behavior of soils based on fundamental theory of mechanics, Approximate engineering methods which can be used for practical cases

UNIT –III

Site Investigation in the Case of Marine Soil Deposits

Challenges of site investigation in marine environment, Different site investigation techniques, sampling techniques, Geophysical methods, Recent advancements in site investigation and sampling used for marine soil deposits

UNIT –IV

Foundations in Marine Soil Deposits

Different offshore and nearshore foundations, Gravity platforms, Jack-up rigs, pile foundations. Caissons, Spud Cans

UNIT –V

Numerical Modeling of Marine Foundations Subjected to Wave Loading

Numerical modeling of cyclic behavior of soils, empirical models, elastic-plastic models, FEM analysis of marine foundations subjected to wave loading.

Text Books:

1. H. G. Poulos. “Marine Geotechnics”, Unwin Hyman Ltd, London, UK, 1988
2. D. V. Reddy and M. Arockiasamy, “Offshore Structures”, Volume: 1, R.E. Kreiger Pub and Co., 1991

Reference Books:

1. D. Thomson and D. J. Beasley, “Handbook of Marine Geotechnical Engineering”, US Navy, 2012.

Course Title	DESIGN OF UNDER GROUND EXCAVATIONS (Program Elective Course-IV)				M. Tech. GTE II Sem		
Course Code	Category	Hours/Week			Credits	Maximum Marks	
2212206	PEC	L	T	P	C	Continuous Internal Assessment	End Exam	Total
		3	0	0	3	40	60	100
Mid Exam Duration: 02.00 Hrs.						End Exam Duration: 03.00 Hrs.		

Course Objectives: The course is designed to students,

- To know the planning and exploration of various underground projects, analyze the stress distribution, analyze the rock quality designation and also evaluate its strength
- To analyze the interaction between the rock mass and tunnel surface.

Course Outcomes: On successful completion of this course, the student will be able to

CO 1	Understand the applications and principles of underground excavations
CO 2	Understand the stress distribution around the tunnel with different shapes
CO 3	Performing the various tests to identify the classification of rock
CO 4	Designing the supporting system for tunnels
CO 5	Performing the tests on rock mass

UNIT –I

Introduction

Introduction, planning of exploration for various underground construction projects, stereographic projection method, principle and its application in underground excavation design.

UNIT –II

Stress Analysis for Tunnels

Elastic stress distribution around tunnels, stress distribution for different shapes and under different in-situ stress conditions, Greenspan method, design principles, multiple openings, openings in laminated rocks, elasto-plastic analysis of tunnels, Daemen's theory

UNIT –III

Rock Mass Classification

Application of rock mass classification systems, ground conditions in tunneling, analysis of underground openings in squeezing and swelling ground, empirical methods, estimation of elastic modulus and modulus of deformation of rocks; uniaxial jacking / plate jacking tests, radial jacking and Goodman jacking tests, long term behaviour of tunnels and caverns, New Austrian Tunneling Method (NATM), Norwegian Tunneling Method (NTM), construction dewatering.

UNIT –IV

Design of Support System

Rock mass-tunnel support interaction analysis, ground response and support reaction curves, Ladanyi's elasto-plastic analysis of tunnels, design of various support systems including concrete and shotcrete linings, steel sets, rock bolting and rock anchoring, combined support systems, estimation of load carrying capacity of rock bolts.

UNIT –V

Test on Rock Mass

In-situ stress, flat jack, hydraulic fracturing and over coring techniques and USBM type drill hole deformation gauge, single and multi-point bore hole extensometers, load cells, pressure cells, etc. Instrumentation and monitoring of underground excavations, during and after construction, various case studies

Text Books:

1. Hoek, E and Brown, E. T.," Underground Excavations in Rocks", Institute of Mining Engineering, 1980.
2. Singh, B. and Goel, R.K., "Rock Mass Classification- A Practical Engineering Approach", Elsevier, 1999.

Reference Books:

1. Obert, L. and Duvall, W.I., "Rock Mechanics and Design of Structures in Rocks", John Wiley.
2. Singh, B. and Goel, R.K., "Tunneling in Weak Rocks", Elsevier

Course Title	DESIGN WITH GEOSYNTHETICS (Program Elective Course-IV)				M. Tech. GTE II Sem		
Course Code	Category	Hours/Week			Credits	Maximum Marks		
2212207	PEC	L	T	P	C	Continuous Internal Assessment	End Exam	Total
		3	0	0	3	40	60	100
Mid Exam Duration: 02.00 Hrs.						End Exam Duration: 03.00 Hrs.		

Course Objectives: The course is designed to students,

- To understand the emerging trends of Geosynthetic in Geotechnical Engineering
- To evaluate the different properties of including different tests
- To analyze the functions of geosynthetic and its suitability
- To design different structures using geosynthetics according to various applications

Course Outcomes: On successful completion of this course, the student will be able to

CO 1	Understand the concepts of geosynthetics
CO 2	Apply the knowledge for designing the structure using geotextiles
CO 3	Apply the knowledge for designing the structure using geogrids
CO 4	Apply the knowledge for designing the structure using geonets
CO 5	Apply the knowledge for designing the structure using geomembranes

UNIT –I

Overview of Geosynthetics

Basic description of Geosynthetics, Polymeric Material, Geotextiles, Geogrids, Geonets, Geomembranes, Geosynthetic Clay Liners, Geopipe, Geofoam, Geocomposites.

