Academic Regulations

M. Tech TWO YEAR DEGREE COURSE
[Choice Based Credit System (CBCS)]
R15 Regulations
(Applicable for the batches admitted from 2015-2016 Onwards)

ANURAG ENGINEERING COLLEGE

(AUTONOMOUS)

Ananthagiri(V), Kodad(M), Nalgonda(Dt), 508 206. TELANGANA STATE

R 15 - ACADEMICREGULATIONS (CBCS) FOR M. Tech. (REGULAR) DEGREE PROGRAMMES

Applicable for the students of M. Tech. (Regular) programme from the Academic Year ***2015-16*** and onwards

The M. Tech. Degree of Jawaharlal Nehru Technological University Hyderabad shall be conferred on candidates who are admitted to the programme and who fulfill all the requirements for the award of the Degree.

1. ELIGIBILITY FOR ADMISSIONS

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

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

2. AWARD OF M. Tech. DEGREE

2.1 A student shall be declared eligible for the award of the M. Tech. Degree, if he pursues a course of study in not less than two and not more than four academic years, failing which he shall forfeit his seat in M. Tech. programme.

2.2 The student shall register for all 88 credits and secure all the 88 credits.

2.3 The minimum instruction days in each semester are 90.

3.0 COURSES OF STUDY

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

1. Computer Science and Engineering
2. Machine Design
3. Power Electronics and Electrical Drives
4. Structural Engineering
5. VLSI System Design

4 Course Registration

4.1 A 'Faculty Advisor or Counselor' shall be assigned to each student, who will advise him on the Post Graduate Programme (PGP), its Course Structure and Curriculum, Choice/Option for Subjects/ Courses, based on his competence, progress, pre-requisites and interest.

4.2 Academic Section of the College invites 'Registration Forms' from students with in 15 days from the commencement of class work through 'ON-LINE SUBMISSIONS', ensuring 'DATE and TIME Stamping'. The ON-LINE

Registration Requests for any 'CURRENT SEMESTER' shall be completed BEFORE the commencement of SEEs (Semester End Examinations) of the 'PRECEDING SEMESTER'.

4.3 A Student can apply for ON-LINE Registration, ONLY AFTER obtaining the 'WRITTEN APPROVAL' from his Faculty Advisor, which should be submitted to the College Academic Section through the Head of Department (a copy of it being retained with Head of Department, Faculty Advisor and the Student).

4.4 If the Student submits ambiguous choices or multiple options or erroneous entries - during ON-LINE Registration for the Subject(s) / Course(s) under a given/ specified Course Group/ Category as listed in the Course Structure, only the first mentioned Subject/ Course in that Category will be taken into consideration.

4.5 Subject/ Course Options exercised through ON-LINE Registration are final and CANNOT be changed, nor can they be inter-changed; further, alternate choices will also not be considered. However, if the Subject/ Course that has already been listed for Registration (by the Head of Department) in a Semester could not be offered due to any unforeseen or unexpected reasons, then the Student shall be allowed to have alternate choice - either for a new Subject (subject to offering of such a Subject), or for another existing Subject (subject to availability of seats), which may be considered. Such alternate arrangements will be made by the Head of Department, with due notification and time-framed schedule, within the FIRST WEEK from the commencement of Class-work for that Semester.

5 ATTENDANCE

The programmes are offered on a unit basis with each subject being considered a unit.

5.1 Attendance in all classes (Lectures/Laboratories etc.) is compulsory. The minimum required attendance in each theory / Laboratory etc. is 75% including the days of attendance in sports, games, NCC and NSS activities for appearing for the End Semester examination. A student shall not be permitted to appear for the Semester End Examinations (SEE) if attendance is less than 75%.

5.2 Condonation of shortage of attendance in each subject up to 10% (65% and above and below75%)in each semester shall be granted by the College Academic Committee on genuine medical grounds and valid reasons on representation by the candidate with supporting evidence.

5.3 Shortage of Attendance below65% in each subject shall not be condoned.

5.4 Students whose shortage of attendance is not condoned in any subject are not eligible to write their end semester examination of that subject and their registration shall stand cancelled.

5.5 A prescribed fees hall be payable towards condonation of shortage of attendance.

5.6 A candidate shall get minimum required attendance at least in three (3) theory subjects in

the present semester to get promoted to the next semester. In order to qualify for the award of the M.Tech Degree, The candidate shall complete all the academic requirements of the subjects, as per the course structure.

5.7 A student shall not be promoted to the next semester unless he satisfies the attendance requirement of the present Semester, as applicable. They may seek readmission into that semester when offered next. If any candidate fulfills the attendance requirement in the present semester, he shall not be eligible for readmission in to the same class.

6 EVALUATION

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

6.1 For the theory subjects 60 marks shall be awarded for the performance in the Semester End Examination and 40 marks shall be awarded for Continuous Internal Evaluation (CIE). The Continuous Internal Evaluation shall be made based on the average of the marks secured in the two Mid Term-Examinations conducted, one in the middle of the Semester and the other, immediately after the completion of Semester instructions. Each mid-term examination shall be conducted for a total duration of 120 minutes with Part A as compulsory question (10 marks) consisting of 5 sub-questions carrying 2 marks each, and Part B with 3 questions to be answered out of 5 questions, each question carrying 10 marks. The details of the Question Paper pattern for End Examination (Theory) are given below:

- The Semester End Examination will be conducted for 60 marks. It consists of two parts. i).Part-A for 20 marks, ii). Part-B for 40 marks.

- Part-A is a compulsory question consisting of 5 questions, one from each unit and carries 4 marks each.

- Part-B to be answered 5 questions carrying 8 marks each. There will be two questions from each unit and only one should be answered.

6.2 For practical subjects, 60 marks shall be awarded for performance in the Semester End Examinations and 40 marks shall be awarded for day-to-day performance as Internal Marks.

6.3 The practical end semester examination shall be conducted with an external examiner and the laboratory teacher. The external examiner shall be appointed by the Principal from the panel of examiners recommended by Chairman, Board of Studies in respective Branches.

6.4 There shall be two seminar presentations during I year I semester and II semester. For seminar, a student under the supervision of a faculty member, shall collect the literature on a topic and critically review the literature and submit it to the department in a report form and shall make an oral presentation before the Departmental Academic Committee

consisting of Head of the Department, Supervisor and two other senior faculty members of the department. For each Seminar there will be only internal evaluation of 50 marks. A candidate has to secure a minimum of 50% of marks to be declared successful. If he fails to fulfill minimum marks, he has to reappear during the supplementary examinations.

6.5 There shall be a Comprehensive Viva-Voce in II year I Semester. The Comprehensive Viva-Voce is intended to assess the students' understanding of various subjects he has studied during the M. Tech. course of study. The Head of the Department shall be associated with the conduct of the Comprehensive Viva-Voce through a Committee. The Committee consisting of Head of the Department, one senior faculty member and an external examiner. The external examiner shall be appointed by the Principal from the panel of 3 examiners recommended by Chairman, Board of Studies in respective Branches. There are no internal marks for the Comprehensive Viva-Voce and evaluates for maximum of 100 marks. A candidate has to secure a minimum of 50% of marks to be declared successful. If he fails to fulfill minimum marks, he has to reappear during the supplementary examinations.

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

6.7 In case the candidate does not secure the minimum academic requirement in any subject (as specified in 6.6) he has to reappear for the Semester End Examination in that subject.

6.8 A candidate shall be given one chance to re-register for the subjects if the internal marks secured by a candidate is less than 50% and failed in that subject for maximum of two subjects and should register within four weeks of commencement of the class work. In such a case, the candidate must re-register for the subjects and secure the required minimum attendance. The candidate's attendance in the re-registered subject(s) shall be calculated separately to decide upon his eligibility for writing the Semester End Examination in those subjects. In the event of the student taking another chance, his Continuous Internal Evaluation (internal) marks and Semester End Examination marks obtained in the previous attempt stands cancelled.

6.9 In case the candidate secures less than the required attendance in any subject, he shall not be permitted to write the Semester End Examination in that subject. He shall re-register for the subject when next offered.

7. Examinations and Assessment - The Grading System

7.1 Marks will be awarded to indicate the performance of each student in each Theory Subject, or Lab/Practicals, or Seminar, or Project, etc., based on the % marks obtained in CIE + SEE (Continuous Internal Evaluation + Semester End Examination, both taken together) as specified in Item 6 above, and a corresponding Letter Grade shall be given.

7.2 As a measure of the student's performance, a 10-point Absolute Grading System using the following Letter Grades (UGC Guidelines) and corresponding percentage of marks shall be followed:

% of Marks Secured (Class Intervals)	Letter Grade (UGC Guidelines)	Grade Points
80% and above (≥ 80%, ≤ 100%)	O (Outstanding)	10
Below 80% but not less than 70% (≥ 70%, < 80%)	**A^+** (Excellent)	9
Below 70% but not less than 60% (≥ 60%, < 70%)	**A** (Very Good)	8
Below 60% but not less than 55% (≥ 55%, < 60%)	**B^+** (Good)	7
Below 55% but not less than 50% (≥ 50%, < 55%)	**B** (Above Average)	6
Below 50% (< 50%)	F (Fail)	0
Absent	Ab	0

7.3 A student obtaining F Grade in any Subject shall be considered 'failed' and is be required to reappear as 'Supplementary Candidate' in the Semester End Examination (SEE), as and when offered. In such cases, his Internal Marks (CIE Marks) in those Subjects will remain the same as those he obtained earlier.

7.4 A student not appeared for examination then 'Ab' Grade will be allocated in any Subject shall be considered 'failed' and will be required to reappear as 'Supplementary Candidate' in the Semester End Examination (SEE), as and when offered.

7.5 A Letter Grade does not imply any specific Marks percentage and it will be the range of marks percentage.

7.6 In general, a student shall not be permitted to repeat any Subject/ Course (s) only for the sake of 'Grade Improvement' or 'SGPA/ CGPA Improvement'.

7.7 A student earns Grade Point (GP) in each Subject/ Course, on the basis of the Letter Grade obtained by him in that Subject/ Course. The corresponding 'Credit Points' (CP) are computed by multiplying the Grade Point with Credits for that particular Subject/ Course.