UNIT –II

Designing with Geotextiles

Design Methods, Geotextile Functions, Mechanism, Properties, Test Methods, Separation, Roadway Reinforcement, Soil Reinforcement, Filtration, Drainage, Multiple Functions, Construction Methods and Techniques.

UNIT –III

Designing with Geogrids

Properties and Test Methods, Designing for Geogrid Reinforcement, Design Critique, Construction Methods.

UNIT –IV

Designing with Geonets

Properties and Test Methods, Designing for Geonet Drainage, Design Critique, Construction Methods.

UNIT –V

Designing with Geomembranes

Properties and Test Methods, Survivability Requirements, Liquid Containment Liners, Covers for Reservoirs, Water Conveyance Liners, Solid Material Liners, Landfill Covers and Closures, Under Ground Storage Tanks, Hydraulic and Geotechnical Applications.

Text Books:

1. "Designing with Geosynthetics by Robert M. Koerner Prantice Hall, Eaglewood cliffs, NJ, 2012.
2. "Engineering with Geosynthetics", by G. Venkatappa Rao and GVS Suryanarayana Raju – Tata McGraw Hill Publishing Company Limited – New Delhi, 1990.

Reference Books:

1. Jewell, R.A., Soil Reinforcement with Geotextile, CIRIA, London, 1996.
2. Jones, C.J.F.P., Earth Reinforcement and Soil Structures, Earthworks, London, 1988.

Course Title	GEOTECHNICAL EARTHQUAKE ENGINEERING (Program Elective Course-IV)					M. Tech. GTE II Sem		
Course Code	Category	Hours/Week			Credits	Maximum Marks		
2212208	PEC	L	T	P	C	Continuous Internal Assessment	End Exam	Total
		3	0	0	3	40	60	100
Mid Exam Duration: 02.00 Hrs.						End Exam Duration: 03.00 Hrs.		

Course Objectives: The course is designed to students,

- To know the causes and quantification of earthquake.
- Exposed to the effect of earthquake and the design criterions to be followed for the design different geotechnical structures.

Course Outcomes: On successful completion of this course, the student will be able to

CO 1	Determine size of earthquake and strong ground motion parameters from a recorded seismogram
CO 2	Analyze deterministic or probabilistic seismic hazard analysis considering the different soil properties and site conditions
CO 3	Study principles of wave propagation through rocks and soil media to derive transfer functions for ground response analysis
CO 4	Analyze liquefaction susceptibility of a site and determine factor of safety against liquefaction
CO 5	Design earthquake resistant geotechnical structures like shallow and deep foundations, retaining walls, slopes

UNIT –I

Earthquake Seismology

Causes of Earthquake, Plate Tectonics, Earthquake Fault Sources, Seismic Waves, Elastic Rebound Theory, Quantification of Earthquake, Intensity and Magnitudes, Earthquake Source Models.

UNIT –II

Earthquake Ground Motion

Seismograph, Characteristics of Ground Motion, Effect of Local Site Conditions On Ground Motions, Design Earthquake, Design Spectra, Development of Site Specification and Code-Based Design.

UNIT –III

Ground Response Analysis

One-Dimensional Ground Response Analysis: Linear Approaches, Equivalent Linear Approximation of Non-Linear Approaches, Computer Code “SHAKE”.

UNIT – IV

Liquefaction and Lateral Spreading

Liquefaction Related Phenomena, Liquefaction Susceptibility: Historical, Geological, Compositional and State Criteria. Evaluation of Liquefaction by Cyclic Stress and Cyclic Strain Approaches, Lateral Deformation and Spreading, Criteria for Mapping Liquefaction Hazard Zones.

UNIT – V

Design of Foundations and Stability Analysis of Slopes

Seismic Design of Foundations, Seismic Slope Stability Analysis: Internal Stability and Weakening Instability and Seismic Design of Retaining Walls.

Text Books:

1. Steven Kramer, "Geotechnical Earthquake Engineering", Pearson, 2008.
2. Ferrito, J.M, Seismic Design Criteria for Soil Liquefaction, Tech. Report of Naval Facilities service center, Port Hueneme, 1997.

Reference Books:

1. Seco e Pinto, P., Seismic Behaviour of Ground and Geotechnical Structure, CRC Press, 1997.
2. Naeim, F., The Seismic Design Handbook, Kluwer Academic Publication, 2nd Edition, 2001.

Course Title	SUBSOIL EXPLORATION LAB					M. Tech. GTE II Sem		
Course Code	Category	Hours/Week			Credits	Maximum Marks		
2212209	PCC	L	T	P	C	Continuous Internal Assessment	End Exam	Total
		0	0	4	2	50	50	100
						End Exam Duration: 03.00 Hrs.		

Course Objectives: The course is designed to students,

- . To estimate the soil properties, load carrying capacity and soil profile

Course Outcomes: On successful completion of this course, the student will be able to

CO 1	Classify the soil based on the collection of soils by borings and SPT
CO 2	Design the suitable foundation based upon the load carrying capacity of the soil

List of Experiments:

1. Auger Boring
2. Standard Penetration Test
3. Plate Load Test
4. Field CBR Test
5. Pile Load Test
6. Geophysical Exploration Tests

Text Books:

1. S. Mittal and JP Shukla, Soil Testing for Engineers, Khanna Publishers, New Delhi, 2008.

Reference Books:

1. Compendium of Indian Standards on Soil Engineering: Part – 1 & 2, Laboratory and Field Testing of Soils for Civil Engineering Purposes.

Course Title	GEOTECHNICAL ENGINEERING MODELING LAB				M. Tech. GTE II Sem		
Course Code	Category	Hours/Week			Credits	Maximum Marks		
2212210	PCC	L	T	P	C	Continuous Internal Assessment	End Exam	Total
		0	0	4	2	50	50	100
						End Exam Duration: 03.00 Hrs.		

Course Objectives: The course is designed to students,

- To estimate the bearing capacity and settlement of footing and pile, safe design of the slope.

Course Outcomes: On successful completion of this course, the student will be able to

CO 1	Design the bearing capacity and settlement of shallow and deep footings
CO 2	Design the slope and find the factor of safety against shear failure.

List of Experiments:

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.

Softwares:

1. GeoWizard
2. GeoStudio
3. Oyasis

Course Title	TECHNICAL SEMINAR					M. Tech. GTE II Sem		
Course Code	Category	Hours/Week			Credits	Maximum Marks		
2212211	Project	L	T	P	C	Continuous Internal Assessment	End Exam	Total
		0	0	4	2	100	-	100
						End Exam Duration: 03.00 Hrs.		

Course Objectives: The course is designed to students,

- To explain themselves with the latest developments, the State of art, in a Particular Area. It will be forum for the exchange of ideas with experts and the professional so with a view to acquiring additional knowledge acquainting each other with new research work, new methods and techniques of investigation or production.

Course Outcomes: On successful completion of this course, the student will be able to

CO 1	Students will get an opportunity to work in actual industrial environment if they opt for internship
CO 2	In case of mini project, they will solve a live problem using software/analytical/computational tools.
CO 3	Students will learn to write technical reports
CO 4	Students will develop skills to present and defend their work in front of technically qualified audience

Description:

Students can take up small problems in the field of design engineering as technical seminar. It can be related to solution to an engineering problem, verification and analysis of experimental data available, conducting experiments on various engineering subjects, material characterization, studying a software tool for the solution of an engineering problem etc.

Course Title	VALUE EDUCATION				M. Tech. GTE II Sem		
Course Code	Category	Hours/Week		Credits	Maximum Marks		
2270A04	Audit	L	T	P	C	Continuous Internal Assessment	End Exam	Total
		2	0	0	0	40	-	40
Mid Exam Duration: 02.00 Hrs.								

Course Objectives: The course is designed to students,

- Understand value of education and self- development
- Imbibe good values in students
- Let the should know about the importance of character.

Course Outcomes: On successful completion of this course, the student will be able to

CO 1	Know the self-development
CO 2	Learn the importance of human values
CO 3	Developing the personality
CO 4	Understanding the true friendship
CO 5	Understanding and improving the character

UNIT –I

Values and Self-Development

Values and self-development –Social values and individual attitudes. Work ethics, Indian vision of humanism. Moral and non- moral valuation. Standards and principles. Value judgements.

UNIT –II

Importance of Cultivation of Values

Importance of cultivation of values. Sense of duty. Devotion, Self-reliance. Confidence, Concentration. Truthfulness, Cleanliness. Honesty, Humanity. Power of faith, National Unity. Patriotism. Love for nature, Discipline.

UNIT –III

Personality and Behavior 1

Personality and Behavior Development - Soul and Scientific attitude. Positive Thinking. Integrity and discipline. Punctuality, Love and Kindness. Avoid fault Thinking. Free from anger, Dignity of labour. Universal brotherhood and religious tolerance.

UNIT – IV

Personality and Behavior 2

True friendship. Happiness Vs suffering, love for truth. Aware of self-destructive habits. Association and Cooperation. Doing best for saving nature

UNIT –V

Character and Competence

Character and Competence – Holy books vs Blind faith. Self-management and Good health. Science of reincarnation. Equality, Nonviolence, Humility, Role of Women. All religions and same message. Mind your Mind, Self-control. Honesty, Studying effectively

Text Books:

1. Chakroborty, S.K. “Values and Ethics for Organizations Theory and Practice”, Oxford University Press, New Delhi, 1999.

Course Title	CONSTITUTION OF INDIA					M. Tech. GTE II Sem		
Course Code	Category	Hours/Week			Credits	Maximum Marks		
2270A05	Audit	L	T	P	C	Continuous Internal Assessment	End Exam	Total
		2	0	0	0	40	-	40
Mid Exam Duration: 02.00 Hrs.								

Course Objectives: The course is designed to students,

- Understand the premises informing the twin themes of liberty and freedom from a civil rights perspective.
- To address the growth of Indian opinion regarding modern Indian intellectuals' constitutional role and entitlement to civil and economic rights as well as the emergence of nationhood in the early years of Indian nationalism.
- To address the role of socialism in India after the commencement of the Bolshevik Revolution in 1917 and its impact on the initial drafting of the Indian Constitution.