Credit Points (CP) = Grade Point (GP) x Credits …. For a Course

7.8 The Student passes the Subject/ Course only when he **gets GP ≥ 6(B Grade or above).**

7.9 The Semester Grade Point Average (SGPA) is calculated by dividing the Sum of

CreditPoints (ΣCP) secured from ALL Subjects/ Courses registered in a Semester, by the TotalNumber of Credits registered during that Semester. SGPA is rounded off to TWODecimal Places. SGPA is thus computed as

SGPA = $\left\{\sum_{i=1}^{N} C_i G_i\right\} / \left\{\sum_{i=1}^{N} C_i\right\}$ **For each Semester**,

where 'i' is the Subject indicator index (takes into account all Subjects in a Semester), 'N' is the no. of Subjects 'REGISTERED' for the Semester (as specifically required and listed under the Course Structure of the parent Department), C is the no. of Credits allotted to the ith Subject, and G represents the Grade Points (GP) corresponding to the Letter Grade awarded for that i^{th} Subject.

7.10 The Cumulative Grade Point Average (CGPA) is a measure of the overall cumulative performance of a student over all Semesters considered for registration. The CGPA is the ratio of the Total Credit Points secured by a student in ALL registered Courses in ALL Semesters, and the Total Number of Credits registered in ALL the Semesters. CGPA is rounded off to TWO Decimal Places. CGPA is thus computed from the I Year Second Semester onwards, at the end of each Semester, as per the formula

CGPA = $\left\{\sum_{j=1}^{M} C_j G_j\right\} / \left\{\sum_{j=1}^{M} Cj\right\}$ **… for all S Semesters registered**

(ie., upto and inclusive of S Semesters, $S \geq 2$ **)**,

where 'M' is the TOTAL no. of Subjects (as specifically required and listed under the Course Structure of the parent Department) the Student has 'REGISTERED' from the 1st Semester onwards upto and inclusive of the Semester S (obviously M > N), 'j' is the Subject indicator index (takes into account all Subjects from 1 to S Semesters), C is the no. of Credits allotted to the jth Subject, and G represents the Grade Points (GP) corresponding to the Letter Grade awarded for that jth Subject. After registration and completion of I Year I Semester however, the SGPA of that Semester itself may be taken as the CGPA, as there are no cumulative effects.

7.11 For Calculations listed in Item 7.6 – 7.10, performance in failed Subjects/ Courses (securing F Grade) will also be taken into account, and the Credits of such Subjects/ Courses will also be included in the multiplications and summations.

8. EVALUATION OF PROJECT/DISSERTATION WORK

Every candidate shall be required to submit a thesis or dissertation on a topic approved by the Project Review Committee.

8.1 A Project Review Committee (PRC) shall be constituted with Head of the Department as Chairperson, Project Supervisor and one senior faculty member of the Departments offering the M. Tech. programme.

8.2 Registration of Project Work: A candidate is permitted to register for the project

work after satisfying the attendance requirement of all the subjects, both theory and practical.

8.3 After satisfying 8.2, a candidate has to submit, in consultation with his Project Supervisor, the title, objective and plan of action of his project work to the PRC for approval. Only after obtaining the approval of the PRC the student can initiate the Project work.

8.4 If a candidate wishes to change his supervisor or topic of the project, he can do so with the approval of the PRC. However, the PRC shall examine whether or not the change of topic/supervisor leads to a major change of his initial plans of project proposal. If yes, his date of registration for the project work starts from the date of change of Supervisor or topic as the case may be.

8.5 A candidate shall submit his project status report in two stages at least with a gap of 3 months between them.

8.6 The work on the project shall be initiated at the beginning of the II year and the duration of the project is two semesters. A candidate is permitted to submit Project Thesis only after successful completion of all theory and practical courses with the approval of PRC not earlier than 40 weeks from the date of registration of the project work. For the approval of PRC the candidate shall submit the draft copy of thesis to the Head of the Department and make an oral presentation before the PRC.

8.7 Three copies of the Project Thesis certified by the supervisor shall be submitted to the College/School/Institute.

8.8 For Project work **Review I** in II Year I Sem. there is an internal marks of 50, the evaluation should be done by the PRC for 25 marks and Supervisor will evaluate for 25 marks. The Supervisor and PRC will examine the Problem Definition, Objectives, Scope of Work, Literature Survey in the same domain. A candidate has to secure a minimum of 50% of marks to be declared successful for Project Work Review I. If he fails to fulfill minimum marks, he has to reappear as per the recommendations of PRC.

8.9 For Project work **Review II** in II Year II Sem. there is an internal marks of 50, the evaluation should be done by the PRC for 25 marks and Supervisor will evaluate for 25 marks. The PRC will examine the overall progress of the Project Work and decide the Project is eligible for final submission or not. A candidate has to secure a minimum of 50% of marks to be declared successful for Project Work Review II. If he fails to fulfill minimum marks, he has to reappear as per the recommendations of PRC.

8.10 For Project Evaluation (Viva Voce) in II Year II Sem. there is an external marks of 150 and the same evaluated by the External examiner appointed by the Institution. The candidate has to secure minimum of 50% marks in Project Evaluation (Viva-Voce) examination.

8.11 If he fails to fulfill as specified in 8.10, he will reappear for the Viva-Voce examination only after three months. In the reappeared examination also, fails to fulfill, he will not be eligible for the award of the degree.

8.12 The thesis shall be adjudicated by one examiner selected by the Institution. For

this, Chairmen, BOS of the respective departments shall submit a panel of 3 examiners, who are eminent in that field with the help of the concerned guide and senior faculty of the department.

8.13 If the report of the examiner is not favourable, the candidate shall revise and resubmit the Thesis. If the report of the examiner is un favourable again, the thesis shall be summarily rejected.

8.14 If the report of the examiner is favourable, Project Viva-Voce examination shall be conducted by a board consisting of the Supervisor, Head of the Department and the external examiner who adjudicated the Thesis.

8.15 The Head of the Department shall coordinate and make arrangements for the conduct of Project Viva- Voce examination.

9. AWARD OF DEGREE AND CLASS

9.1 A Student who registers for all the specified Subjects/ Courses as listed in the Course Structure, satisfies all the Course Requirements, and passes the examinations prescribed in the entire PG Programme (PGP), and secures the required number of **88** Credits (with CGPA $\geq$ 6.0), shall be declared to have 'QUALIFIED' for the award of the M.Tech. Degree in the chosen Branch of Engineering and Technology with specialization as he admitted.

9.2 **Award of Class**

After a student has satisfied the requirements prescribed for the completion of the programme and is eligible for the award of M. Tech. Degree, he shall be placed in one of the following three classes based on the CGPA:

Class Awarded	CGPA
First Class with Distinction	$\geq$ 7.75
First Class	6.75$\leq$CGPA < 7.75
Second Class	6.00$\leq$CGPA < 6.75

9.3 A student with final CGPA (at the end of the PGP) < 6.00 will not be eligible for the Award of Degree.

10. WITHHOLDING OF RESULTS

If the student has not paid the dues, if any, to the institution or if any case of indiscipline is pending against him, the result of the student will be withheld and he will not be allowed into the next semester. His degree will be withheld in such cases.

11. TRANSITORY REGULATIONS

11.1 If any candidate is detained due to shortage of attendance in one or more subjects, they are eligible for re-registration to maximum of two earlier orequivalentsubjects at a time as and when offered.

11.2 The candidate who fails in any subject will be given two chances to pass the same

subject; otherwise, he has to identify an equivalent subject as per R15 Academic Regulations.

12 GENERAL

12.1 **Credit**: A unit by which the course work is measured. It determines the number of hoursof instructions required per week. One credit is equivalent to one hour of teaching (lecture or tutorial) or two hours of practical work/field work per week.

12.2 **Credit Point:** It is the product of grade point and number of credits for a course.

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

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

12.5 In the case of any doubt or ambiguity in the interpretation of the above rules, the Decision of the Academic Council is final.

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

MALPRACTICES RULES

DISCIPLINARY ACTION FOR IMPROPER CONDUCT IN EXAMINATIONS

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

		of the original candidate who has been impersonated, shall be cancelled in all the subjects of the examination(including practical's and project work) already appeared and shall not be allowed to appear for examinations of the remaining subjects of that semester/year. The candidate is also debarred for two consecutive semesters from class work and all semester examinations. The continuation of the course by the candidate is subject to the academic regulations in connection with forfeiture of seat. If the imposter is an outsider, he will be handed over to the police and a case is registered against him.
4.	Smuggles in the Answer book or additional sheet or takes out or arranges to send out the question paper during the examination or answer book or additional sheet, during or after the examination.	Expulsion from the examination hall and cancellation of the performance in that subject and all other subjects the candidates has already appeared including practical examinations and project work and shall not be permitted for the remaining examinations of the subjects of that semester/year. The candidate is also debarred for two consecutive semesters from class work and all semester examinations. The continuation of the course by the candidate is subject to the academic regulations in connection with forfeiture of seat.
5.	Uses objectionable, abusive or offensive language in the answer paper or in letters to the examiners or writes to the examiner requesting him to award pass marks.	Cancellation of the performance in that subject.
6.	Refuses to obey the orders of the Chief Superintendent/Assistant-Superintendent/ any officer on duty or misbehaves or creates disturbance of any kind in and around the examination hall or organizes	In case of students of the college, they shall be expelled from examination halls and cancellation of their performance in that subjects and all other subjects the candidate(s) has

	a walk out or instigates others to walk out, or threatens the officer-in-charge or any person on duty in or outside the examination hall of any injury to his person or to any office relations whether by words, either spoken or written or by signs or by visible representation, assaults the officer-in-charge, or any person on duty in or outside the examination hall or any of his relations, or indulges in any other act of misconduct or mischief which result in damage to or destruction of property in the examination hall or any part of the college campus or engages in any other act which in the opinion of the officer on duty amounts to use of unfair means or misconduct or has the tendency to disrupt the orderly conduct of the examination.	(have) already appeared and shall not be permitted to appear for the remaining examinations of the subjects of that semester/year. The candidates also are debarred and forfeit their seats. In case of outsiders. They will be handed over to the police and a police case is registered against them.
7.	Leaves the exam hall taking away answer script or intentionally tears of the script or any part thereof inside or outside the examination hall.	Expulsion from the examination hall and cancellation of performance in that subject and all the other subjects the candidates has already appeared including practical examinations and project work and shall not be permitted for the remaining examinations of the subjects of that semester/year. The candidate is also debarred for two consecutive semesters from class work and all semester examinations. The continuation of the course by the candidate is subject to the academic regulation in connection with forfeiture of seat.
8.	Posses any lethal weapon or firearm in the examination hall.	Expulsion from the examination hall and cancellation of performance in that subject and all the other subjects the candidates has already appeared including practical examinations and project work and shall not be permitted for the remaining examinations of the subjects of that semester/year. The candidate is also