Course Outcomes: On successful completion of this course, the student will be able to

CO 1	Discuss the growth of the demand for civil rights in India for the bulk of Indians before the arrival of Gandhi in Indian politics.
CO 2	Discuss the intellectual origins of the framework of argument that informed the conceptualization of social reforms leading to revolution in India.
CO 3	Discuss the circumstances surrounding the foundation of the Congress Socialist Party [CSP] under the leadership of Jawaharlal Nehru and the eventual failure of the proposal of direct elections through adult suffrage in the Indian Constitution.
CO 4	Discuss the passage of the Hindu Code Bill of 1956.

UNIT –I

History and Philosophy of the Indian Constitution

History, Drafting Committee, (Composition & Working), Preamble, Salient Features

UNIT – II

Contours of Constitutional Rights & Duties

Fundamental Rights, Right to Equality, Right to Freedom, Right against Exploitation, Right to Freedom of Religion, Cultural and Educational Rights, Right to Constitutional Remedies, Directive Principles of State Policy, Fundamental Duties.

UNIT –III

Organs of Governance

Parliament, Composition, Qualifications and Disqualifications, Powers and Functions, Executive, President, Governor, Council of Ministers, Judiciary, Appointment and Transfer of Judges, Qualifications, Powers and Functions

UNIT –IV

Local Administration

District's Administration head: Role and Importance, Municipalities: Introduction, Mayor and role of Elected Representative, CEO of Municipal Corporation. Pachayati raj: Introduction, PRI: Zila Pachayat. Elected officials and their roles, CEO Zila Pachayat: Position and role. Block level: Organizational Hierarchy (Different departments), Village level: Role of Elected and Appointed officials, Importance of grass root democracy

UNIT –V

Election Commission

Election Commission: Role and Functioning. Chief Election Commissioner and Election Commissioners. State Election Commission: Role and Functioning. Institute and Bodies for the welfare of SC/ST/OBC and women.

Text Books:

1. The Constitution of India, 1950 (Bare Act), Government Publication., 2021.
2. D.D. Basu, Introduction to the Constitution of India, Lexis Nexis, 2015.

Reference Books:

1. Dr. S. N. Busi, Dr. B. R. Ambedkar framing of Indian Constitution, 1st Edition, 2015.
2. M. P. Jain, Indian Constitution Law, 7th Edn., Lexis Nexis, 2014.

Course Title	PEDAGOGY STUDIES				M. Tech. GTE II Sem		
Course Code	Category	Hours/Week			Credits	Maximum Marks	
2270A06	Audit	L	T	P	C	Continuous Internal Assessment	End Exam	Total
		2	0	0	0	40	-	40
Mid Exam Duration: 02.00 Hrs.								

Course Objectives: The course is designed to students,

- Review existing evidence on the review topic to inform programme design and policy making undertaken by the DfID, other agencies and researchers.
- Identify critical evidence gaps to guide the development.

Course Outcomes: On successful completion of this course, the student will be able to

CO 1	What pedagogical practices are being used by teachers in formal and informal classrooms in developing countries?
CO 2	What is the evidence on the effectiveness of these pedagogical practices, in what conditions, and with what population of learners?
CO 3	How can teacher education (curriculum and practicum) and the school curriculum and guidance materials best support effective pedagogy?

UNIT –I

Introduction and Methodology

Aims and rationale, Policy background, Conceptual framework and terminology, Theories of learning, Curriculum, Teacher education. Conceptual framework, Research questions**.** Overview of methodology and Searching.

UNIT –II

Thematic Overview

Pedagogical practices are being used by teachers in formal and informal classrooms in developing countries. Curriculum, Teacher education.

UNIT –III

Pedagogical Practices

Evidence on the effectiveness of pedagogical practices, Methodology for the in depth stage: quality assessment of included studies. How can teacher education (curriculum and practicum) and the school curriculum and guidance materials best support effective pedagogy? Theory of change. Strength and nature of the body of evidence for effective pedagogical practices. Pedagogic theory and pedagogical approaches. Teachers' attitudes and beliefs and Pedagogic strategies.

UNIT –IV

Professional Development

Alignment with classroom practices and follow- up support, Peer support, Support from the head teacher and the community. Curriculum and assessment, Barriers to learning: limited resources and large class sizes

UNIT –V

Research Gaps and Future Directions

Research design, Contexts, Pedagogy, Teacher education, Curriculum and assessment, Dissemination and research impact.

Text Books:

1. Alexander RJ, Culture and pedagogy: International comparisons in primary education. Oxford and Boston: Blackwell, 2001.
2. Akyeampong K, Teacher training in Ghana - does it count? Multi-site teacher education research project (MUSTER) country report 1. London: DFID., 2003.

Reference Books:

1. Ackers J, Hardman F, Classroom interaction in Kenyan primary schools, Compare, 31 (2): 245-261., 2001.
2. Agrawal M, Curricular reform in schools: The importance of evaluation, Journal of Curriculum Studies, 36 (3): 361-379., 2004.

M.TECH.-
III- SEMESTER SYLLABUS

Course Title	STABILITY ANALYSIS OF SLOPES (Program Elective Course-V)				M. Tech. GTE III Sem		
Course Code	Category	Hours/Week			Credits	Maximum Marks		
2212301	PEC	L	T	P	C	Continuous Internal Assessment	End Exam	Total
		3	0	0	3	40	60	100
Mid Exam Duration: 02.00 Hrs.						End Exam Duration: 03.00 Hrs.		