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

ANURAG ENGINEERING COLLEGE

(AUTONOMOUS)

M.TECH (STRUCTURAL ENGINEERING)

COURSE STRUCTURE AND SYLLABUS

I Year I Semester

Sub. Code	Category	Subject Name	L	P	C
A31012	Core Course I	Theory of Elasticity and plasticity	4	0	4
A31013	Core Course II	Advanced structural analysis	4	0	4
A31014	Core Course III	Advanced Reinforced Concrete Design	4	0	4
A31015	Core Elective-I	Concrete Technology	4	0	4
A31016	Core Elective-I	Experimental Stress Analysis			
A31017	Core Elective-I	Optimization Techniques in Structural Engineering			
A31018	Core Elective-II	Theory and Analysis of plates	4	0	4
A31019	Core Elective-II	Soil dynamics and foundation Engineering			
A31020	Core Elective-II	composite materials			
A31021	Open Elective I	Computer Oriented Numerical Methods	4	0	4
A31022	Open Elective I	Reliability Engineering Experimental Stress Analysis			
A31203		Advanced Concrete Laboratory	0	4	2
A31204		Seminar	-	4	2
	Total		24	8	28

I Year II Semester

Subject Code	Category	Subject Name	L	P	C
A32012	Core Course V	Finite Element Methods	4	0	4
A32013	Core Course VI	Structural Dynamics	4	0	4
A32014	Core Course VII	Earthquake Resistant Design of Buildings	4	0	4
A32015	Core Elective-III	Pre stressed concrete	4	0	4
A32016	Core Elective-III	Advanced Foundation Engineering			
A32017	Core Elective-III	Computer Aided Design in Structural Engineering (CAD).			
A32018	Core Elective-IV	Principles of Bridge Engineering	4	0	4
A32019	Core Elective-IV	Analysis and Design of Shells and Folded plates			
A32020	Core Elective-IV	Advanced. Steel Design			
A32021	Open Elective I	Plastic Analysis and Design	4	0	4
A32022	Open Elective I	Stability of Structures			
A32203		CAD Laboratory	0	4	2
A32204		Seminar	-	4	2
	Total		**24**	**8**	**28**

II Year I Semester

Subject Code	Category	Subject Name	L	P	C
A33203		Comprehensive Viva-Voce	-	-	4
A33204		Project work Review I	-	24	12
		Total Credits	-	24	16

II Year II Semester

Subject Code	Category	Subject Name	L	P	C
A34203		Project work Review II	-	8	4
A34204		Project Evaluation (Viva-Voce)		16	12
		Total Credits	-	24	16

ANURAG ENGINEERING COLLEGE
(AUTONOMOUS)

I Year M.Tech – I Sem(Structural Engineering)

THEORY OF ELASTICITY AND PLASTICITY

Course Objectives:

To impart knowledge of Principal stresses and strains and to develop analytical skills of solving problems using plain stress and plain strain. . Thus, the objective of this course is to enablestudents to obtain an intuitive and working understanding of knowledge of engineering application of plasticity.

UNIT-I

Introduction: Elasticity - notation for forces and stresses - components of stresses - components of strain - Hooks law. Plane stress and plane strain analysis - plane stress - plane strain - differential equations of equilibrium - boundary conditions - compatibility equations - stress function - boundary condition.

UNIT II.

Two dimensional problems in rectangular coordinates - solution by polynomials - Saint-Venant's principle - determination of displacements - bending of simple beams - application of corier series for two dimensional problems - gravity loading. Two dimensional problems in polar coordinates - stress distribution symmetrical about an axis - pure bending of curved bars - strain components in polar coordinates - displacements for symmetrical stress distributions - simple symmetric and asymmetric problems - general solution of two- dimensional problem in polar coordinates - application of general solution in polar coordinates.

UNIT III.

Analysis of stress and strain in three dimensions - principal stresses - stress ellipsoid - director surface - determination of principal stresses - max shear stresses – homogeneous deformation - principal axes of strain rotation. General Theorems: Differential equations of equilibrium - conditions of compatibility - determination of displacement - equations of equilibrium in terms of displacements - principle of super position - uniqueness of solution - the reciprocal theorem.

UNIT IV.

Torsion of Prismatic Bars - torsion of prismatic bars - bars with elliptical cross sections - other elementary solution - membrane analogy - torsion of rectangular bars - solution of torsion problems by energy method - use of soap films in solving torsion problems - hydro dynamical analogies - torsion of shafts, tubes , bars etc. Bending of Prismatic Bars: Stress function - bending of cantilever - circular cross section - elliptical cross section - rectangular cross section - bending problems by soap film method - displacements.

UNIT V.

Theory of Plasticity: Introduction - concepts and assumptions - yield criterions.

Course Outcomes:

1. The students shall be able to demonstrate the application of plane stress and plane strain in a given situation.
2. The student will demonstrate the ability to analyze the structure using plasticity.
3. To impart the knowledge of stress-strain relations for linearly elastic solids, and Torsion.
4. To impart the knowledge in concepts of theory of Plasticity and their assumptions.

REFERENCES:

1. Theory of Elasticity by Timeshanko, McGrawhill Publications.
2. Theory of Plasticity by J.Chakarbarthy, McGrawhill Publications.
3. Theory of Elasticity by Y.C.Fung.
4. Theory of Elasticity by Gurucharan Singh.

ANURAG ENGINEERING COLLEGE

(AUTONOMOUS)

I Year M.Tech – I Sem(Structural Engineering)

ADVANCED STRUCTURAL ANALYSIS

Course Objectives:

Learn how to compute static and kinematic indeterminacies of various types of structures. Know how to generate the stiffness matrix for continuous beams, portal frames and trusses. Know how to generate the flexibility matrix for continuous beams, portal frames and trusses. Understand the structural behavior of frames with and without shear walls.

UNIT I

Introduction to matrix methods of analysis - static indeterminacy and kinematic indeterminacy - degree of freedom - coordinate system - structure idealization stiffness and flexibility matrices - suitability element stiffness equations - elements flexibility equations - mixed force - displacement equations - for truss element, beam element and tensional element.

Transformation of coordinates - element stiffness matrix - and load vector - local and global coordinates.

UNIT II

Assembly of stiffness matrix from element stiffness matrix - direct stiffness method - general procedure - bank matrix - semi bandwidth - computer algorithm for assembly by direct stiffness matrix method.

UNIT III

Analysis of plane truss - continuous beam - plane frame and grids by flexibility methods.

UNIT IV

Analysis of plane truss - continuous beam - plane frame and grids by stiffness methods.

UNIT V. Special analysis procedures - static condensation and sub structuring - initial and thermalstresses.

Shear walls- Necessity - structural behaviour of large frames with and without shear walls - approximate methods of analysis of shear walls.

Course Outcomes:

1. Generate the global stiffness matrix by assembling the element stiffness matrices.
2. Analyze the continuous beams, portal frames and trusses by matrix stiffness method.
3. Analyze the continuous beams, portal frames and trusses by matrix flexibility method.
4. Understand the necessity of shear walls and its analysis by various methods.

REFERENCES

1. Matrix Analysis of Frames structures by William Weaver J.R and James M.Geve, CBS publications.
2. Advanced Structural Analysis by Ashok.K.Jain, New Channel Brothers.
3. Structural Analysis by C.S.Reddy.
4. Matrix Structural Analysis by Kanchi.
5. Matrix Methods of Structural Analysis by J.Meek.
6. Structural Analysis by Ghali and Neyveli.

ANURAG ENGINEERING COLLEGE
(AUTONOMOUS)
I Year M.Tech – I Sem(Structural Engineering)

ADVANCED REINFORCED CONCRETE DESIGN

Course Objectives:

Compare, contrast and apply alternative methods of design for reinforced concretebeams& slabs.Understand and apply the design guidance used in current codes of practice for thedesign of Shear Walls & Corbels.Understandthe different sources of cracking in concrete structures.Understand the mechanisms causing flexural and shrinkage cracking, the designguidance in current codes of practice and the use and limitations of suchmethods indesign.

UNIT I

Basic Design Concepts: Behaviour in flexure, Design of singly reinforced rectangular sections,Design of doubly reinforced rectangular sections, Design of flanged beams, Design of shear, Design for Torsion, Limit state of Serviceability: Deflections of Reinforced concrete beams and slabs, short term deflection and long term deflection, estimation of crack width in RCC members, calculation of crack widths.

UNIT II

Limit Analysis of R.C.Structures: Rotation of a plastic hinge, Redistribution of moments, momentrotation characteristics of RC member, I.S. code provisions, applications for fixed and continuous beam. Yield line analysis for slabs: Upper bound and lower bound theorems – yield line criterion – Virtual work and equilibrium methods of analysis for square and circular slabs with simple and continuous end conditions.

UNIT III

Design of Ribbed slabs, Flat slabs: Analysis of the Slabs for Moment and Shears, Ultimate Momentof Resistance, Design for shear, Deflection, Arrangement of Reinforcements.

Flat slabs: Direct design method – Distribution of moments in column strips and middle strip-momentand shear transfer from slabs to columns – Shear in Flat slabs-Check for one way and two way shears - Introduction to Equivalent frame method. Limitations of Direct design method, Distribution of moments in column strips and middle strip.

UNIT IV

Design of Reinforced Concrete Deep Beams & Corbels: Steps of Designing Deep Beams, Designby IS 456, Checking for Local Failures, Detailing of Deep Beams, Analysis of Forces in a Corbels , Design of Procedure of Corbels, Design of Nibs.

UNIT V

Design of Compression members: Estimation of effective length of a column-Code requirements onSlenderness Limits, Design of Short Columns under Axial Compression, Design of Short Columns with Uniaxial Bending, Design of Short Columns under Biaxial Bending, Design of Slender Columns.

Design of Combined Footings- Distribution of soil Pressure – Geometry of Two Column Combined Footing – Design Considerations in Combined Footing for Two – Columns.

Course Outcomes:

1. Calculate short term and long term deflections for RCC elements.
2. Analyze the flexural and shear capacity of existing RCC elements.

3. Calculate the ductility of a reinforced concrete section.
4. Design for shear of RCC elements. Science & Mathematics (Knowledge and understanding of mathematical models as applied to reinforced concrete design).
5. Understanding for engineering Practice of how the physical and mechanical properties of concrete influence design methods and construction processes.

TEXT BOOKS:

1. Reinforced concrete design by S. UnnikrishnaPillai&Menon, Tata Mc. Graw Hill, 2nd Edition, 2004
2. Advanced Reinforced Concrete Design – P.C. Varghese, Practice Hall, 2008
3. Limit state theory and design of reinforced concrete by Dr. S.R. Karve and Dr. V.L. Shah, Standard publishers, Pune, 3rd Edition, 1994

REFERENCE BOOKS:

1. Reinforced concrete design by KennathLeet, Tata Mc. Graw-Hill International, editions, 2nd edition, 1991.
2. Reinforced concrete structural elements – behaviour, Analysis and design by P.Purushotham, Tata Mc.Graw-Hill, 1994.
3. Design of concrete structures – Arthus H. Nilson, David Darwin, and Chorles W. Dolar, Tata Mc. Graw-Hill, 3rd Edition, 2005.
4. Reinforced concrete structures, Vol.1, by B.C. Punmia, Ashok Kumar Jain and Arun Kumar Jain, Laxmi Publications, 2004.
5. Reinforced concrete structures – I.C. Syal& A.K. Goel, S. Chand, 2004.

ANURAG ENGINEERING COLLEGE
(AUTONOMOUS)

I Year M.Tech – I Sem(Structural Engineering)

CONCRETE TECHNOLOGY
(ELECTIVE -I)

Course Objectives:

Use different types of cement as per their properties for different field applications.Design economic concrete mix proportion for different exposure conditions andintended purposes.Supervise various concreting operations.Carry out fieldand laboratory tests on concrete in plastic and hardened stage.

UNIT – I

Concrete Making Materials: Cement- Bogues compounds – Hydration Process– Types of cement – Aggregates – Gradation Charts – Combined aggregate-Alkali Silica Reaction -Admixtures – Chemical and Mineral admixtures..

UNIT – II

Fresh and Hardened Concrete: Fresh Concrete - workability tests on Concrete Setting times of Fresh Concrete - Segregation and bleeding.
Hardened Concrete : Abram's law- Gel space ratios, Maturity Concept – Stress Behaviour – Creep and Shrinkage – Durability tests on concrete - Non destructive testing of concrete.

UNIT - III

High Strength Concrete – Micro structure – Manufacturing and Properties- Design 0s HSC Using ErintroyShaklok Method- Ultra High Strength Concrete.
High Performance Concrete- Requirements and properties of High Performance Concrete- Design Considerations.

UNIT –IV

Special Concrete: Self Compacting concrete – Polymer concrete – Fiber reinforced concrete –Reactive Powder concrete – Requirements and Guidelines – Advantages and Applications. Light weight concrete.
Concrete mix design : Quality Control - Quality assurance - Quality audit- Mix Design method - BIS method, ACI method, DOE method.

UNIT –V

Form work – materials – structural requirements – form work systems – connections – specifications –design of form work – shores – removal for forms – reshoring – failure of form work.

Course Outcomes:

1. Determine the properties of concrete ingredients i.e. cement, sand, coarse aggregate by conducting different tests.
2. Recognize the effects of the rheology and early age properties of concrete on its long-term behavior.
3. Develop an advanced knowledge of the mechanical performance of cement based materials and how it can be controlled
4. Use various chemical admixtures and mineral additives to design cement based materials with tailor-made properties
5. Use advanced laboratory techniques to characterize cement-based materials.

6. Understand the mix design and engineering properties of special concretes such as high-performance concrete, self-consolidating concrete, fibre reinforced concrete,sprayed concrete, etc

TEXT BOOKS:

1. Properties of Concrete by A.M.Neville, ELBS publications.
2. Concrete Technology by A.K. Santhakumar, Oxford Press.
3. Concrete Technology by M.S.Shetty, S.Chand& Co.

REFERENCES:

1. Special Structural concretes by RajatSiddique, Galgotia Publications.
2. Design of Concrete Mixes by N.KrishnaRaju, CBS Publications.
3. Concrete: Micro Structure by P.K.Mehta, ICI, Chennai.

ANURAG ENGINEERING COLLEGE
(AUTONOMOUS)

I Year M.Tech – I Sem(Structural Engineering)

EXPERIMENTAL STRESS ANALYSIS
(ELECTIVE -I)

UNIT I

Basic equations and Plane Elasticity Theory: Introduction, Strain equations of Transformation, Compatibility, Stress-Strain Relations-Two dimensional State of Stress. The Plane-Elastic problem, The Plane-Strain Approach, Plane Stress, Airy's Stress function-Cartesian Co-ordinates-Two dimensional problems in Polar Co-ordinates, Polar Components of Stress in terms of Airy's Stress function, Forms.

Principles of Experimental Approach: Merit of Experimental Analysis introduction, uses of experimental stress analysis-Advantages of experimental stress analysis, Different methods, Simplification of problems.

UNIT II

Strain Measurement using Strain Gauges: Definition of strain and its relation to Experimental Determinations, properties of strain-gauge systems, Types of strain gauges, Mechanical and Optical strain gauges. Electrical Strain Gauges - Introduction, LVDT - resistance strain gauge - various types - gauge factor, Materials for adhesion base, etc.

Strain Rosettes: Introduction, The three element rectangular Rosette - The delta rosette - Corrections for Transverse strain effects.

UNIT III

Brittle Coating Method: Introduction, Coating stresses - Failure theories - Brittle coating Crack pattern - Crack detection - Types of Brittle coating - Test procedures for brittle coating analysis - Calibration procedures - Analysis of brittle coating data.

UNIT IV

Theory of Photo Elasticity: Introduction, Temporary double refraction - The stress optic law - Effects of stressed model in a Polaris cope for various arrangements - Fringe sharpening, Brewster stress optic law.

UNIT V

Two Dimensional Photo Elasticity: Introduction, Isochromatic Fringe patterns - Isoclinic fringe patterns, passage of light through plane Polaris cope and circular Polaris cope, Isoclinic fringe pattern - Compensation techniques - calibration methods, separation methods, scaling Model to Proto type stress- Materials for photo - elasticity, properties of photo elastic materials.

REFERENCES :

1. Experimental Stress Analysis by J.W.Dally and W.F.Riley
2. Experimental Stress Analysis by Dr. Sadhu Singh
3. Experimental Stress Analysis by Dove and Adams

ANURAG ENGINEERING COLLEGE
(AUTONOMOUS)

I Year M.Tech – I Sem(Structural Engineering)

OPTIMIZATION TECHNIQUES IN STRUCTURAL ENGINEERING
(ELECTIVE -I)

Course Objectives:

Define statement of optimization problem. Solve optimization problems using linear programming, solve optimization problems using Dynamic programming. Optimize structural elements like beams, trusses and frames and achieve efficient designs based on various applications and objective functions for professional practice

UNIT I

Introduction to Optimization: Introduction - Historical developments - Engineering applications ofOptimization - Statement of an Optimization problem - Classification of Optimization problems - Optimization Techniques. Optimization by calculus: Introduction - Unconstrained functions of a single variable - Problems involving simple constraints - Unconstrained functions of several variables - treatment of equality constraints - Extension to multiple equality constraints - Optimization with inequality constraints - The generalized Newton-Raphson method.

UNIT II

Linear Programming: Introduction - Applications of linear programming - standard form of a linearprogramming problem - Geometry of linear programming problems - Definitions and theorems - Solution of a system of Linear simultaneous equations - Pivotal reduction of a general system of equations - Motivation of the Simplex Method - Simplex Algorithm - Two phases of the simplex method. non-Linear Programming: Introduction - Unimodal Function - Unrestricted search - Exhaustive search - Dichotomous search - Interval Halving method - Fibonacci method - Golden section method - Comparison of elimination methods - Unconstrained optimization techniques - Direct search methods - Random search methos - grid search method - Univariate method - Powell's method - Simplex method - Indirect search methods - Gradient of a function - Steepest descent method - Conjugate gradient - Newton's method.

UNIT III

Dynamic Programming: Introduction - Multistage decision processes - concept of sub-optimizationand the principle of optimality - computational procedure in dynamic programming - example illustrating the Calculus method of solution - example illustrating the Tabular of solution - conversion of a final value problem into an initial value problem - continuous dynamic programming - Additional applications.

UNIT IV

Network Analysis: Introduction - Elementary graph theory - Network variables and problem types -Minimum-cost route - Network capacity problems - Modification of the directional sense of the network.

UNIT V

Application of Optimization techniques to trusses, Beams and Frames.

Course Outcomes:

1. Understand Engineering optimization.
2. Classify the optimization problems.
3. Understand various methods of linear programming & Dynamic programming.
4. Apply optimization techniques to trusses, beams & frames.

REFERENCES:

1. Optimization: Theory and Applications by S.S.Rao.
2. Numerical Optimization Techniques for Engineering Design with applications by G.N.Vanderplaats.
3. Elements of Structural Optimization by R.T.Haftka and Z.Gurdal.
4. Optimum Structural Design by U.Kirsch.
5. Optimum Design of Structures by K.I.Majid.
6. Introduction to Optimum Design by J.S.Arora.

ANURAG ENGINEERING COLLEGE
(AUTONOMOUS)

I Year M.Tech – I Sem (Structural Engineering)

THEORY AND ANALYSIS OF PLATES

Course Objectives:

Achieve fundamental understanding of the classical theory of elastic plates. Introduce analytical and numerical solution techniques in thin plate theory. Apply theory of plates to the problems involving various geometrics and boundary conditions. Apply Navier Levy's, and Rayleigh—Ritz solutions to plates with different end conditions.Provide enhanced knowledge in solid mechanics and advanced structural mechanics

UNIT I

Cylindrical Bending : Different kind of plates – Assumptions - Derivation of differential equation forcylindrical bending of long rectangular plates - Analysis of uniformly loaded rectangular plates with edges simply supported and fixed subjected to uniform load.

Pure Bending of Plates : Slope and curvature of slightly bent plates – Relations betweenmoments and curvature - Particular cases of pure bending - Strain energy in pure bending –Energy methods like Ritz and Galerkin Methods to rectangular plates subjected to simple loadings.

UNIT II

Small Deflection Theory of Thin Rectangular Plates : Assumptions – Derivation of governingdifferential equation for thin plates – Boundary conditions – simplysupportedplateundersinusoidal load – Navier's solution – Application to differentcases– Levy's solution forvariousboundary conditions subjected to different loadings like uniform andhydrostatic pressure.

UNIT III

Circular Plates : Symmetrical loading – Relations between slope, deflection, moments and curvature– Governing differential equation – Uniformly loaded plates with clamped and simply supported edges– Central hole – bending by moments and shearing forces uniformly distributed.