Course Objectives: The course is designed to students,

- To introduce the concepts of slope stability, introduce the concepts of slope stability analyses using simplified methods, and to describe some of the sophisticated methods of slope stability analyses.

Course Outcomes: On successful completion of this course, the student will be able to

CO 1	Understand the types of slopes and their failures
CO 2	Design the stability for finite and infinite slopes
CO 3	Check the stability of a slope when there is a seepage
CO 4	Adopt the advanced methods to strengthen the slope
CO 5	Investigate the failures in stability of slopes

UNIT –I

Slopes

Types and Causes of Slope Failures, Mechanics of Slope Failure, Failure Modes.

UNIT – II

Stability Analysis

Infinite and Finite Slopes with or Without Water Pressures; Concept of Factor of Safety, Pore Pressure Coefficients, Mass Analysis, Wedge Methods, Friction Circle Method; Method of Slices, Bishop's Method, Janbu's Method, Morgenstern and Price, Spencer's Method

UNIT –III

Stability Analysis in the Presence of Seepage

Two Dimensional Flow – Laplace Equation and its Solution, Graphical Method, Determination of Phreatic Line, Flow Nets in Homogeneous and Zoned Earth Dams under Steady Seepage and Draw-Down Conditions, Seepage Control in Earth Dams, Influence of Seepage on Slope Stability Analysis of Dam Body During Steady Seepage

UNIT – IV

Strengthening Measures

Stabilization of Slopes by Drainage Methods, Surface and Subsurface Drainage, Use of Synthetic Filters, Retaining Walls, Stabilization and Strengthening of Slopes, Shotcreting, Rock Bolting and Rock Anchoring, Instrumentation and Monitoring of Slopes, Slope Movements, Warning Devices, Maintenance of Slopes

UNIT –V

Case studies of urban slope stability

Aims, Regional perspective, Landslide inventory, Stability analyses of three sites, Case study 1 – Site 64 in the suburb of Scarborough, Case study 2 – Site 77, Morrison Avenue – Wombarra, Case study 3 – Site 134, Woonona Heights, concluding remarks on the three case studies, Landslide-triggering rainfall, Landslide susceptibility and hazard, Observational approach and monitoring.

Text Books:

1. Chowdhary R Phil Flentje and Bhattacharya G, “Geotechnical Slope Analysis”, CRC Press., 2009.
2. YM Cheng and CK lau, “Slope Stability Analysis and Stabilization”, CRC Press., 2017.

Reference Books:

1. Milton E. Harr., “Groundwater and Seepage”, Dover Publications. 2012.

Course Title	FOUNDATION ON WEAK ROCKS (Program Elective Course-V)				M. Tech. GTE III Sem		
Course Code	Category	Hours/Week			Credits	Maximum Marks		
2212302	PEC	L	T	P	C	Continuous Internal Assessment	End Exam	Total
		3	0	0	3	40	60	100
Mid Exam Duration: 02.00 Hrs.						End Exam Duration: 03.00 Hrs.		

Course Objectives: The course is designed to students,

- To study the properties of weak rock and classification, analyze the effect of structural planes, study the requirements of satisfactory performance of foundation and analyze the pile on weak rock

Course Outcomes: On successful completion of this course, the student will be able to

CO 1	Estimate the properties of rock.
CO 2	Understand the effect of weak rock on foundations.
CO 3	Estimate the satisfactory conditions and bearing capacity.
CO 4	Designing the shallow foundation on sloping ground and suggesting the treatment methods of foundations.
CO 5	Design of pile foundations on rock and performing the load tests.

UNIT –I

Properties of Weak Rock

Engineering Properties of Weak Rocks, Different Rock Mass Classification Systems, Relative Merits and Demerits, Failure Criteria for Weak Rocks, Bi-Linear Mohr-Coulomb Failure Criterion, Hoek and Brown Criterion and Modified Hoek and Brown Failure Criterion Etc.

UNIT –II

Effect of Weak Rock

Effect of Structural Planes on Rock Foundations, Possible Modes of Failure of Foundations on Rocks/ Rock Masses, Determination of In-Situ Shear Strength of Rocks and Rock Masses

UNIT –III

Performance of Foundations

Requirements for Satisfactory Performance of Foundations, Bearing Capacity of Foundations on Rocks and Rock Masses, Allowable Bearing Pressure of Rock Foundations Using a Nonlinear Failure Criterion, Monotonic and Cyclic Plate Load Tests, Pressure-Settlement Characteristics, Effect of Layering, Anisotropy, Heterogeneity and Inelasticity

UNIT –IV

Shallow Foundations

Shallow Foundations, Shallow Foundations on Sloping Ground, Raft Foundations, Stilt Foundations, Foundations for Suspension Bridges, Transmission Line Towers, Framed Buildings etc., Treatment of Foundations - Open Joints, Solution Cavities, Weak Seams

UNIT –V

Pile Foundations

Piles in Weak Rocks, Bearing Capacity and Settlement of Piles, Piles in Stratified Rock Masses, Field Load Tests on Piles in Weak Rocks, Behaviour of Bored / Driven Piles in Soft / Weathered Rocks.