Orthotropic Plates: Introduction – Bending of anisotropic plates - Derivation of governing differentialequation – Determination of Rigidities in various cases like R.C. slabs, corrugated sheet – Application to the theory of grid works.

UNIT IV

Plates on Elastic Foundations : Governing differential equation – deflection of uniformly loadedsimply supported rectangular plate – Navier and Levy type solutions - Large plate loaded at equidistant points by concentrated forces P.

UNIT V

Buckling of Plates: Governing equation for Bending of plate under the combined action of in-planeloading and lateral loads – Buckling of rectangular plates by compressive forces acting in one and two directions in the middle plane of plate

Finite Difference Methods: Introduction - Application to rectangular plates subjected to simpleloading.

Course Outcomes:

1. Apply the theory of plates in engineering designs.
2. Discover and exploit various modelling avenues for structural engineering components and obtain the exact and/or approximate solutions.
3. Select an appropriate plate theory for different Engineering applications.
4. Gain a thorough understanding of Kirchhoff's, First order shear deformation theories.

REFERENCES:

1. Theory of Plates and Shells by Timoshenko, McGraw Hill Book Co., New York.
2. Theory and Analysis of Plates by P. Szilard, Prentice Hall.
3. Theory of Plates by Chandrasekhar, University Press.
4. Plate Analysis by N. K. Bairagi, Khanna Publishers. New Delhi.

ANURAG ENGINEERING COLLEGE
(AUTONOMOUS)

I Year M.Tech – I Sem(Structural Engineering)

SOIL DYNAMICS AND FOUNDATION ENGINEERING

(ELECTIVE-II)

Course Objectives:

Use the techniques, skills, and modern engineering tools necessary for engineering practice. Understand the impact of engineering solutions in economic and environmental context. Design, analyze and interpret data related to the geotechnical engineering.

UNIT I

Types of machine foundations – general requirements design – criteria for machine foundations, permissible amplitudes and bearing pressure. Resonance and its effect – free and forced Vibrations with and without damping – constant force and rotating mass type excitation – magnification steady state vibrations – logarithmic decrement.

UNIT II

Natural frequency of foundation – soil system – Barkan's and I.S. methods of determining natural frequency.

UNIT III

Elastic properties of soil for dynamical purpose and their experimental determination – Elastic waves and their characteristics – Experimental determination of shear modulus from wave theory.

UNIT IV

Apparent soil mass – bulb of pressure concept – Pauw's analogy of foundation – soil systems (Concept only) - Theory of elastic half space – lamb and the dynamic Boussinesq's problem – Relsner's solution and its limitations – Quinlan and Sung's modifications – Hsiegh's equations for vertical vibration.

UNIT V

Principles of design of foundations for reciprocating and impact type of machine – as per I.S. Codes. Vibration isolation – types and methods of isolation – isolating materials and their properties.

Course Outcomes:

1. Accentuate the understanding of the basic principles and exposes the student to the latest developments, with a strong research orientation.
2. Identify, formulate and solve foundation related problems.
3. Understand the latest trends, modern standards and state of the art techniques for geotechnical engineering.

REFERENCES:

1. Hand Book of Machine Foundations by S. Srinivasulu and Vaidganathan.
2. Soil Mechanics & Foundation Engineering by B.C. Punmia.
3. Analysis and Design of Foundation and retaining structures-Sham SherPrakets, Etal.
4. Vibration of Soils & Foundations – Richant Hall & Woods.

ANURAG ENGINEERING COLLEGE
(AUTONOMOUS)

I Year M.Tech – I Sem(Structural Engineering)

COMPOSITE MATERIALS
(ELECTIVE-II)

Course Objectives:

Develop an understanding of the linear elastic analysis of composite materials. Understandingtheconcepts such as anisotropic material behavior and the analysis of laminatedplates.Understand the underlying principles and techniques associated with the stress analysis and strength predictions of composite material structures.

UNIT - I

Introduction: Requirements of structural materials, influence of nature of materials in structural form, Nature of structural materials- Homogeneous materials, composite materials.

UNIT - II

Macro mechanical Properties of composite Laminae: Introduction, Assumptions and Idealizations, Stress Strain relationships for composite Laminae- Isotropic, Orthotropic laminae, Strength Characteristics- Basic concepts, Strength hypothesis for isotropic and Orthotropic laminae. Macromechanical Analysis ofcomposite Laminae: Introduction, Assumptions and Limitations, Stiffnesscharacteristics of glass reinforced laminae- Stress- Strain relationships in continuous, discontinuousfibrelaminae, Strengthcharacteristics of glass reinforced laminae- Strengths in continuous,discontinuous fibrelaminae.

UNIT - III

Behaviour of Glass Fibre-Reinforced laminates: Introduction, Stiffness characteristics of Laminated composites-Behaviour of Laminated beams and plates, Strength characteristics of Laminated composites- Strength analysis and failure criteria, Effect of inter laminar structures. Glass Reinforced Composites: Introduction, Continuously reinforced laminates- uni-directionally and multi directionally continuously reinforced laminates, Discontinuously reinforced laminates – Stiffness and Strength properties.

UNIT - IV

GRP properties relevant to structural Design: Introduction, Short-term strength and stiffness-Tensile,Compressive, Flexural and Shearing. Long term strength andstiffness properties, Temperatureeffects, Effect of fire, Structural joints- Adhesive, mechanical, Combinational, Transformed sections.

UNIT - V

Design of GRP Box Beams: Introduction, loading, span and cross-sectional shape, Selection of material, Beam manufacture, Beam stresses, Experimental Behaviour, Effect on Beam performance-Modulus of Elasticity, Compressive Strength, I value, prevention of compression buckling failure, Behaviour under long term loading.
Design of Stressed skinned roof structure: Introduction, loading and material properties, preliminary design, and computer analysis.

Course Outcomes:

1. Analyze problems on macromechanical behavior of lamina.
2. Analyze problems on micromechanical behavior of lamina.
3. Analyze problems on macromechanical behavior of laminate.

4. Analyze problems on bending, buckling, and vibration of laminated plates and beams.

REFERENCE:

1. GRP in Structural Engineering M.Holmes and D.J.Just.
2. Mechanics of Composite materials and Structures byManjunathMukhopadhyay;Universities Press

ANURAG ENGINEERING COLLEGE
(AUTONOMOUS)

I Year M.Tech– I Sem(Structural Engineering)

COMPUTER ORIENTED NUMERICAL METHODS
(Open Elective – I)

Course Objectives:

With the current deployment of computer technology and tools, it is very important to develop efficient algorithms for solving in science, engineering, technology, insurance and banking.Thus, the objective of this course is to enable students to obtain an intuitive and working understanding of numerical methods for the basic problems of numerical analysis and gain an experience in the implementation of numerical methods using a computer. They would also gain an appreciation of the concept of error in these methods and need to anlayze and predict it.

Unit I:
Solutions of linear equations: Direct method – Cramer's rule, Guass – Elimination method- Gauss – Jordan elimination – Triangulation (LU Decomposition) method – Iterative methods Jacobi – Iteration method – Gauss – Siedel iteration, Successive over – relaxation method.
Eigen values and eigen vectors: Jacobi method for symmetric matrices- Given's method for symmetric matrices-Householder's method for symmetric matrices-Rutishauser method of arbitrary matrices – Power method.

UNIT II:
Interpolation: Linear Interpolation - Higher order Interpolation - Lagrange Interpolation – Interpolating polynomials using finites differences- Hermite Interpolation -piece-wise and spline Interpolation.

Unit III
Finite Difference and their Applications: Introduction- Differentiation formulas by Interpolating parabolas
– Backward and forward and central differences- Derivation of Differentiation formulae using Taylor series- Boundary conditions- Beam deflection – Solution of characteristic value problems- Richardson's extrapolation- Use of unevenly spaced pivotal points- Integration formulae by interpolating parabolas-Numerical solution to spatial differential equations

UNIT IV.
Numerical Differentiation: Difference methods based on undetermined coefficients- optimum choice of step length– Partial differentiation.
Numerical Integration: Method based on interpolation-method based on undetermined coefficient – Gauss – Lagrange interpolation method- Radaua integration method- composite integration method – Double integration using Trapezoidal and Simpson's method.

UNIT V
Ordinary Differential Equation: Euler's method – Backward Euler method – Mid point method – single step method, Taylor's series method- Boundary value problems.

Course Outcomes:

1. Be aware of the use of numerical methods in modern scientific computing,
2. Be amiliar with finite precision computation,
3. Be familiar with numerical solutions of nonlinear equations in a single variable,
4. Be familiar with numerical interpolation and approximation of functions,
5. Be familiar with numerical integration and differentiation
6. Be familiar with numerical solution of ordinary differential equations
7. Be familiar with calculation and interpretation of errors in numerical methods.

REFERENCES:

3. Numerical methods for scientific and engineering computations. M.K.Jain- S.R.K.Iyengar – R.K.Jain Willey Eastern Limited.
4. Numerical methods by S.S.Shastry.
5. Applied numerical analysis by – Curtis I.Gerala- AddissionWasley – published campus.
6. Numerical methods for Engineers StevanC.Chopra, Raymond P.Canal Mc. Graw Hill book company.
7. C Language and Numerical methods by C.Xavier – New age international publisher.
8. Computer based numerical analysis by Dr. M.Shanta Kumar, Khanna Book publishers, New Delhi.

ANURAG ENGINEERING COLLEGE
(AUTONOMOUS)

I Year M.Tech – I Sem (Structural Engineering)

RELIABILITY ENGINEERING EXPERIMENTAL STRESS ANALYSIS
(Open Elective – I)

Objectives: To impart knowledge on concepts of reliability, discrete distributions and hierarchical systems.

UNIT I Basic Concepts of Reliability: Introduction, Reliability and Quality, Failures and Failure Modes, Cuses of Failures and Unreliability, Maintainability and Availability, History of Reliability, Reliability Literature.

UNIT II Design for Reliability: Constraints and Considerations : Reliability Analysis, Mathematical Models and Numerical Evaluation, Designing for Higher Reliability, Redundancy Techniques, Equipment Hierarchy, Reliability and Cost.

UNIT –III Discrete Distributions: Density and distributions, Continuous Distributions, Numerical Characteristics of Random Variables, Laplace Transform.

UNIT-IV Maintainability and Availability Concepts : Introduction, Maintainability Function, Availability Function, Frequency of Failure, Two-unit parallel system with Repair, K-out-of M systems, Preventive Maintenance.

UNIT-V: Hierarchical Systems: Introduction, Logic Diagram Approach, Conditional Probability Approach, System Cost, Illustrations and Discussions, Reliability Approximations.