Text Books:

1. Ramamurthy, T., “Engineering in Rocks”, PHI Learning Pvt. Ltd., 2014.
2. Hoek, E., “Practical Rock Engineering”, Rock Science., 2006.

Reference Books:

1. Wyllie Duncan C.,” Foundations on Rock: Engineering Practice”, E & Fn Spon, Taylor and Francis., 2005.
2. Hudson J.A. and J.P. Harrison. Engineering Rock Mechanics: An Introduction to the Principles, 1997. Elsevier, Oxford

Course Title	COMPUTATIONAL GEOMECHANICS (Program Elective Course-V)					M. Tech. GTE III Sem		
Course Code	Category	Hours/Week			Credits	Maximum Marks		
2212303	PEC	L	T	P	C	Continuous Internal Assessment	End Exam	Total
		3	0	0	3	40	60	100
Mid Exam Duration: 02.00 Hrs.						End Exam Duration: 03.00 Hrs.		

Course Objectives: The course is designed to students,

- To understand different numerical and statistical tools for analyzing various geotechnical engineering problems.
- To apply probabilistic approach for selection of design parameters and compute their impact on risk assessment.

Course Outcomes: On successful completion of this course, the student will be able to

CO 1	Analyze linear and non-linear equations using numerical techniques
CO 2	Apply finite difference and finite element method for analyzing behaviour of geotechnical structures
CO 3	Apply correlation and regression analysis for the geotechnical data.
CO 4	Solve multilayered soil system by FEM and FDM
CO 5	Solve problem of consolidation and flow through porous media using numerical technique.

UNIT –I

Solution of Non-Linear and Linear Equations

Bisection, False Position, Newton-Raphson, Successive Approximation Method, Iterative Methods, Jacobi's Method, Gauss Seidal Method, Successive over Relaxation Method.

UNIT – II

Finite Difference and Finite Element Method

Two Point Boundary Value Problems – Disichlet Conditions, Neumann Conditions; Ordinary and Partial Differential Equations. Fundamentals, Constitutive Finite Element Models for Soils.

UNIT – III

Correlation and Regression Analysis

Correlation - Scatter Diagram, Karl Pearson Coefficient of Correlation, Limits of Correlation Coefficient; Regression –Lines of Regression, Regression Curves, Regression Coefficient, Differences Between Correlation and Regression Analysis.

UNIT –IV

One-Dimensional Consolidation

Theory of Consolidation, Analytical Procedures, Finite Difference Solution Procedure for Multilayered Systems, Finite Element Formulation.

UNIT – V

Flow through Porous Media and Risk Assessment in Geotechnical Engg.

Geotechnical Aspects, Numerical Methods, Applications and Design Analysis, Flow in Jointed Media. Probabilistic Site Characterization and Design of Foundations.

Text Books:

1. S. Chandrakant., Desai and John T. Christian, "Numerical Methods in Geotechnical Engineering", Mc. Graw Hill Book Company, 1977.
2. M.K. Jain, S.R.K. Iyengar and R.K. Jain, "Numerical Methods for Scientific and Engineering Computations", Third Edition, New Age International (P) Ltd. Publishers, New Delhi. 2019.

Reference Books:

1. D.J. Naylor and G.N. Pande, "Finite Elements in Geotechnical Engineering", Pineridge Press Ltd., UK., 1981.
2. Sam Helwany, "Applied Soil Mechanics", John Wiley & Sons, Inc,, 2007.

Course Title	BUSINESS ANALYTICS					M. Tech. GTE III Sem		
Course Code	Category	Hours/Week			Credits	Maximum Marks		
2212304	OEC	L	T	P	C	Continuous Internal Assessment	End Exam	Total
		3	0	0	3	40	60	100
Mid Exam Duration: 02.00 Hrs.						End Exam Duration: 03.00 Hrs.		

Course Objectives: The course is designed to students,

- Understand the role of business analytics within an organization.
- Analyze data using statistical and data mining techniques and understand relationships between the underlying business processes of an organization.
- To gain an understanding of how managers use business analytics to formulate and solve business problems and to support managerial decision making.
- To become familiar with processes needed to develop, report, and analyze business data.
- Use decision-making tools/Operations research techniques.
- Mange business process using analytical and management tools.
- Analyze and solve problems from different industries such as manufacturing, service, retail, software, banking and finance, sports, pharmaceutical, aerospace etc.

Course Outcomes: On successful completion of this course, the student will be able to

CO 1	Demonstrate knowledge of data analytics
CO 2	Demonstrate the ability of think critically in making decisions based on data and deep analytics
CO 3	Demonstrate the ability to use technical skills in predicative and prescriptive modeling to support business decision-making
CO 4	Demonstrate the ability to translate data into clear, actionable insights

UNIT –I

Business Analytics

Overview of Business analytics, Scope of Business analytics, Business Analytics Process, Relationship of Business Analytics Process and organization, competitive advantages of Business Analytics. Statistical Tools: Statistical Notation, Descriptive Statistical methods, Review of probability distribution and data modeling, sampling and estimation methods overview.

UNIT –II

Trendiness and Regression Analysis

Modeling Relationships and Trends in Data, simple Linear Regression. Important Resources, Business Analytics Personnel, Data and models for Business analytics, problem solving, Visualizing and Exploring Data, Business Analytics Technology.

UNIT –III

Organization Structure

Organization Structures of Business analytics, Team management, Management Issues, Designing Information Policy, Outsourcing, Ensuring Data Quality, measuring contribution of Business analytics, Managing Changes. Descriptive Analytics, predictive analytics, predicative Modelling, Predictive analytics analysis, Data Mining, Data Mining Methodologies, Prescriptive analytics and its step in the business analytics Process, Prescriptive Modelling, nonlinear Optimization.

UNIT –IV

Forecasting Techniques

Qualitative and Judgmental Forecasting, Statistical Forecasting Models, Forecasting Models for Stationary Time Series, Forecasting Models for Time Series with a Linear Trend, Forecasting Time Series with Seasonality, Regression Forecasting with Casual Variables, Selecting Appropriate Forecasting Models. Monte Carlo Simulation and Risk Analysis: Monte Carle Simulation Using Analytic Solver Platform, New-Product Development Model, Newsvendor Model, Overbooking Model, Cash Budget Model.

UNIT –V

Decision Analysis

Formulating Decision Problems, Decision Strategies with the without Outcome Probabilities, Decision Trees, The Value of Information, Utility and Decision Making. Recent Trends in: Embedded and collaborative business intelligence, Visual data recovery, Data Storytelling and Data journalism.

Text Books:

1. Business Analytics Principles, Concepts, and Applications by Marc J. Schniederjans, Dara G. Schniederjans, Christopher M. Starkey, Pearson FT Press, 2014.

Reference Books:

1. Business Analytics by James Evans, Persons Education., 2014.

Course Title	OPERATIONS RESEARCH				M. Tech. GTE III Sem		
Course Code	Category	Hours/Week			Credits	Maximum Marks	
2212305	OEC	L	T	P	C	Continuous Internal Assessment	End Exam	Total
		3	0	0	3	40	60	100
Mid Exam Duration: 02.00 Hrs.						End Exam Duration: 03.00 Hrs.		

Course Objectives: The course is designed to students,

- The course is intended to identify and develop operations research models, understand the mathematical tools to solve optimization problems and develop a report that describes the model, the solving techniques and analyze the results.

Course Outcomes: On successful completion of this course, the student will be able to

CO 1	Apply the dynamic programming to solve problems of discreet and continuous variables.
CO 2	Apply the concept of non-linear programming.
CO 3	Carry out sensitivity analysis.
CO 4	Model the real world problem and simulate it.

UNIT –I

Optimization Techniques and Model Formation

Optimization Techniques, Model Formulation, models, General L.R Formulation, Simplex Techniques, Sensitivity Analysis, Inventory Control Models

UNIT –II

Formulation of LPP and Graphical Solution

Formulation of a LPP - Graphical solution revised simplex method - duality theory - dual simplex method - sensitivity analysis - parametric programming

UNIT –III

Nonlinear Programming

Nonlinear programming problem - Kuhn-Tucker conditions min cost flow problem - max flow problem - CPM/PERT

UNIT –IV

Scheduling

Scheduling and sequencing - single server and multiple server models - deterministic inventory models - Probabilistic inventory control models - Geometric Programming.

UNIT –V

Competitive Models

Competitive Models, Single and Multi-Channel Problems, Sequencing Models, Dynamic Programming, Flow in Networks, Elementary Graph Theory, Game Theory Simulation

Text Books:

1. Panner Selvam, Operations Research: Prentice Hall of India 2010
2. Harvey M Wagner, Principles of Operations Research: Prentice Hall of India 2010

Reference Books:

1. H.M. Wagner, Principles of Operations Research, PHI, Delhi, 1982.
2. J.C. Pant, Introduction to Optimization: Operations Research, Jain Brothers, Delhi, 2015.

Course Title	WASTE TO ENERGY					M. Tech. GTE III Sem		
Course Code	Category	Hours/Week			Credits	Maximum Marks		
2212306	OEC	L	T	P	C	Continuous Internal Assessment	End Exam	Total
		3	0	0	3	40	60	100
Mid Exam Duration: 02.00 Hrs.						End Exam Duration: 03.00 Hrs.		

Course Objectives: The course is designed to students,

- To create awareness in students of energy conservation.
- To identify the use of different types of Bio waste energy resources.
- To understand different types of bio waste energy conservations.
- To detect different waste conversion into different forms of energy.

Course Outcomes: On successful completion of this course, the student will be able to

CO 1	Find different types of energy from waste to produce electrical power
CO 2	Estimate the use of bio waste to produce electrical energy
CO 3	Understanding different types of bio waste and its energy conversions
CO 4	Analyze the bio waste utilization and to avoid the environmental pollution

UNIT –I

Introduction to Energy from Waste

Classification of waste as fuel – Agro based, Forest residue, Industrial waste - MSW – Conversion devices – Incinerators, gasifiers, digesters

UNIT –II

Biomass Pyrolysis

Pyrolysis – Types, slow fast – Manufacture of charcoal – Methods - Yields and application – Manufacture of pyrolytic oils and gases, yields and applications.

UNIT –III

Biomass Gasification

Gasifiers – Fixed bed system – Downdraft and updraft gasifiers – Fluidized bed gasifiers – Design, construction and operation – Gasifier burner arrangement for thermal heating – Gasifier engine arrangement and electrical power – Equilibrium and kinetic consideration in gasifier operation.