TEXT BOOKS :

1. Reliability Engineering by E. Balagurusamy, McGraw Hill Education(India) Pvt. Ltd.
2. Reliability Evaluation of Engineering Systems by Roy Billinton & Ronald N. Allan, Springer.
3. Reliability of Structures, Second Edition by Andrzej S. Nowak, Kevin R. Collins December 20, 2012 by CRC Press Outcomes :

The learner will be able to design a reliable systems and develop and analyse reliability and cost models for hierarchical systems

ANURAG ENGINEERING COLLEGE
(AUTONOMOUS)

I Year M.Tech – I Sem(Structural Engineering)

ADVANCED CONCRETE LABORATORY

1 Tests on cement - Consistency, Setting times, Soundness, Compressive Strength.

2. Gradation Charts of Aggregates.
3. Bulking of fine Aggregate.
4. Aggregate Crushing and Impact value
5. Workability Tests on Fresh self compacting concrete
6. Air Entrainment Test on fresh concrete.
7. Marsh cone test.
8. Permeability of Concrete.
9. Non Destructive Testing of Concrete.
10. Accelerated Curing of Concrete.
11. Influence of W/C ratio on strength and Aggregate / Cement ratio on workability and Strength
12. Influence of Different Chemical Admixtures on concrete.

ANURAG ENGINEERING COLLEGE
(AUTONOMOUS)

I Year M.Tech – II Sem(Structural Engineering)

FINITE ELEMENT METHODS

Course Objectives:

Develop the skills in applying the basic matrix operation to form a globalmatrix equation and enforce the concept of steps in obtaining solutions for 1-Dstructures.Develop the skills in applying the interpolation functions to solve bar,beam problems.Gainsomeknowledge and analysis skills in forming basicdata required in a FEMcomputer program.Develop the skills in applying the Gaussianquadrature in computingintegration in FEM.

UNIT I

Introduction: Concepts of FEM - steps involved - merits and demerits - energy principles – discrimination - Raleigh - Ritz method of functional approximation.
Principles of Elasticity: Stress equations - strain displacement relationships in matrix form plane stress, plane strain and axi-symmetric bodies of revolution with axi-symmetric loading.

UNIT II

One dimensional FEM: Stiffness matrix for beam and bar elements - shape functions foe ID elements.
Two dimensional FEM: Different types of elements for plane stress and plane strain analysis - displacement models - generalized coordinates - shape functions - convergent and compatibility requirements - geometric invariance - natural coordinate system - area and volume coordinates - generation of element stiffness and nodal load matrices

UNIT III

Isoparametric formulation: Concept - different isoparametric elements for 2D analysis - formulation of 4-noded and 8-noded isoparametric quadrilateral elements - Lagrange elements - serendipity elements.

Axi Symmetric Analysis: bodies of revolution - axi symmetric modeling - strain displacement relationship - formulation of axi symmetric elements.

Three dimensional FEM: Different 3-D elements-strain-displacement relationship – formulation of hexahedral and isoparametric solid element.

UNIT IV

Introduction to Finite Element Analysis of Plates: basic theory of plate bending - thin plate theory - stress resultants - Mindlin's approximations - formulation of 4-noded isoperimetric quadrilateral plate element – Shell Element.

UNIT V

Introduction to non – linear analysis – basic methods – application to Special structures.

Course Outcomes:

1. Learn how to apply it to basic (linear) ordinary and partial differential equations.

2. Learn how to implement the finite element method efficiently in order to solve field problems.
3. Identify mathematical model for solution of common engineering problems.
4. Formulate simple problems into finite elements.
5. Solve structural, fluid flow, impact and crash problems.
6. Solve complicated 3D structural problems for stress analysis under different loads.

REFERENCES:

1. Concepts and Applications of Finite Element Analysis by Robert D.Cook, David S. Malkus and Michael E. Plesha, John Wiley & Sons.
2. Finite element Methods by OC Zienkiewicz
3. Finite element analysis, theory and progarmming by GS Krishna Murthy.
4. Introduction to Finite element Method by Tirupathi Chandra Patila and Belugunudu.
5. Introduction to Finite element Method by JN Reddy.

ANURAG ENGINEERING COLLEGE
(AUTONOMOUS)

I Year M.Tech – II Sem(Structural Engineering)

STRUCTURAL DYNAMICS

Course Objectives:

Know the fundamental concepts and theory of dynamic analysis.Understand the free vibrations concepts and the problem of determining the natural frequency of a system.Understand thefreevibrations concepts of harmonically excited vibrations.Understand thefree Vibrations of Multi-degree of freedom.

UNIT I:

Theory of vibrations:Introduction - Elements of vibratory system - Degrees of Freedom - ContinuousSystem - Lumped mass idealization - Oscillatory motion - Simple Harmonic motion - Vectorial representation of S.H.M. - Free vibrations of single degree of freedom system - undamped and damped vibrations - critical damping - Logarithmic decrement - Forced vibration of SDOF systems - Harmonic excitation -Dynamic magnification factor – Phase angle – Bandwidth

UNIT II

Introduction to Structural Dynamics : Fundamental objectives of dynamic analysis - Types ofprescribed loading - Methods of discretization - Formulation of equations of motion by different methods – Direct equilibration using Newton's law of motion / D'Alembert's principle, Principle of virtual work and Hamilton principle.

Single Degree of Freedom Systems : Formulation and solution of the equation of motion - Freevibration response - Response to Harmonic, Periodic, Impulsive and general dynamic loadings - Duhamel integral.

UNIT III

Multi Degree of Freedom Systems : Selection of the degrees of Freedom - Evaluation of structuralproperty matrices - Formulation of the MDOF equations of motion - Undamped free vibrations - Solutions of Eigen value problem for natural frequencies and mode shapes - Analysis of Dynamic response – Normal co-ordinates - Uncoupled equations of motion - Orthogonal properties of normal modes - Mode superposition procedure.

UNIT IV

Practical Vibration Analysis: Introduction - Stodola method - Fundamental mode analysis - Analysisof second and higher modes - Holzer method - Basic procedure.

Continuous Systems: Introduction - Flexural vibrations of beams - Elementary case – Derivation ofgoverning differential equation of motion - Analysis of undamped free vibrations of beams in flexure - Natural frequencies and mode-shapes of simple beams with different end conditions - Principles of application to continuous beams.

UNIT V

Introduction to Earthquake Analysis: Introduction - Excitation by rigid base translation - Lumpedmass approach - SDOF and MDOF systems - I. S. Code methods of analysis for obtaining response of multi storeyed buildings.

Course Outcomes:

1. Apply the fundamental concepts and definitions used in structural dynamics.
2. Calculate the natural frequency of a system using equilibrium or energy methods.
3. Determine the effect of viscous damping on the response of a freely vibrating system.
4. Determine the response of a system to a harmonic excitation.
5. Understand of the fundamental concepts of earthquake engineering.

REFERENCES:

1. Dynamics of Structures by Clough &Penzien, McGraw Hill, New york
2. Structural Dynamics by Mario Paz, C.B.S Publishers, New Delhi.
3. Dynamics of Structures by Anil K. Chopra, Pearson Education (Singapore), Delhi.
4. I.S: 1893 - 1984, “Code of practice for Earthquake resistant design of Structures” and latest I.S: 1893 - 2002 (version) Part-1

ANURAG ENGINEERING COLLEGE

(AUTONOMOUS)

I Year M.Tech – II Sem(Structural Engineering)

EARTHQUAKE RESISTANT DESIGN OF BUILDINGS

Course Objectives:

Understand possible causes for the movements of the plates. Describe elastic rebound theory as it is related to seismic activity. Distinguish between earthquake magnitude and earthquake damage (intensity). Understand the Static and Dynamic methods (Response Spectrum Analysis Method) for Earthquake resistant R/C Buildings.

UNIT - I

Engineering Seismology: Earthquake phenomenon cause of earthquakes-Faults- Plate tectonicsc -Seismic waves-Terms associated with earthquakes-Magnitude/Intensity of an earthquake-scales-Energy released-Earthquake measuring instruments-Seismoscope, Seismograph, accelerograph-Characteristics of strong ground motions-Seismic zones of India.

UNIT - II

Conceptual design: Introduction-Functional planning-Continuous load path-Overall form-simplicity and symmetry-elongated shapes-stiffness and strength-Horizontal and Vertical members-Twisting of buildings-Ductility-definition-ductility relationships-flexible buildings-framing systems-choice of construction materials-unconfined concrete-confined concrete-masonry-reinforcing steel. Introduction to earthquake resistant design: Seismic design requirements-regular and irregular configurations-basic assumptions-design earthquake loads-basic load combinations-permissible stresses-seismic methods of analysis-factors in seismic analysis-equivalent lateral force method-dynamic analysis-response spectrum method-Time history method.

UNIT - III

Reinforced Concrete Buildings: Principles of earthquake resistant deign of RC members- Structural models for frame buildings- Seismic methods of analysis- Seismic deign methods- IS code based methods for seismic design- Seismic evaluation and retrofitting- Vertical irregularities- Plan configuration problems- Lateral load resisting systems- Determination of design lateral forces-Equivalent lateral force procedure-Lateral distribution of base shear. Masonry Buildings: Introduction-Elastic properties of masonry assemblage- Categories of masonry buildings- Behaviour of unreinforced and reinforced masonry walls- Behaviour of walls- Box action and bands- Behaviour of infill walls-Improving seismic behaviour of masonry buildings- Load combinations and permissible stresses-Seismic design requirements- Lateral load analysis of masonry buildings.

UNIT - IV

Structural Walls and Non-Structural Elements: Strategies in the location of structural walls- sectional shapes- variations in elevation- cantilever walls without openings – Failure mechanism of non-structures- Effects of non-structural elements on structural system- Analysis of non-structural elements-Prevention of non-structural damage-Isolation of non-structures.

UNIT - V

Ductility Considerations in Earthquake Resistant Design of RC Buildings: Introduction-Impact of Ductility- Requirements for Ductility- Assessment of Ductility- Factors affecting

Ductility- Ductile detailing considerations as per IS 13920. Behaviour of beams, columns and joints in RC buildings during earthquakes-Vulnerability of open ground storey and short columns during earthquakes.
Capacity Based Design: Introduction to Capacity Design, Capacity Design for Beams and Columns-Case studies.