UNIT –IV

Biomass Combustion

Biomass stoves – Improved chullahs, types, some exotic designs, fixed bed combustors, Types, inclined grate combustors, Fluidized bed combustors, Design, construction and operation - Operation of all the above biomass combustors.

UNIT – V

Biogas

Properties of biogas (Calorific value and composition) - Biogas plant technology and status - Bio energy system - Design and constructional features - Biomass resources and their classification - Biomass conversion processes - Thermo chemical conversion - Direct combustion - biomass gasification - pyrolysis and liquefaction - biochemical conversion - anaerobic digestion -Types of biogas Plants – Applications - Alcohol production from biomass - Bio diesel production - Urban waste to energy conversion - Biomass energy programme in India.

Text Books:

1. Non-Conventional Energy, Desai, Ashok V., Wiley Eastern Ltd., 1990.
2. Food, Feed and Fuel from Biomass, Chahal, D. S., IBH Publishing Co. Pvt. Ltd., 1991.

Reference Books:

1. Biogas Technology - A Practical Hand Book - Khandelwal, K. C. and Mahdi, S. S., Vol. I & II, Tata McGraw Hill Publishing Co. Ltd., 1989.
2. Biomass Conversion and Technology, C. Y. WereKo-Brobby and E. B. Hagan, John Wiley & Sons, 1996

<table>
<tr><td>Course Title</td><td colspan="5">DISSERTATION PHASE – 1
(to be continued next semester)</td><td colspan="3">M. Tech. GTE III Sem</td></tr>
<tr><td>Course Code</td><td>Category</td><td colspan="3">Hours/Week</td><td>Credits</td><td colspan="3">Maximum Marks</td></tr>
<tr><td rowspan="2">2212307</td><td rowspan="2">Project</td><td>L</td><td>T</td><td>P</td><td>C</td><td>Continuous Internal Assessment</td><td>End Exam</td><td>Total</td></tr>
<tr><td>0</td><td>0</td><td>20</td><td>10</td><td>100</td><td>00</td><td>100</td></tr>
<tr><td colspan="6">Mid Exam Duration: 00.00 Hrs.</td><td colspan="3">End Exam Duration: 00.00 Hrs.</td></tr>
<tr><td colspan="9">Course Objectives: The course is designed to students,
• The purpose of dissertation is to introduce to students, the research methods and to develop competencies for critically examining topics of their interest and present them. This will be a preparatory stage for the terminal or thesis project.</td></tr>
<tr><td colspan="9">Course Outcomes: On successful completion of this course, the student will be able to</td></tr>
<tr><td>CO 1</td><td colspan="8">Students will be exposed to self-learning various topics</td></tr>
<tr><td>CO 2</td><td colspan="8">Students will learn to survey the literature such as books, national/international refereed journals and contact resource persons for the selected topic of research</td></tr>
<tr><td>CO 3</td><td colspan="8">Students will learn to write technical reports</td></tr>
<tr><td>CO 4</td><td colspan="8">Students will develop oral and written communication skills to present and defend their work in front of technically qualified audience</td></tr>
</table>

Description:

The Project Work will start in semester 3rd and should preferably be a problem with research potential and should involve scientific research, design, generation/collection and analysis of data, determining solution and must preferably bring out the individual contribution. Seminar should be based on the area in which the candidate has undertaken the dissertation work as per the common instructions for all branches of M. Tech. The examination shall consist of the preparation of report consisting of a detailed problem statement and a literature review. The preliminary results (if available) of the problem may also be discussed in the report. The work has to be presented in front of the examiners panel set by Head and PG coordinator. The candidate has to be in regular contact with his guide and the topic of dissertation must be mutually decided by the guide and student.

M.TECH.-
IV- SEMESTER SYLLABUS

Course Title	DISSERTATION PHASE – 2					M. Tech. GTE IV Sem		
Course Code	Category	Hours/Week			Credits	Maximum Marks		
2212401	Project	L	T	P	C	Continuous Internal Assessment	End Exam	Total
		0	0	32	16	50	50	100
Mid Exam Duration: 00.00 Hrs.						End Exam Duration: 00.00 Hrs.		
Course Outcomes: On successful completion of this course, the student will be able to								
CO 1	Use different experimental techniques, different software/ computational/analytical tools.							
CO 2	Design and develop an experimental set up/ equipment/test rig							
CO 3	Conduct tests on existing set ups/equipments and draw logical conclusions from the results after analyzing them.							
CO 4	Able to either work in a research environment or in an industrial environment, conversant with technical report writing.							
CO 5	Able to present and convince their topic of study to the engineering community.							

Description:

It is a continuation of Project work started in semester 3rd. He has to submit the report in prescribed format and also present a seminar. The dissertation should be presented in standard format as provided by the department. The candidate has to prepare a detailed project report consisting of introduction of the problem, problem statement, literature review, objectives of the work, methodology (experimental set up or numerical details as the case may be) of solution and results and discussion. The report must bring out the conclusions of the work and future scope for the study. The work has to be presented in front of the examiners panel consisting of an approved external examiner, an internal examiner and a guide, co-guide etc. as decided by the Head and PG coordinator. The candidate has to be in regular contact with his guide.