Course Outcomes:

1. Predict damage to un-reinforced masonry buildings and identify the vulnerable features.
2. Employ the Response Spectrum Analysis Method and static equivalent method for Earthquake resistant R/C Buildings.
3. Apply ductility requirements for the design of structural components.
4. Assess existing building structures and provide plans for their effective retrofitting.
5. Assess seismic performance of non-structural components and building contents and identify effective measures to mitigate potential damage.

REFERENCE BOOKS:

1. Earthquake Resistant Design of structures – S. K. Duggal, Oxford University Press
2. Earthquake Resistant Design of structures – PankajAgarwal and Manish Shrikhande, Prentice Hall of India Pvt. Ltd.
3. Seismic Design of Reinforced Concrete and Masonry Building – T. Paulay and M.J.N. Priestly, John Wiley & Sons
4. Masory and Timber structures including earthquake Resistant Design – AnandS.Arya, Nemchand& Bros
5. Earthquake –Resistant Design of Masonry Building –MihaTomazevic, Imperial college Press.
6. Earthquake Tips – Learning Earthquake Design and Construction C.V.R. Murty

REFERENCE CODES:

1. IS: 1893 (Part-1) -2002. “Criteria for Earthquake Resistant – Design of structures.” B.I.S., New Delhi.
2. IS:4326-1993, “ Earthquake Resistant Design and Construction of Building”, Code of Practice B.I.S., New Delhi.
3. IS:13920-1993, “ Ductile detailing of concrete structures subjected to seismic force” – Guidelines, B.I.S., New Delhi.

ANURAG ENGINEERING COLLEGE
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I Year M.Tech – II Sem(Structural Engineering)

PRE-STRESSED CONCRETE
(ELECTIVE -III)

Course Objectives:

An understanding of the necessity of prestressed concrete structures. Develop an understanding of various techniques of prestressing. Develop an understanding of the design of prestressed concrete members for ultimate limit state and limit state of serviceability. Develop an understanding of the design of continuous beams and simple portal frames.

UNIT I.

General Principles of PrestressedConcrete : Pre–tensioning and post – tensioning – Prestressingby straight, concentric, eccentric, bent and parabolic tendons – Different methods and systems ofprestressing like Hoyer system, Freyssinet system,MagnelBlaton system – Lee-Mc call system.

Losses of Prestress : Loss of prestress in pre-tensioned and post-tensioned members due tovarious causes like elastic shortening of concrete, shrinkage of concrete, creep of concrete, relaxation of steel, slip in anchorage, bending of member and frictional loss – Analysis of sections for flexure.

UNIT II.

Design of Section for Flexure : Allowable stresses – Elastic design of simple beams havingrectangular and I-section for flexure – kern lines – cable profile and cable layout.

Design of Sectionsfor Shear : Shear and Principal stresses – Improving shear resistance by different prestressingtechniques – horizontal, sloping and verticalprestressing – Analysis of rectangular and I–beam –Design of shear reinforcement – Indian code provisions.

UNIT III.

Deflections of Prestressed Concrete Beams : Short term deflections of uncracked members–Prediction of long-time deflections – load – deflection curve for a PSC beam – IS code requirements for max. deflections.

UNIT IV

Transfer of Prestress in PretensionedMembers : Transmission of prestressing force by bond –Transmission length – Flexural bond stresses – IS code provisions – Anchoragezone stresses inpost tensioned members – stressdistribution in Endblock– Analysisby approximate,Guyon and Magnel methods – Anchorage zone reinforcement.

UNIT V.

Statically Indeterminate Structures : Advantages & disadvantages of continuousPSC beams– Primary and secondary moments – P and C lines – Linear transformation concordant and non-concordant cable profiles – Analysis of continuous beams and simple portal frames (single bay and single story)

Course Outcomes:

1. Acquire the knowledge of evolution of process of prestressing.
2. Acquire the knowledge of various prestressing techniques.
3. Develop skills in analysis and design of prestressed concrete beams, and slabs.
4. Develop skills to satisfy the serviceability and strength provisions of the Indian Standards (IS: 1343-1980).

REFERENCES :

1. Prestressed concrete by Krishna Raju, Tata McGraw Hill Book – Co ., New Delhi.
2. Design of prestress concrete structures by T.Y. Lin and Burn, John Wiley, New York.
3. Prestressed concrete by S. RamamruthamDhanpatRai& Sons, Delhi.

ANURAG ENGINEERING COLLEGE
(AUTONOMOUS)

I Year M.Tech – II Sem(Structural Engineering)

ADVANCED FOUNDATION ENGINEERING
(ELECTIVE -III)

Course Objectives:

The main objective of Course is to enable students to select the best foundation solution for different types of civil engineering problems. After completing the course students should be able to design deep and shallow foundations and supervise their construction. The course philosophy is to provide the students with the information they need to design foundations at the state of the art. The information is supplied in a systematic way, discussing topics where current knowledge is lacking and research is needed.

UNIT – I

Bearing capacity of Footings subjected to Eccentric and Inclined Loading – Meyrhoff's andHanse's theories – elastic settlement of Footings embedded in sands and clays of Infinite thickness – Footings on soils of Finite thickness-Schmertamaunn's method, Jaubu and Morgensternmethod.

UNIT - II

Pile Foundations – settlement of Pile groups resting in sands and clays – Negative skin friction – in single piles and groups of piles – under – reamed piles – specifications – load – carrying capacity in sands and clays.

UNIT – III

Caissons and well foundations : Types of caissons – well foundation Different shapes of wells – Components of wells – functions and Design – Design Criteria – Sinking of wells – lateral stability by Terzaghi's analysis.

UNIT – IV

Cantilever sheet piles and anchored bulkheads Earth pressure diagram – DeterminationofDepth of embedment in sands and clays – Timbering of trenches- Earth pressure diagrams – Forces in struts.

UNIT - V

Foundations in Expansive soils – Problems in Expansive soils – Mechanism ofswelling – SwellPressure and Swelling potential – Heavefoundation practices – Sand cushion – CNS cushion –under –reamed pile Foundations – Granular pile – anchor technique, stabilization of expansive soils.

Course Outcomes:

1. Describe the requirements for the successful design of foundation elements;
2. Evaluate factors affecting the planning of subsurface investigations;
3. Analyze the bearing capacity of shallow foundations;
4. Synthesize the concepts of allowable stress design, appropriate factors of safety, margin of safety, and reliability;
5. Evaluate immediate settlement of deep foundations.

REFERENCES:

1. Analysis and Design of Substractenes – Swami Saran
2. Basic and Applied Soil Mechanics – GopalRanjan and A.S.R.Rao
3. Soil Mechanics & Foundation Engineering, Foundation Engineering – II V.N.S.Murthy.

ANURAG ENGINEERING COLLEGE
(AUTONOMOUS)

I Year M.Tech – II Sem(Structural Engineering)

COMPUTER AIDED DESIGN IN STRUCTURAL ENGINEERING
(ELECTIVE -III)

Course Objectives:

Understand computer as a design medium. Write different programs using "C" language. Write various program using "C" graphics. Understand database management systems. Know about artificial intelligence.

UNIT I

Introduction to computer aided design-An over view-computer as a design medium hardware components of a computer -programming languages.
C - Programming language-Introduction-An over view of programming in C-variables and data types-Declaration of variables-Initialization of variables-operators-arithmetic operators- precedence and associability-Input and output-Character I/O-Formatted output. Print f ()-Formatted input scan f ()-Examples.

UNIT II

C Programming Language-Control structures-If statement-Switch statement-loops-nested loops-while and for ,Do-While-continue statement-Go to statement-Examples.
C Programming Language-Arrays-One dimensional Arrays-Two Dimensional Arrays-pointer operators-pointer arithmetic-pointers and arrays-Matrix manipulations using arrays and pointers-pointers to functions-data files-basic operations-reading and writing and file accessing files-examples.

UNIT III

Computer Graphics-introduction-applications graphic devices-display devices-output and input devices-two dimensional geometric transformations-homogeneous co-ordinates-world co-ordinates-device co-ordinates-window to view port-transformations-clipping operations.

UNIT IV

Data base management system-introduction-data base systems-hardware-software-users-operational data independence-architecture of data base system-distributed databases.

UNIT V

Knowledge based expert system-introduction-artificial intelligence-components of an expert system-stages in expert system development-knowledge representation-inference mechanisms-applications.

Course Outcomes:

1. Write programs using C language
2. Write programs using C graphics and generate display of geometries
3. Analyse problems of structural analysis using C and C graphics
4. Work with the operations of DBMS
5. Represent development of Knowledge based expert system

REFERENCES:

1. Computer Aided Design by C.S.Krishnamoorthy and S.Rajeev.
2. Computational Structures by S.Rajasekharan.

ANURAG ENGINEERING COLLEGE
(AUTONOMOUS)

I Year M.Tech – II Sem(Structural Engineering)

PRINCIPLES OF BRIDGE ENGINEERING
(ELECTIVE-IV)

Course Objectives:

Develop an understanding of and appreciation for basic concepts in proportioning anddesign ofbridges in terms of aesthetics, geographical location and functionality. Develop an intuitive feeling about the sizing of bridge elements.ie. Develop a clearunderstanding of conceptual design.Understand the load flow mechanism and identify loads on bridges. Carry outthedesign of bridge starting from conceptual design, selecting suitable bridge,geometry to sizing of its elements.

UNIT I.

Concrete Bridges: Introduction-Types of Bridges-Economic span length-Types of loading-Dead load-live load-Impact Effect-Centrifugal force-wind loads-Lateral loads-Longitudinal forces-Sesmic loads-Frictioal resistance of expansion bearings-Secondary Stresses-Temperature Effect-Erection Forces and effects-Width of raodway and footway-General Design Requirements.

UNIT II.

Solid slab Bridges: Introduction-Method of Analysis and Design.

UNIT III

Girder Bridges: Introduction-Method of Analysis and Design-Courbon's Theory, Grillage analogy

UNIT IV.

Pre-Stressed Concrete Bridges: Basic principles-General Design requirements-Mild steel reinforcement in prestessed concrete member-Concrete cover and spacing of pre-stressing steel-Slender beams-Composite Section-Propped-Design of Propped Composite Section-Unproped composite section-Two-stage Prestressing-Shrinking stresses-General Design requirements for Road Bridges.

UNIT V.

Analysis of Bridge Decks: Harmonic analysis and folded plate theory-Grillage analogy-Finite strip method and FEM. Sub-srtucture of bridges: Substructure- Beds block-Piers-Pier Dimensions- Design loads for piers- Abutments- Design loads for Abutments.

Course Outcomes:

1. Design a system, component, or process to meet desired needs such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability.
2. Function on multidisciplinary teams.
3. Identify, formulate and solve engineering problems
4. Use the techniques, skills and modern engineering tools necessary for engineering practice.

REFERENCES:

1. Design of Concrete Bridges by M.G.Aswani, V.N.Vazirani and M.M.Ratwani.
2. Bridge Deck Behaviour by E.C.Hambly.
3. Concrete Bridge Design and Practice by V.K.Raina.

ANURAG ENGINEERING COLLEGE
(AUTONOMOUS)

I Year M.Tech – II Sem(Structural Engineering)

ANALYSIS AND DESIGN OF SHELLS AND FOLDED PLATES
(ELECTIVE -IV)

Course Objectives:

Understand different types of shells and folded plates. Know different theories for the analysis. Know procedure to analyze the structures. Differentiate between different theories of analysis.

UNIT I

Shells – functional behaviour – examples – structural behaviour of shells classification of shells – Definitions – various methods of analysis of shells – merits and demerits of each method – 2D. Membrane equation.

Equations of equilibrium: Derivation of stress resultants – cylindrical shells – Flugges simulations equations.

UNIT II

Derivation of the governing DKJ equation for bending theory, - Schorer's theory - Application to the analysis and design of short and long shells.

Beam theory of cylindrical shells: Beam and arch action, Analysis using beam theory.

UNIT III

Introduction to the shells of Double curvatures: Geometry, analysis and design of elliptic paraboloid, conoid and hyperbolic parabolic shapes, inverted umbrella type.

UNIT IV

Axi- Symmetrical shells: General equation - Analysis and axi-symmetrical by membrane theory. Application to spherical shells and hyperboloid of revolution cooling towers.

UNIT V

Folded plates – Introduction – Types of folded plates – structural behaviour of folded plates – advantages – Assumptions Whitney method of analysis – Edge shear equation - Analysis of folded plates of Whitney's method.

Simpsons method of Analysis of folded plates – moment and stress distribution – no rotation and rotation solutions – continuous folded plates – pre stressed continuous folded plates.

Course Outcomes:

1. Use appropriate theory to analyse the shell structures
2. Differentiate a shell structure based on its properties
3. Design shell structures
4. Understand the structural importance of shell and folded plates.

TEXT BOOKS:

1. Analysis and design of concrete shell roofsBy G.S.Ramaswami.
2. Design of concrete shell roofsBy Chaterjee.

REFERENCES:

1 Design of concrete shell roofsBy Billington
2 Shell AnalysisBy N.K.Bairagi.
3 Advanced R.C DesignBy Dr.N.KrishnaRaju.

ANURAG ENGINEERING COLLEGE
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I Year M.Tech – II Sem(Structural Engineering)

ADVANCED STEEL DESIGN
(ELECTIVE -IV)

Course Objectives:

Learn how to compute the Dead, Live and Wind loads on roofs. Know the analysis of multistory building frames by various approximate methods such as Portal, Cantilever and Factor method. Learn how to design compression and tension members of a steel truss girder bridges. Understand the Static and Kinematic methods of Plastic analysis.

UNIT-I:
SIMPLE CONNECTIONS –RIVETED, BOLTED PINNED AND WELDED CONNECTIONS:

Riveted connections-Bolted Connections- Load Transfer Mechanism – Failure of Bolted Joints – Specifications for Bolted Joints – Bearing – Type Connections – Tensile Strength of Plate – Strength and Efficiency of the Joint – Combined Shear and Tension – Slip – Critical Connections – Praying Action – Combined Shear and Tension for Slip- Critical Connections. Design of Groove welds- Design of Fillet Welds- Design of Intermittent fillet welds- Failure of Welds.

UNIT –II: ECCENTRIC AND MOMENT CONNECTIONS:
Introduction – Beams – Column Connections- Connections Subjected to Eccentric Shear – Bolted Framed Connections- Bolted Seat Connections – Bolted Brackete Connections. Bolted Moment Connections – Welded Framed Connections – Welded Brackete Connections - Moment Resistant Connections.

UNIT III Analysis and Design of Industrial Buildings :
Dead loads, live loads and wind loads on roofs. Design wind speed and pressure, wind pressure on roofs; wind effect on cladding and louvers; Design of angular roof truss, tubular truss, truss for a railway platform. Design of purlins for roofs, design of built up purlins, design of knee braced trusses and stanchions. Design of bracings.

UNIT IV : DESIGN OF STEEL TRUSS GIRDER BRIDGES :
Types of truss bridges, component parts of a truss bridge, economic proportions of trusses, self weight of truss girders, design of bridge compression members, tension members; wind load on truss girder bridges; wind effect on top lateral bracing; bottom lateral bracing; portal Bracing; sway bracing.

UNIT V : Design of Steel Bunkers and Soils
Introduction – Janseen's Theory – Airy's Theory – Design of Parameters – Design Criteria – Analysis of Bins – Hopper Bottom –Design of Bins.

Course Outcomes:

1. Analyse and design the industrial buildings

2. Compute the axial forces, shear forces and bending moments in beams and columns of a multistory building frame and can sketch SFD, BMD.
3. Calculate the forces in various members of steel truss girder bridge and design the components of the bridge.
4. Compute the collapse loads, plastic moment capacities of continuous beams, portal frames and gable frames.

References:

1. Design of Steel Structures. P. Dayaratnam, Publisher : S. Chand, Edition 2011 – 12.
2. Design Steel Structures Volume – II, Dr. Ramachandra&VivendraGehlotScientitic Publishes Journals Department.
3. Limit State Design of Steel Structures S.K. DuggalMcGraw Hill Education Private Ltd. New Delhi.
4. Design of Steel Structures Galyord& Gaylord, Publisher ; Tata McGraw Hill, Education. Edition 2012.
5. Indian Standard Code – IS – 800-2007.

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I Year M.Tech – II Sem(Structural Engineering)

PLASTIC ANALYSIS AND DESIGN
(ELECTIVE -IV)

Course Objectives:

Know the static and kinematic methods of plastic analysis.Analyze the continuous beams ofuniform & different c/s.Analyze the single span frames and gable frames.Find out thedeflections at working load & ultimate load.

UNIT – I

Analysis of Structures for Ultimate Load: Fundamental Principles – statical method of Analysis – Mechanism method of analysis – Method of analysis, Moment check – Carry over factor – Moment Balancing Method.

UNIT - II

Design of Continuous Beams: Continuous Beams of uniform section throughout – Continuous Beams with different cross-sections.

UNIT - III

Secondary Design Problems: Introduction – Influence of Axial force on the plastic moment – influence of shear force – local buckling of flanges and webs – lateral buckling – column stability.

UNIT - IV

Design of Connections: Introduction – requirement for connections – straight corner connections – Haunched connection – Interior Beam-Column connections.

UNIT - V

Design of Steel Frames: Introduction – Sinole span frames – simplified procedures for Sinole span frames – Design of Gable frames with Haunched Connection. Ultimate Deflections: Introduction – Deflection at ultimate load – Deflection at working load – Deflections of Beams and Sinole span frames.

Course Outcomes:

1. Identify the locations of plastic hinges and understands the beam, sway and combined mechanism.
2. Design the continuous beams, frames and gable frames of uniform c/s and varying c/s.
3. Design the straight corner and haunched connections, interior beam-column connections.
4. Find out the deflections of beams and frames

REFERENCES:

1. Plastic Design of Steel Frames, L.S.Beedle.
2. Plastic Analysis, B.G.Neal.
3. Plastic Analysis, Horve.

ANURAG ENGINEERING COLLEGE

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I Year M.Tech – II Sem(Structural Engineering)

STABILITY OF STRUCTURES
(ELECTIVE -IV)

Course Objectives:

Recognise the shortcomings of the structural analysis learnt thus far and appreciate the need to include stability as a fourth concept in any complete theory of structures. Draw stable and unstable paths on a load/displacement diagram for various bifurcations and snap through models. Understand how elastic stability may be determined from the total potential energy and may be described by the eigenvalues of the total stiffness matrix. Determine elastic critical loads for simple structures by eigenvalue analysis, whilst appreciating the importance of imperfection sensitivity and the limitations of such analysis.

UNIT – I

Beam Columns: Differential equations for beam columns- beam columns with concentrated loads – continuous lateral loads-couples- beam columns with built in ends – continuous beams with axial load – application of trigonometrically series – Effects of initial curvature on deflections – Determination of allowable stresses.

UNIT - II

Elastic Buckling of bars and frames: Elastic Buckling of straight columns – Effect of shear stress on buckling – Eccentrically and laterally loaded columns- Buckling of frames-large deflections of buckled bars-Energy methods- Buckling of bars on elastic foundations- Buckle line of bar with intermediate compressive forces - Buckling of bars with change in cross-section – Effect of shear force on critical load- built up columns.

UNIT - III

In Elastic Buckling: Buckle line of straight bar- Double modulus theory – Tangent modulus theory, Inelastic lateral Buckling. Experiments and design formulae: Experiments on columns – Critical stress diagram – Empirical formulae for design – various end conditions

UNIT - IV

Torsion Buckling: Pure torsion of thin walled bars of open cross section – Non-uniform torsion of thin walled bars of open cross section- Torsional buckling – Buckling by torsion and flexure.

UNIT – V

Lateral buckling of simply supported Beams: Beams of Rectangular cross-section subjected to pure bending. Buckling of simply supported Rectangular plates: Derivation of equation of plate subjected to constant compression in one and two directions.

Course Outcomes:

1. Apply the approximate methods based on energy to determine the stability of simple systems.
2. Differentiate how the tangent modulus and double modulus theories of inelastic buckling led to the column paradox, thereby preventing further difficulties for a general theory of structures.
3. Understand the importance of lateral - torsional buckling of beams.

4. Know the fundamentals of buckling and stability by total potential energy approach and direct equilibrium approach

REFERENCES:

1. Theory of elastic Stability by Timshenko& Gere-McGraw Hill
2. Stability of metallic structures by Blunch- McGraw Hill
3. Theory of Beam- Columns Vol I by Chem. &Atste Mc. Graw Hill

ANURAG ENGINEERING COLLEGE
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I Year M.Tech – II Sem(Structural Engineering)

CAD LAB

1. Program using arrays and functions for matrix manipulation.
2. Programs to draw bending moment and shear force diagrams using graphics in C
3. Program for design of slabs. Using Excel
4. Program for design of beams. Using Excel
5. Program for design of column and footing using excel
6. Analysis of truss using STAAD Pro.
7. Analysis of multistoreyed space frame, using STAAD Pro.
8. Analysis of Bridge deck slab.